Recording: The broadcast is now starting. All attendees are in listen-only mode.

Holly Carr: Hello everyone. I'm Holly Carr with the U.S. Department of Energy. I'd like to welcome you to the grand finale of our Better Buildings Webinar Series 2014/2015 Season. In this series we profile the best practices of Better Buildings challenge partners, Better Buildings alliance members and aligned organizations who are working to improve energy efficiency in buildings.

Today we'll be talking about zero energy buildings, also called net zero energy buildings. As we'll hear today, the terminology and even the exact definitions are still in flux and under discussion. But generally we're talking about buildings that produce as much energy as they consume. A concept that is quickly moving from lofty goal to reality in some sectors.

So let me go ahead and introduce our presenters. You've got an all-start lineup for our grand finale here. We can move to the next slide. First off, actually you can go ahead, John, and move to the next slide. There we go.

So first off we'll hear from Roger Grant, program director for the National Institutes of Buildings Sciences or NIBS. Roger manages the integrated resilient design program, the high-performance building council, and commercial workforce credentialing council at NIBS. He's focused on developing and delivering information productions and services to support design, construction and management of the built environment for more than 30 years.

NIBS, DOE and a number of other partners have been working together to come to consensus on a definition for zero energy buildings. And Roger will describe this process as well as its likely outcomes in our session today.

Next up, we'll hear from Roy Torbert and Roy Buchert, from McDonald's Corporation and Rocky Mountain Institute. Roy Buchert is the global energy director at McDonald's Corporation. Roy's main role at McDonald's is to enhance restaurant energy efficiency across the system by focusing on operations, equipment, buildings and technology.

Roy Torbert specializes at RMI in helping corporations and universities reach their net zero goals. He has a background in project management and renewable and efficiency finance. Roy currently leads RMI's collaboration with Caribbean Island nations

to reduce their dependence on fossil fuels. And, in fact, Roy is joining us for this webinar from Aruba. I'll refrain from teasing you about that right now *[laughs]*, Roy. But Roy and Roy together will present on the recent project they worked on to assess the feasibly of zero energy quick serve restaurants.

And then, finally, Jason Robbins at Walgreens will move us from theory to practice, as he describes Walgreens adventure designing, constructing, and now operating a zero store in Evanston, Illinois. Jason provides direction for Walgreens mechanicals and refrigeration program, including piloting of new concepts and designs.

Jason led the engineering design for the state of the art mechanical system at the zero energy store, that we'll be hearing about today. And he's been with Walgreens since 2005.

So thank you all very much for joining us today. Before we get started with our presentations, I want to remind our audience that we will hold questions until near the end of the hour, so please send in questions as you think of them through the chat box on your webinar screen, on the control panel. And we will try to get to as many of those as we can. We've got a big crowd today so we will do our best with all the questions I'm sure will be coming in.

Also this session will be archived and posted to the web for your reference on the Better Buildings Challenge website. And you'll receive an e-mail about that after the session. With that, let me turn it over to Roger and let him tell us about the zero energy definition work and the results. Roger?

Roger Grant: Okay. Thank you, Holly. Thanks everyone for the opportunity to present on this work that the National Institute of Building Sciences has been doing through our high-performance building council with the Department of Energy's Building Technologies Office.

We've been working to come up with a common definition for zero energy buildings. Next slide, please. And I guess go right on to the next slide.

Some background on this is really evidenced by the increasing interest in and examples of zero energy and zero energy ready buildings in the marketplace. They're becoming more prevalent. There's a growing number of definitions as a result of that, both by different organizations as well as increasingly by state and local

governments and organizations that are trying to build policy around zero energy buildings.

And so this has a potential to create some confusion and uncertainty, and that might have an impact on the growth of zero energy buildings and clearly on the way that they can be used as parts of both voluntary and mandatory programs. So the Department of Energy felt that there was a role for them to play in helping to clarify this and helping to bring together kind of all the good work that was being done and the goals that are being set by clear national definition.

And certainly, this fit in with our strategy through the high performance building council of trying to work with professional trades standards, and industry organizations to establish clear and incremental goals and standards for all aspects of building performance.

Next slide. We've worked together to try to sort this out. And when you say zero it seems like a pretty simple concept, but in fact there's number of ways that zero energy is being measured in buildings by the type of energy metric, site energy versus source energy, by the impact on greenhouse gases or emissions, by energy cost. And those energy measurements might be made based on modeled energy or based on actual energy.

So even with this concept there were a number of different ways that it was being played out. Next slide. And a number of different – so this is leading to some confusion. But there's also a lot of good work that has been done and that the foundation for zero energy building is built on. Especially work done by the National Renewable Energy Lab made up a lot of what we did and provided a strong foundation.

We also see a number of states, California, moving to define zero energy and put it into regulatory requirements. Massachusetts, Delaware, Washington State. A number of federal agencies in response to regulations that they're subject to, such as the ESA Act, are coming up with their own definitions. And then a number of non-governmental organizations are also developing definitions and there's more coming. Next slide.

Our goal was to try to use those different foundations and build an industry accepted national definition that Department of Energy could publish that would be have been developed in concert with a wide group of stakeholders, and that could help encourage new

construction and major renovations projects, help to support program and policy goals. And ultimately help to achieve high levels of energy efficiency in a built environment.

Next slide. With this goal we set out some guiding principles that this definition would create a standardized basis for identification of zero energy buildings for use in industry. It needed to be capable of being measured and verified, but also be rigorous and transparent, so we had to go beyond just a definition but to how to measure it.

But we're not putting in a rating system, just a definition here. We wanted to be able to really drive energy efficiency and reduce energy consumption and make something that could be clearly and easily understood. Keep it simple, but have it be durable and lasting for some time to come.

Next slide. We followed a process which involved really doing some research both in literature and with subject matter experts, convening stakeholders, sharing with them our work, taking their input. We created a second set of draft materials. We have conducted a public comment period, which has been completed. And now we're working through that.

And here's what we've come up with in terms of a zero energy building definition, next slide, that a zero energy building would be an energy efficient building where the actual annual source energy consumption is balanced by onsite renewable energy. Now, we definitely heard that this needed to be able to be cover more than just individual buildings. So one of the things we did was craft this in such a way that building can be replaced by campus, portfolio, or community, and you could still establish a zero energy goal and a way to meet it.

Within this definition there's some critical concepts, sourced energy, actual, annual, and onsite renewable energy, are all important terms and components. Next slide. We identified a set of nomenclature that support the definition and this is all going to be available in the document that has been circulated already quite widely, and will be published at the end of this process, which has a clear definition for each of these component parts.

Next slide. These parts needed to be put together in a way that they could be measured and implementation could be done using this definition we felt. So the first thing was to have a clear boundary over which the energy used could be energy consumed

could be offset by the energy generated. And that boundary is where the measurement of delivered energy to the site and exported renewable energy from the site is measured.

And it was important that we do that in a way that it could support building, community, portfolio, or a campus. The measurements needed to be done in a way that the energy consumed was balanced by the energy generated and that that was measured on an actual basis. It was operational. It wasn't modeled. And we established an annual time period as the period for that measurement.

And then the final key component was that source energy would be the metric, and this allowed for different energy sources to be compared equally or the focus to be on achieving renewable energy and not on the source of energy used. And we're working on this now, what should be the appropriate national conversion factor, such that you can have a calculation that source energy – or energy delivered times the conversion factor, can be offset by energy generated times the conversion factor. And you can thus achieve zero energy.

So this is how the calculation is made. Next slide. So we have conducted this process. We're now completing the definitions, the nomenclature and guidelines. We're looking at a few of the issues that came up in the public comment period, which we received over 70 comments and which has helped greatly. And we're looking at some of the issues like renewable energy credits, and net and zero energy ready buildings, for example, as we complete that work.

And we expect to publish the results by the end of July and we'll be making those available on the DOE website and on the NIBS website. Our goal and our hope is that this will contribute to energy efficiency and energy performance of buildings. Thank you.

Holly Carr: Great. Thank you, very much, Roger. It's a little bit of the Wild West out there with regards to zero energy buildings, so it's really great to have some of these definitions and a little bit of guidance put in place by a trusted organization.

Let's turn our attention now to the McDonald's program. McDonald's and RMI project, which looks at a very energy intensive sector, the food service sector, and asks if zero energy is possible with current technologies. Roy and Roy, can you tell us what you found?

Roy Torbert: Absolutely. Thanks, Holly. So my name is Roy Torbert from Rocky Mountain Institute. On behalf of the entire McDonald's net zero energy study team, I'm really glad to be able to speak with all of you today.

That team is comprised of first McDonald's, of course. And Fisher Nickel, experts in food service equipment, who run the food service technology center in California, as well as New Buildings Institutes, who have been really leading the charge for net zero energy buildings for years now. And lastly, Rocky Mountain Institute, a think and do tank with over 30 years expertise in working with businesses to reinvent the way we use energy.

Last year McDonald's, let by their global head of energy Roy Buchert, who's with us today, challenged his team and ours to develop a roadmap on the technologies and their costs to build the first ever net zero energy quick service restaurant. So we're excited to talk with all of you about that today.

Next slide, please. It really is a challenge, though quite an exciting one for our entire team. Expressed in energy use per square foot, or EUI measured at the site, a quick service restaurant is more than ten times more energy intensive than your average office in the United States.

McDonald's has worked through both kitchen equipment improvements, and efficient building systems, to drive that energy use down. But a McDonald's still uses more than three times as much energy as a, say, convenience store. Making an effort to become net zero for a standalone restaurant, without changing the McDonald's menu, or operations in any significant way, a really aggressive target, and certainly a logical one.

So prior to our team's work, a group of grad students from Duke explored net energy for McDonald's and found that energy efficiency of the building systems, particularly the HVAC and the lighting, can reduce energy needs by almost 20 percent. That's that Duke NZE study bar on the chart you see there.

So McDonald's came to us and said we're ready to take the next step on our path towards this aggressive net zero target. And particularly to target the energy used by the kitchen equipment. Next slide, please.

The team's energy modeling over the course of this project really confirmed other McDonald's data that in a standard restaurant

more than half of the energy goes through the kitchen including the hood exhaust. The remaining energy use in a standard McDonald's is primarily HVAC, service hot water, lighting, and walk-in freezers.

So the story here really is all about the food, as you might have thought at the start. Tackling net zero then requires that McDonald's look closely at the unique energy requirements of each piece of equipment in the kitchen, to reexamine how to deliver the menu most efficiently while assessing how the kitchen interrelates with the design of the rest of the building.

Next slide, please. So this slide represents our findings, and I'll walk all of you through it, because there's a lot on it. The simplest way to interpret this chart is that McDonald's can achieve net zero energy on a standard site with today's technology. To be clear, especially as we're getting the definition here today, that is site net zero energy, that was the premise of our study.

So for this location displayed, in this case it's Chicago, the team found a conceptual design that first prioritizes energy efficiency to cut energy needs more than 60 percent for the restaurant. And to orient you to the chart, on the left most bar, that light brown bar, the starting energy intensity was around 615. After each successive efficiency improvement, those are all the blue bars, that show that stepping down, the Chicago McDonald's could consume 224 kBtu per square foot.

Then onsite solar, the right most green bar on the chart, primarily through parking solar canopies can provide the remainder of the energy needed over a typical year to reach that net zero status. You see a little bit extra just as a buffer.

So to get this much energy efficiency really required a holistic whole systems view on a McDonald's restaurant the team took over the last six months or so. Starting inside the kitchen a mix of currently available type equipment and select future designs, can cut the kitchen energy use in half. Then carefully managing outside air through the shell of the building, or the envelope, as well as the hoods, which are pretty critical, cuts both the heating and the cooling required.

The remaining space and water heating needs can be met through an integrated heat loop, that would link together a geothermal heat pump, solar thermal on the roof, and waste heat capture from select equipment.

That system could in the future be used to centralize and supplement kitchen equipment energy use. Effectively cooking with the sun, again, a first ever.

That's just a few of the technologies we assessed. Let's dig a bit deeper on the kitchen equipment component. Next slide.

So for the team, the kitchen equipment really required a fairly novel approach, quite different than designing a standard office building. Energy modeling doesn't individually assess plugged in equipment, with a standard piece of energy modelling software. Often it just depends on a watts per square foot that you plug in a schedule.

However, with the expertise of Fisher Nickle and really critical prior sub metered data that McDonald's has collected, we were able to assess individual pieces of McDonald's equipment, and examine their patterns across a typical day. So this chart shows both real sub meter data, that's the solid line on top. And a theoretical energy use, that's the dash line at the bottom.

We derived that theoretical energy use by looking at transaction data collected, again, in real McDonald's stores in assessing how much energy really needs to go into cook, say, a burger, or other pieces of the menu, independent of the type of its equipment or its operation.

So the gap, the delta between those two lines, between that real and the best possible line, really is our opportunity. The biggest chunk of that occurs when that equipment is idling. When it's not having a lot of menu items used through that that piece of equipment.

Achieving an instant on state, for example, so the equipment could cycle up to operational right away, for key pieces of equipment, that could cut their energy use by 50 to 75 percent. Certainly a big opportunity for restaurateurs and equipment suppliers.

And for almost every piece of equipment we assessed, the team uncovered ways to improve. Next slide.

We grouped all those possible improvements for kitchen equipment into three categories. The first those that are commonly available, meaning they're used in quick service restaurants today. Second, cutting-edge, which are minor modifications to existing equipment like say adding insulation or lids to a fryer. And, third, future technologies, such as, say, induction cooking. That would

require R&D and quite a bit of time from suppliers in tandem with McDonald's to develop.

So big savings can come from what's available today. That was a key finding of our study. One chunk of those savings come from switching key pieces of equipment from gas to electric, which may save site energy, but can certainly have a higher operating cost.

Other improvements that little incremental cost to save energy, but do need support from equipment suppliers. Very important to bring to the table in this effort.

So current a quarter more of the energy used by this kitchen equipment, could save tens of thousands of dollars a year for a McDonald's franchisee or a corporate-owned restaurant. Next slide, please.

We've talked about the savings, and I hope many of you've been asking, "Well, then what's all this cost?" So in parallel with identifying energy opportunities, the team estimated overall and individual technology costs.

We put all those costs together, the end result is that a McDonald's net zero restaurant for the locations we assessed, would have a negative net present value. Meaning it's not cost effective today. However, much of the total energy savings, particularly in the kitchen, they are cost effective, that's another key finding. There's a lot of cost effective efficiency.

The biggest cost, that big red bar on the right, the solar panels, can be brought down, that cost can be brought down through financing, incentives, or perhaps expanding the boundary beyond the site to include community solar.

So there's still a lot profitable here. And McDonald's, all of us in this space, can push that boundary. Push these technologies to become more cost effective, and develop new solutions for a more sustainable food service industry overall. Next slide, please.

I'll wrap up with just a few conceptual drawings we've done, to give you a sense of what this might look like. So if McDonald's pursued onsite net zero without aggressive energy efficiency I've described, McDonald's would have to purchase additional land to install all the required solar panels. That's what you see in the left half of this conceptual drawing.

It's certainly a highly costly strategy. Next slide.

With efficiency, McDonald's can fit all the solar on a standard site, in the three locations we assessed around the country. And meet code requirements, say, for emergency vehicle access and getting around that site. So the darker panels you might see on the roof there, those are just the solar thermal panels. The panels displayed here would allow McDonald's to reach a site net zero status in a typical year. Next slide, please.

This land angle gives the concept drawing a more typical customer view, with highly visible branding, but certainly a new take on a McDonald's. A restaurant like this would be a statement building, indicating a commitment to environmental performance and the advancing efficient building industry. And we think it could open up new opportunities for the global restaurateur.

Now, I'll hand it off to Roy Buchert, from McDonald's, to wrap things up with key themes and intended next steps.

Roy Buchert: Thank you, Roy Torbert. Boy, as you can imagine we're very excited about the study and the energy conservation measures that were the outcomes of the study. And I'm not going to go into those specifically, but I did want to share with you several of the key themes that did come out of the study. And in the interest of time I'll only cover several of them.

So the first theme is systems thinking and integrative design. Most equipment in QSR are typically designed in a standalone form and to do only one thing. It uses a single unit of energy to deliver one outcome. In this standalone form, while we've made a lot of progress in increasing efficiency, we fill that only marginal efficiency improvements are left.

From an integrative design and systems thinking perspective, we believe this will result in equipment that will deliver multiple benefits for the same unit of energy previously being used, and is key to unlocking the needed efficiency gains to achieve a net zero restaurant.

The second theme here that's very important is efficiency before renewable supply. I think in some of the slides shown earlier by Roy Torbert, you can see the difference in the outcomes of the physical site that might be needed. And the amount of solar PV that might be needed if we're not myopically focused on driving efficiency.

So even though we've already accomplished much in this area, the study did reveal that we still have a lot more opportunity, especially around the kitchen equipment.

The third common theme – or key theme here, is transparency and collaboration. Systems thinking and integrative design will drive the need for more transparency and collaboration between suppliers as they work together to develop equipment with enhanced performance.

And, lastly, transparency of performance. You know, we need this – the equipment has to help all stakeholders understand how it is performing, or in some cases not performing. And it's got to do this in real time. New equipment will need to identify when the performance is trending in the wrong direction. And it's got to be able to message that to all the pertinent stakeholders so performance can be optimized in the shortest amount of time.

Next slide, please. So in terms of next steps, our focus in the short term will be to put together a roadmap of the things that we need to do over the next few years by reviewing and prioritizing the recommended energy conservation measures. And then to start working against those measures.

Some of the energy conservation measures, such as instant off/on will require us to engage not only our suppliers, but also the broader industry in order to bring about the needed changes. From another efficiency solution standpoint, you get these solutions that have a strong business case are likely to become integrated into not only our new restaurant prototypes, but will be made available for our existing restaurants in the system.

And, clearly, again, we're very excited about the NZE study and feel that once we are ready, it will make sense and would make sense for us to build an NZE restaurant in one of our markets. Since it would serve as a great learning laboratory, if you will, to help us validate new technologies, as well as to continue to refine our approach to net zero as well as overall energy efficiency.

And with that, I will turn it back over to Holly Carr. Holly?

Holly Carr: Great. Thank you, Roy. I would like to volunteer Washington, D.C. for that prototype restaurant. So I'll just through that out there. *[Laughs]* Thank you, both for your presentation. It's very exciting work and certainly with outcomes that are relevant to the food service sector. Whether or not you're looking at net zero just

getting that energy efficiency strategies in our restaurants is really important as well. So thank you both.

A quick remember to our audience to continue to send in questions, we are collecting those and sending them on to our panelists. We'll be responding to questions at the end of our session.

Our final speaker, with his organization, has put zero energy theory into practice. Jason, at Walgreens, has worked to design and build a zero energy store in Evanston, Illinois. Jason, you've now been operating that store for over a year and can you tell us about the design process, and what you've learned in operation, and what this story means for Walgreens energy efficiency efforts across the portfolio?

Jason Robbins: Sure, thank you, Holly. We started this process all the way back in September of 2012 when none of this really was defined. In fact, this presentation at the beginning, some of the stuff I haven't even seen yet for how to define net zero, so we took our own stab at it having no definition of really what we were trying to target with this project.

Next slide. So Walgreens, I mean everyone, I'm sure, has seen a Walgreens somewhere in the U.S., but now we've merged with alliance Boots, to form one company that has 12,800 retail locations throughout the globe. So we have a huge footprint on the planet. And we felt that it was important to really figure out how could we reduce as much as possible.

We operate not just in retail stores, but we have over 340 distribution centers, infusion and respiratory services, mail service facilities, all kinds of buildings throughout the U.S. So we've constantly been looking at how we use energy in each of those facilities, and any ways that we could reduce that, and reduce our impact.

Next slide. So without having a definition of what to shoot for net zero, we kind of came up with our own vision and then tried to come up with some definitions on our own, as well as some early industry guiding for how net zero should or could be defined, that are just coming around to being worked on now.

But we really wanted to create a showcase product to show some of our most innovative and sustainable design features in a retail location, as that's most of our footprints. And we really wanted to

do that in a way that didn't change what Walgreens was.

Because if we had to create a facility that had shorter operating hours, or didn't provide the same services as a regular Walgreens, or operated really the – operational characteristics of the building any way, it would probably be the last one we would ever build, and it wouldn't be a good showcase for the industry, as it would show that you have to change your operating model to really achieve this. And that's not what we wanted to show.

We wanted to show you could keep your operating model the same and achieve this. Next slide.

So this is a picture of the exterior of the store. Like I said, we started the process in September of 2012 with just an idea from upper management saying if we had tried some of the different things we tried in the past, such as geothermal, LED, wind, and put them all in one location, could we actually produce more power than we use in a given year.

And we did a lot of expensive modeling with three different modeling companies, several different design firms, and we looked at it and said, "You know, it's pretty close. And we think it's possible. But we're not quite sure." Because energy models can have a varying degree of accuracy depending on the inputs and detail going into it. As well as, they kind of predict energy consumption based on a typical meteorological year. And no year is typical, especially the year that we opened this store.

One month after opening, we went into what everybody kind of remembers as the Polar Vortex, which was one of the coldest winters on record in Chicago, which was not the greatest opportunity. And this project is actually in Evanston, Illinois, which is a suburb of Chicago, about 30 minutes north of the city.

So if you're ever flying through the Chicagoland area, just head a little bit north, and you can come see it. Next slide.

So knowing that we wanted to produce as much as energy as we consumed – next bullet. And you can just continue on through them. We wanted to do the first net zero energy retail store in the U.S. And nobody had really attempted it as retail stores have a higher EUI than some of the buildings that have been trying to do net zero at the time. Nowhere near what's a food service restaurant might have, but our typical EUI's around 90 to 100. Most buildings that have been attempting net zero at that time, while we

were trying to do this, were in the 20 to 30 range.

In addition to being net zero, we wanted to achieve LEED Platinum Certification. We wanted to get Living Building Challenge Net Zero certification, which was kind of the leading organization at the time, when we designed this, for certifying net zero.

Be a member of the DOE's Better Building challenge showcase projects. Achieve Green Chill Platinum with the U.S. EPA. To do Energy Star certification, which was not a problem. And the hardest one was open before Thanksgiving, just 14 months after kind of the idea surfaced. Which really ended up being probably the hardest thing to do, which was to build, open, and operate a store in a 14-months construction schedule. Which is about six months sooner than a regular Walgreens we build.

Next slide. So we went and first thing we looked at was, if you're going to be producing a whole lot of energy at a high rate, for instance, that solar that was show in the McDonald's was a pretty high cost to do. The first thing you should look at is how do you reduce your energy as much as possible.

We started with an ultrahigh-efficiency mechanical and refrigeration system, that uses CO2 as a refrigerant. It's a transcritical CO2 heat pump. And it uses eight geothermal bore holes to provide constant condenser water to a transcritical CO2 heat pump system.

It provides all of the heating and cooling for the entire building for HVAC, as well as CO2 for direct expansion for both the coolers and the freezers. We did all LED lighting inside and outside the store. As well as daylight harvesting, within the perimeter and entire of the building using clear story, natural ventilation with operable windows, which is the first time Walgreens has ever attempted to do a retail store with windows that open.

And we have five separate dimming zones, including peak output reduction after dark. And what that means is when it gets darks outside, we actually reduce the lighting level inside, because when you come from outside to inside, your eyes would have to adjust to a higher lighting level. And we found that we can reduce our lighting levels to 80 percent at night, and still have the same perceived brightness.

We added a revolving door, which is typical of our city locations,

which help us reduce energy consumption by five percent. And a building automation system to control all of these different technologies. Next slide.

This is a picture of our mechanical room, and that transcritical CO2 heat pump, which there's actually glass from the sales area looking up onto that mezzanine. So you can see some of the stuff that's going on. All the piping's color-coded. And there's a chart that shows what's going where.

So our customers can really interact with what we're trying to do that the store. We felt that that was important to really engage the community to get their involvement in this project. Next slide.

This is what that system looks like. And so when McDonald's was talking about some of the different existing technologies, cutting edge and future, this kind of lies between the cutting edge and future. No system had been built like this at the time. There have been a few build since where it integrated a CO2 transferal heat pump with geothermal technology. Which had only been attempted once in northern Europe. Next slide.

So this is a quick schematic of what that looks like and how do you really integrate the entire thermal envelope of a building into once piece of equipment instead of several different pieces. So there's the geothermal, which is highlighted in green. Our chilled water in blue. And that couples with our geothermal system as in a buffer tank, so that if the water temperature in the geo system is adequate, we don't have the run the chill water system at all.

And we also do our heating loads and domestic hot water all through one package system, which helped to keep the complexity of the system reasonable to operate in a retail store. Next slide.

We did a little bit of different spin with LED lighting as well have – we targeted an initial lighting power density of .8 watts per square foot, and ended up with .9. The original lighting design actually came in at 1.35 watts per square foot, which was higher than our typical fluorescent lighting package lighting power density.

So we missed the mark quite a bit on the initial design. But we did go back and look at what went wrong and repackaged that. And the figure on the left, you can see the lighting distribution pattern might be different than anything you've seen with fluorescent, and maybe some of the LED fixture you've worked with.

We used an optic pattern right on the LED chip to focus the lighting right at the product shelves. So we got the same product light shell – product lighting intensity on the shelves that we did before. But we're just not getting as much light on the floor, which we don't really sell anything there, so we didn't care.

We're able to reduce our HVAC load by 2.3 tons and reduce our lighting power usage by 30 percent. All by just targeting lighting where we needed and away from where we didn't. Next slide.

So this is a picture on the inside of the store. You can see some of the different LED lighting fixtures and the clear story windows between each roof plane. Those open to provide our natural ventilation strategy. And the LED lighting, the ones focused on in this picture are use a lighting panel that has laser-etched micro optics in it. And that's how we're directing the lighting where we need it. Next slide.

So along with the LEED Platinum Certification, it wasn't all about energy for this project. We also wanted to achieve some other things that we thought were important in our statement to the environment. And that was to recycle as much of the existing building as possible. Reduce our water consumption as much as we could. Use low VOC fixtures and finishes.

And add an electric vehicle charging station, which we provided as a free service to our customers. And has been using quite a bit more energy that we thought it would. So we're working on how do we back that out of the building power consumption because it's driving away with our customers. We weren't expecting a whole lot of charges from the electrical vehicle charging station, but we get an average of 12 full vehicle charges a day. Next slide.

So along with what we were trying to do at the time, we really wanted to tie this building together with our brand image of being happy and healthy. And being in the facilities department, we don't have a lot to do with our operations groups, and we wanted to say that as much as we could in terms of what does happy and healthy mean for the built environment today. Next slide.

So the results. Our Chicago averages around 100 EUI. We did an Oak Park, which is another Chicago suburb, which ground sourced heat pumps back in 2010. Which was around 60. Our first 12 months was a 40 EUI with the solar, down to 20. And you can see our detailed energy model on the very right-hand side. So you can see we're quite above that detailed energy model in the first 12

months of operation.

But like I said, that included the Polar Vortex, which increased our energy consumption quite a bit over typical. And right now we are actually tracking towards net zero. Next slide.

So this was our year-to-date performance for the last calendar year. And you can see that there are some months that we're way off, and some months that are targeted right on. Most of that had to do with identifying different technologies in the store that were malfunctioning or had broken, or weren't working as intended. So we're constantly evaluating the building in terms of how it's operating to get it into where it's supposed to run. Next slide.

So we had targeted a 49 EUI for consumption, a 54 for production for equaling a minus 5, or being net positive. After one year we're actually operating at a positive 20 EUI. So we're still using energy, but it's roughly 80 percent less than a typical store in the Chicagoland area.

And after replacing some of the refrigeration compressors, repiping some of the systems, diagnosing some malfunctioning equipment, and getting some things set up the way that they were supposed to be that didn't get set up at the beginning because of the escalated construction schedule, we do thing that within the next calendar year we will achieve net positive. Next slide.

I guess we will turn this back over to Holly. Thank you, Holly.

Holly Carr: All right. Thank you so much. Great project. And I know you've had many visitors, including folks from DOE who have already come by and want to learn about this landmark building and help move this effort forward. So thank you for sharing your experience to date.

I'd like to point out a few additional resources to our audience that we've collected from our panelists. First off we have a hyperlink, which will be available in the archived presentation to sign up for project notifications from NIBS. So if you're interested in the definition work that's happening, and you'd like to know when the final results come out and the final reports are posted and so forth, you can click that link to be added to the LISTSERVE from NIBS.

We also have down at the bottom, from Department of Energy, regarding that project. We've provided a hyperlink here to the website on Department of Energy's site, which will have all of the

information about the zero energy building's definition project.

That is, if you go there today, you will not find anything, but if you go there in a couple of weeks everything will be up. It's coming soon.

Back up to the second bullet from Rocky Mountain Institute, there is a hyperlink to publically available information about the Rocky Mountain Institute McDonald's zero energy project. And then links to the Walgreens showcase project for their Better Buildings challenge participation. So Walgreens is a great partner with us in the Better Buildings challenge and the Evanston store is one of their showcase projects. So you can get more information on the details of that project there as well as a link to press releases and all kinds of information from the media about the Walgreens project and their Facebook Page, so you can Like it.

Thank you, John, next slide, please. All right, so let's go ahead and take some questions from the audience. You have sent us many questions and we really appreciate those. We'll try to answer as many as those as we can.

Going back to Roger's presentation, let's see here. Roger, I think you had presented a slide on the source energy factor, and we had a question asking if there's going to be detailed information on the source energy factors for the individual fuel types used to generate electricity that lead to general source or site factors for electricity. So if the final report will include more information on that.

Roger Grant: It will. That was definitely one of the areas that we received comment on and we're actually working on it right now. We used the site to source factors from EPA since those were publically and readily available. And we know there's some inconsistencies in that table and some questions. So we don't quite have that resolved yet.

But, yes, we will be addressing that with more information and potentially with some changes from what published in draft, and what was in that table that was on my slide.

Holly Carr: Okay. Great, thank you. Some questions for Roy and Roy regarding the McDonald's RMI work. One of the questions was can you speak to the specific future equipment designs that would be needed to reach the energy efficiency levels that you're hoping for, for zero energy? And what existing cutting-edge equipment could be used? So if you can provide additional detail on – I know

you mentioned the immediate heat equipment, but what's out there right now that would be contributing to your energy savings? And can you tell us a little bit more about the future stuff?

Roy Buchert: Great, Holly. Roy Buchert, here. One of the probably the largest things that we're going have to go after, and I think it was called out as induction. Not sure if that's exactly what it ends up being, but the notion of instant on is something that we're looking to explore with our suppliers and probably across a broader industry.

The one graph that Roy Torbert did show clearly there's a huge gap between the amount of energy needed to actually cook the food, and the amount of energy that we're actually using today. So that notion really comes back into play to say how do we develop equipment that can be turned on and in a very short amount of time is ready to go. Versus the kinds of equipment that we are using today.

Holly Carr: Great. And we had another question – lots of questions that also provide you with some ideas *[laughs]* for future designs. One person was asking if you considered micro CHP, that you might use kitchen waste, including used cooking oil as part of the plan?

Roy Buchert: So, again, those are fantastic questions. I'd have to say at this point we've just recently received the study and so we're still sorting through all the recommended energy conservation measures. And we're working to prioritize those. I don't know that we've gotten this far, you know, far enough along to really delve into any one of them.

But that's the plan now as we get things mapped out and we start moving forward.

Holly Carr: We had another question that's interesting given that 90 percent or so, I believe, of McDonald's restaurants are franchised, what, if any, plan is in place to reach out to those franchisees to encourage them to move in this direction?

Roy Buchert: So one of the things, again this is still very early on in the game here, so we haven't had a chance to really start thinking about some kind of a net zero strategy. But we do know that as we move through these different solutions and we find those that have strong business cases, we will make those available to our existing restaurant base, as you've noted primarily franchised restaurants, to make sure that they understand what these solutions are and how

those solutions fit into helping them deliver a restaurant that are more energy efficient.

Holly Carr: Great. A couple of cost questions. One, someone wondering if you can share the cost difference between a standard McDonald's and the zero energy McDonald's that?

Roy Buchert: I won't get into the particulars, I think some of the cost data that were shared clearly indicated that the solar PV was one of the primarily drivers. Part of the study did not take into account the R&D cost, are assume that those R&D costs would be covered primarily by the suppliers.

And so I think if you look at it right now there is a significant premium, which really makes this a bit of a challenge for us to get our arms around. But we do know that we've got a lot of work to do. We know the kinds of things that we need to focus on, which is fantastic.

We also know that over time solar PV those costs are coming down as the output goes up. And we're hoping sometime in the not too distant future that those lines will intersect and we'll be at the point where we can say, hey, you know what, it makes sense. And cost premium isn't anywhere near significant as it is now, to make something like this happen.

Holly Carr: Great, thank you. Question for both Walgreens and McDonald's on the work that you've done with your energy and the modeling work that went into those projects. Can both of you speak to the modeling software that you used for the simulations?

Roy Buchert: So, Roy Buchert here for McDonald's, and Roy Torbert correct me if I get the wrong name here, but I think it was called EnergyPlus, was the software.

Holly Carr: Yay. That's what we like to hear. That's DOE. *[Laughs]*

Roy Buchert: Yeah. That was used on our side. And I think Jason had pointed out while, you know, any kind of software simulation is not always perfect, boy it sure allows you to run a lot of nice and quick what-if scenarios to understand the kinds of things that can really move things forward and some of the other things that might be just incremental. So it's a great way of generating and prioritizing the energy conservation measures.

Jason Robbins: Yeah.

Holly Carr: *[Inaudible]*

Jason Robbins: Walgreens used our energy modelers the same way in our design process. Where we brought them right at the beginning to evaluate where should we focus in our time for making significant improvements in what areas. We used TRNSYS, Train Tracer, DOE-2, eQUEST, and I think a couple of others. We had several different models running simultaneously of different options and solutions.

Because they all had something a little bit different to say. And each program kind of has its ins and outs of different scenarios that it models better than others. And we had some different technologies we were trying to simulate that no one had built any modeling tools around, such as the combined CO2 heat pump.

Holly Carr: Great. Thanks. We have a number of questions about your next efforts for both Walgreens and McDonald's, everybody wants to see where your next zero energy store will be. Jason, are there any plans for another store at this point? And McDonald's the same? I already advocated for Washington, but.

Jason Robbins: We are currently still evaluating the store as it is, but there are plans, conceptual plans for a second one without a timeline associated with it yet. We're still trying to gather as much information as we can from lessons learned from the first one before we attempt a second.

But right now there are conceptual studies and plans for a second one. We don't think it will be DC though, apologies. We're going to try a slightly more temperate climate this time, to see if we can reduce the cost impact associated with doing these projects in a more temperate client like California.

Holly Carr: Well, and from what I understand putting the initial store in Evanston was also to see if, hey, we can do this more easily in the South, but could we do it in – could we do it in a northern climate, and to really test that out. So I thought that –

Jason Robbins: Yeah. It was kind of statement to show if it could be done in a climate like Chicago, it can be done in almost every climate zone in the U.S.

Holly Carr: Yeah. One more sort of technical question for Roy and Roy, could you clarify which equipment you had moving to electric? We had some interest on more specifics of that transition.

Roy Torbert: This is Roy Torbert, I can take that one. It's a good question. And it's important to note that this is not a true fuel switch, in that there are many McDonald's built around the world that are all electric. But as we did many of our simulations we did find that the all-electric seem to give the path toward net zero.

And the specific pieces of equipment included the fryer. Many fryers are gas. The heat, the water heater. And lastly, RTUs are often gas. All of those McDonald's can with their suppliers source quite efficiency electric alternatives, and then we pushed those further and said how much better can we get within that all-electric set.

Holly Carr: Okay. Thank you. Another equipment question for Walgreens, with regard to the turbines, question from the audience wondering if they are working to your expectations. The wind turbine.

Jason Robbins: Unfortunately no. They're performing significantly under initial projections. We have figured out why and we are attempting to get those repaired. But as they are standing right now, no, they're significantly under the initial projections.

Holly Carr: And a question that was asked of both McDonald's and Walgreens projects, how critical is the building envelop to achieving your energy goals? And similarly – yeah, how did passive insulation impact the design?

Roy Buchert: From McDonald's perspective the building envelope obviously plays a role. But something else that I think we need to get our arms around is the amount of air that we have to move through the building, especially specifically for the exhaust hoods and things that we have to put over some of the heavy cooking equipment.

So until we understand and are able to address that effectively, I'm not sure that the tweaks to the building envelop will have the kind of impact that it might have on a building that's not moving the amount of air that we move.

Jason Robbins: And for – it's actually surprisingly a lot less impact from the envelope than you would think for a net zero building. Although it's more what the architecture and the design style of the building, than the actual envelop.

You know super insulating the walls and ceiling, and floor, really had insignificant impacts on the building performance in the modeling that we did. So the envelope of the building is more

insulated than typical for a Walgreens, but most of our loads are internal with the refrigeration, lighting, and plug loads.

As you get into more temperate climates, the impact on the envelope continues to decrease. So in climate zones three and four, California, coastal, the envelop was a lot less impactful. What was impactful was the glazing, especially the direction of the glazing and amount.

So doing the right thing with your glass direction and design strategies on your glazing was impactful.

Holly Carr: Okay. Thank you to you both. And thank you Roger for those responses. As you can see we're coming close to the end of our session here. I do encourage folks to reach out to our panelists if you'd like to continue the conversation with them.

We'll go ahead and go to the next slide, John, if you will. And this is our last Building Buildings webinar for the 2014/2015 season. So our next opportunity to get together is actually in person at the end of May, May 27 through the 29, we're holding our Better Buildings Summit here in Washington, D.C. So if you enjoy this conversation, if you're passionate about energy efficiency and you'd like to hobnob with other colleagues who are also working hard on these issues, I really encourage you to take a look at the program and to joint us here in Washington.

There's a link here to the agenda and also to registration and hotel reservations. This is a two-and-a-half-day event that we do once a year and we'd love to have folks from the audience join us as well. Next slide, please.

With that, I'd really like to extend a hardy thank you to our panelists. We have contact information for both some of our panelist and also our DOE leads, so myself as well as my colleague, Kristen Taddonio. If you're interested in either the Better Buildings challenge, or the Better Buildings Alliance, place reach out to either one of us, and we'd be happy to talk with you more about that.

I encourage you also to follow us on Twitter. That's where we send out all the late-breaking news from the Better Buildings program. And you will receive an e-mail notice with the archive of this session is available online, probably in about a week.

So with that, thank you so very much. And we hope to see you at the summit.

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