Jordan Hibbs: Better Buildings was launched in 2011 by President Obama with the goal of making commercial, public, industrial and residential buildings 20 percent more energy efficient over the next decade. A lot of individuals on the call today have a mixed background. Some are already members of Better Buildings and some aren't, so we'll give a little bit more information about the different portions of Better Buildings.

Better Buildings is made up of the Better Buildings Alliance and the Better Buildings Challenge. As you can see on the screen some of the requirements for both of us. Joining the Better Buildings Alliance requires an organization to set a goal to reduce energy consumption and to participate in a certain number of Better Buildings activities to support their goals. Joining the Better Buildings Challenge requires an organization to set a goal of at least 20 percent energy intensity reduction and requires providing building-level data to the Department of Energy.

For the Better Buildings Alliance and the Better Buildings Challenge members, the Department of Energy supports partners by providing technical assistance by connecting partners with the network of allies that can help them achieve their energy savings pledges and by publicly recognizing partners for achieving energy and cost-savings goals. Next slide.

Currently the Better Buildings Alliance has 213 partners, which covers 11 billion square feet and makes up 12 percent of U.S. commercial buildings. With our Better Buildings partners, we work together to develop informative case studies, implementation models, decision guides and much more. Currently we have 100 resources available for our partners. Next slide.

On the slide here, you can see the link to the website if you're looking for more information about Better Buildings. You can visit the website and also check out the Better Buildings Solution Center which hosts all those tools. The search engine allows you to search by sector, by building type, by solution type. It's a really great resource to use. Next slide.

When partners join Better Buildings, they are grouped according to their sector. As you can see on the slide here, they're grouped according to if they're in commercial real estate, food service, retail and grocery, healthcare and hospitality and higher education, and after they do join and are grouped in a sector, then they have the opportunity to participate with the market solutions team, which are listed here, the Energy Efficiency Project Financing, Leasing and Tenant Build Out, Energy Data Access, and High Performance Property Evaluation and Mortgages based off of their own personal or organizational interests. They can also choose to participate in technology solution teams, which are also listed here, ranging from lighting and electrical to space conditioning, and of course our newest tech team, which we're excited to be here today for the Building Envelope team. Each team is led by a subject matter expert and the content of each team is driven by a member interest as well as objective research by the Department of Energy.

The tech teams can really be thought of as working groups for peers from different sectors to collaborate and learn from each other. So throughout this call you'll hear about upcoming activities and plans for the Building Envelopes team, and if you're a current Buildings member and would like to join the Envelopes tech team or if you'd like more information on joining Better Buildings, Melissa's contact information is here and I'll make sure that you get in touch with the right person. Thanks so much. Next slide.

Melissa Voss Lapsa: Excellent. Thanks so much, Jordan. At this point I will turn it over to Dr. Simon Pallin who's going to give an overview of Building Envelope opportunities. Dr. Pallin has worked in the building industry since 2006 and spent several years conducting research in Europe. He joined the Building Envelope systems research group at Oak Ridge National Lab in 2013. He serves as the risk assessment moisture simulation expert and works with new and existing simulation tools designed to estimate the hydrothermal or heat and moisture performance of building elements such as walls and roofs. So with that, I'll turn it over to you, Simon.

Simon Pallin: Thank you, Melissa. Hi, everyone. I am going to walk through my part of this presentation quite quickly because we are very excited to have Greg Farley from Chesapeake College presenting today, and we want to allow him to have as much time as possible talking about a successful building envelope retrofit of one of their facilities. On my agenda today I will talk about the building envelope market potential, discuss a couple main components of the building envelope where the potential for energy savings are big, such as making sure buildings are relatively air tight. I'll also talk about windows and attachments, and I'm excited to be able to walk you through our newly developed building on the local website under building, the Building Alliance. So let's get started.

In 2010, the primary energy consumption in the U.S. was 98 quadrillion BTU, also referred to as quads. Of this, commercial buildings were responsible for 41 percent, and that's dominantly from lighting and space heating and cooling. The energy consumption associated with heating and cooling will naturally vary greatly, mainly depending on the climate. This pie chart present the bars that were presented on the previous slide illustrating different categories associated with energy consumption. In this chart, space heating and cooling is highlighted and these are of special interest to building envelope designed since they are a result of how efficiently buildings thermally perform. Obviously there's normally large thermal load inside a commercial buildings due to whatever activity is taking place, and that thermal load will have been taken care of by the HVAC system. And despite of that, whatever energy that is used by the HVAC system is basically a result of energy losses through the building envelope. Therefore, designing the building envelope to reduce these losses is of high priority. Since you will not only reduce the actual energy loss but also reduce the peak demand, and thus cost associated with such.

If we look into detail of where the energy losses occur in a commercial building, on average most losses are associated with the thermal performance of windows but closely followed by walls, air leakage, roofs and foundation. In total, commercial buildings contributed to 5.81 quads of primary energy consumption in 2010. This is a number which could be quite difficult to understand what it actually represents. As an example, 5.81 quads represents roughly 210 million tons of coal or 1,000 million barrels of oil. Obviously these are not sole energy sources presently used but it helps to better appreciate the amount of energy used to heat and cool our commercial buildings.

I'm going to start here and talk about air leakage, which is responsible for a large portion of the energy consumption in commercial buildings. We're exactly about 20 percent on average. This energy loss can naturally be both higher or lower depending on climate conditions, the building size, building envelope, thermal properties or activities taking place inside the building and so on. Despite that there are a large number of factors that will impact the actual energy loss associated with air leakage, it is clear that making buildings more air tight will significantly reduce the energy consumption in buildings.

In 2009, we started to see air barrier language in code, and that it must be installed so that it is continuous over the whole building enclosure. The purpose of the air barrier is to prevent air flow, thus air leakage through building components which otherwise may result in energy penalties or decreased service life or building materials. Interfaces such as wall-to-roof or wall-to-foundations are examples of critical details where the design must allow for the air barrier to be continuous. Also penetrations and installations are examples of where extra efforts are usually needed to prevent unintended air leakage. Also important is that the air barrier needs to withstand forces during and under construction, and it should have a service life beyond that of the building.

According to present code, there are three paths to compliance. The first two tests are laboratory based, while the third is based on field test. Amongst the three, the field test is obviously the only test that will give a natural indication of how a building will actually perform. For those not familiar with the procedure of the third test, what is usually called the Blower Door Test. Basically you place one or more fans in alignment with a air barrier of the building such as a door or a window opening. Then you pressurize or depressurize a building up to a certain relative air pressure difference, typically 75 Pa, and while doing so, you also measure simultaneously measure the amount of air passing through the fans, and this amount will also be equal to the amount of air traveling through the building envelope, which thus is an indicator of the air barrier performance.

This chart here depicts field tests conducted to study how air tight buildings are depending on whether an air barrier was installed or not. According to the result here, those buildings where an air barrier was installed, about 70 percent of the buildings were code compliant. While for buildings where no air barrier was installed, only 23 percent of the buildings were air tight enough to meet code requirements. So this study clearly shows the importance of installing an air barrier to reduce the energy penalties associated with air leakage.

So one of the most typical air barriers we see in commercial buildings today: for the categories of membranes, we have interior membranes such as polyethylene, mechanically fastened such as house wrap, self-adhere, and fluid-applied non-foaming membrane. And air barrier can also consist of sheetings, insulating or non-insulating, or sprayed-applied sealants or foam. Many of the air barriers also serve as water barrier and drainage plane. The difference are mainly costs, installation procedure, water vapor permeance, which is how much water vapor transportation the product allows, and also the thermal resistance between the different air barrier products.

There are also fairly new air barrier products such as primer-less and self-adhered membranes. We see exterior gypsum sheathing with an integrated air and water barrier, as well as liquid flashings spray applied or installed with gun, putty knife or spreader.

I'm also going to talk a little bit about windows today. Windows contribute to the largest energy loss in commercial buildings on average and out of the presented categories. Being associated with 1.71 quads energy losses through windows consists of 30 percent of the total energy loss through the building envelope of commercial buildings. However, there is a large market potential for reducing energy losses associated with windows.

According to the building energy data book from 2012, the most common window type is still single pane, and that most windows in commercial buildings are clear without any tinted, low-E or reflective coating. There are many different window designs and their performance mainly depend on how many glass panes are used, different type of coating, what type of gas is used between the glass panes. As an indicator of performance U-factor center-of-glass is used. U-factor represents how effectively heat can travel. Thus, the lower the U-factor, the better in terms of energy performance. We mark that center-of-glass U-factor only represents the performance of the glass and thus not taking into account the framing, which normally has less thermal resistance.

For single pane windows, we look at this slide here. For a single pane window without any coating, the center-of-glass U-factor is about 1. While you have four times better performance if you instead have a double coated, double pane window. If using a triple pane, double coated, the U-factor is about 1/8 of that of the single pane. Since we earlier saw that the single pane dominates the market, there is obviously a huge potential for improvement. There are also emerging and future window technologies that are not yet sufficiently cost-effective or market-ready but have a great potential for future use by using other type of gases between the panes, vacuum, and nano-pore materials such as aerogel, the U-factor can be reduced even further.

As an example of a new technology, technology that is readily available, is a R-5 aluminum frame window. The thermal performance of this window is actually almost as good as two-inches glass wall. And the successful design is a result of a DOE investment. Actually it has 40 percent better thermal performance compared to other high structural windows, and also have obtained the highest structural rating for windows. Since it has an aluminum frame, it will never rot, warp or buckle due to moisture and weather exposure. In climates where solar radiation acts as a heat load, window attachments is another great opportunity to reduce energy losses. It is also a great option when a window replacement is not possible or the best solution in terms of cost, timing or historical preservation demands.

DOE and the Building Technology office has estimated that window attachments had the potential of saving nearly 800 trillion BTU in the residential and commercial building sector. Since we already use quads, this number is equal to 0.8 quads. What is also considered as an attachment is any extra window pane you add to an existing window. That technology presented here will increase the thermal performance of the window by adding one or more layers of polymer storm window panes. The polymer panes are low-E coated and are designed to be installed on the interior side of the existing window. As seen on this slide, the total R value of the window can be as high as 13, which is equivalent to the thermal performance of bat insulations you typically put between a 2 by 4 studs in a wall.

Finally, I would like to present to you the newly developed that the Building Alliance website for building envelope. This site has a number of different resources related to energy efficient and durable building envelope design. For convenience, three different subcategories have been defined to help users to easily find requested resources. These categories are windows, walls and roofs.

So let us click on walls here. Find out what this website provides. Here we have featured solutions which could be case studies, toolkits or other resources of information related to energy efficient wall design. If you scroll down further we see here under Other Resources, we find topics such as – separate topic for case studies and we also have fact sheets. Here we have an insulation fact sheet which will guide and inform the user on available insulation materials and how much and what type of insulation should be used depending on climate conditions. And we also have some additional information here. Here we have further resources such as the Whole Building Design Guide. We have trade organizations, green improving ground program and standard organizations. Since walls is one out of three subcategories, you will find similar resources for roof systems and window and window attachment.

So one of the main purposes of this website is to help you, building owner, engineers, architects, manufacturer, member or other members of the Building Alliance and so on to take advantage of energy saving potentials through building envelope technologies. And to help you identify which technology are best suited for your building retrofits or new construction. With that, I'm done and I'm going to turn back over to Caroline.

Caroline Hazzard: Great. Thank you, Simon. So we're going to go ahead and run another poll question here. We'd like to get a sense – we'll get that poll up for you. Here we go. We'd like to get a sense from you if you've been working with any energy saving building envelope technologies, if you've completed any projects. You can click yes, no or maybe you're not sure. And if you have done that, go ahead and chat that into your chat window. So we've got some great voting going on here. Give it another second or so. I'll use this as a reminder that if you do have questions for Simon or Jordan or Melissa, you can go ahead and chat those into your chat window and we'll get to those at the end of the session here. Okay, let's go ahead and close that out, and we'll show you the results.

We're really excited to see that many of you have done some projects with envelope technologies: 76 percent. And surprisingly only 6 percent aren't sure. So that's really exciting to know. We'd love to hear more about that, so hopefully some of you are interested in joining the tech team and share your experiences.

So we're going to run one more poll here before we get to our next speaker. Go ahead and put that up. We're doing a little bit more of a deep dive into the technology areas. We'd like to get a sense from you if you've done any projects with any of these newer technologies. You can click more than one. There's dynamic windows such as electrochromic or chromogenic windows, air sealants, sprayables, primer-less membranes, et cetera. Maybe some of the R-5 windows or vacuum insulated panels.

So taking some time here to see what kind of results we get on this. Thank you to those who've chatted in what kind of projects you've been doing. That's really helpful, exciting to see. I'm getting some if back but it's only allowing for one clicking. So apologies for that. Why don't we go ahead and close out that poll. So the majority of you did pick the air sealant category, so that's great to know that that technology is being used. We do have a handful also with dynamic windows and R-5 windows and rounding out the race here is vacuum insulated panels. So again, thank you for your input. We're excited about that. These are some of the technologies we'll be looking to build out more toolkits around. So stay tuned to get involved in the tech team. Let's go ahead, Melissa, if you want to introduce our next speaker.

Melissa Voss Lapsa: Yes. Thanks, Caroline. I'm really pleased to present Greg Farley, and he is a member of the Better Buildings Alliance. He's the first director of the Chesapeake College Center for Leadership and Environmental Education in Wye Mills, Maryland. He's a biologist by training and holds degrees from Duke University and Florida State University and served as a visiting scholar with the Sustainable Living Institute of Maui, which is just part of the University of Hawaii's Maui College. So Greg, I'm turning it over to you.

Gregory Farley: Great. Well, hello, everybody out there and thanks for having us into today. We're really pleased to be part of this and I want to give a generous shout to the Better Buildings team and you guys have been great allies to us here at Chesapeake College. So my goals for today are just to walk you through a little bit about who the college is and why we approached sustainability the way we do, and then to walk you through our Better Buildings Challenge showcase building. It's a building renovation and addition that actually turned out to be a fantastic energy performer for us. So next slide please.

So just a little bit the college. We're in Maryland, but we're in the other half of Maryland. Most of you probably think of Maryland as the Baltimore-DC corridor. We are across the Chesapeake Bay from there. The college serves the five counties that are colored in on this map and it's a very rural area. We serve 20 percent of the land area of the state but only 2 percent of the population. This is all farm country here. This is mostly chicken countries. We raise a lot of grain for chickens and we raise a lot of chickens out for the meat market. And so at any given semester we've got about 2,000 students. Next slide please.

And we're in a very ecologically sensitive region, particularly with regard to climate change and sea level rise. We are seeing sea level rise here at about twice the rate of global average due to some underlying geology on the mid-Atlantic coast as well. But significant parts of our service area are going to be impacted by things like sea level rise, periodic tidal inundation and certainly we're at increased risk for inundation from storms. We're also at a very fiscally conservative area, and so our goals for sustainability are both to introduce a little resiliency and deal with the ecological challenges coming towards us while simultaneously dealing with the financial challenges of serving rural and very conservative counties. So this is an interesting set of challenges and sustainability sort of offers us a strong way to do that. Next slide please.

I'm responsible for measuring our campus carbon footprint, and we're just shy of 7,000 metric tons, and that's largely from purchased electricity and campus commuting. The purchased electricity component is – that is almost all of our power on campus. We don't have any generation. Our campus was built in the late 60s and draws almost all of its power from the regional electricity grid. We do have a small footprint from on-campus fuel oil, but we don't even have a vehicle fleet. So that 5 percent is gas for the laboratories and cooking fuel and things of that nature. Next slide please.

So we started our journey towards sustainability in 2011 when we put up a 50 kilowatt wind turbine. It makes about $7,000.00 a year for us, about 70,000 kilowatt hours. And they're a really visible symbol for what the college has been trying to do. Simultaneously we went after conservation really, really hard. We had a lot of low hanging fruit on the campus, a lot of bad habits in how we used the infrastructure we had. So we've been busy installing motion sensor light switches and LED lights and changing building schedules and trying not to light the parking lot up at night and things like that. So at present, we're just about 20 percent of our energy costs have been reduced over the past three-year period. Next slide please.

So in the middle of last summer, we finally went live with solar photovoltaic infrastructure. The aerial photograph at the bottom of the slide here, on the right hand side there's a yellow circle around a 5.5-acre solar array. That's about 1.5 megawatts of solar PV and in the parking lot for the building I'd like to talk about, in the center yellow circle there's about another 250 kilowatts, those are on racking systems over the parking lot, which is actually been a really great thing for us. Our students really like this. It offers them a chance to park in the shade in the hot Maryland summers, and it will offer them a chance to park out of the snow in the cold Maryland winters. So we get triple duty out of those.

Associated with both the building and with the parking lot panels, we have 14 electric vehicle charging stations, which by my count is about 7 times more charging stations than we have electric vehicle users on campus, but we're building for the future and hoping to provide the infrastructure. Remember the pie chart slide you said about 60 percent of our emissions come from student commuting. That's just a function of being a commuter campus in a very large area. We're hoping that providing electric vehicle infrastructure that we'll make that a less remote possibility for our students. We'll put it that way. Next slide.

Oh, pardon. One more thing, and that is as a function of solar and wind turbine work we've done, our partner utility here for the region is looking to bring a 1.75 megawatt battery. It would be about 2 megawatt hours – actually it's ¾ megawatt battery and a 1 megawatt PCS power control system. The idea behind this is we should be able to use the solar panels to charge the battery before we push power back to the grid. The battery also helps grid reliance and address our grid reliability and safety, and it helps us put more renewables on the grid in this region because we're starting to approach grid saturation. It may also allow us to build a two-building micro grid and answer some campus resiliency needs, which is really nice for us. Now next slide please.

So this is the building I would like to talk to you about. This is our new health professions and athletic center. It is an absolutely gorgeous facility. I think it came out, I mean, right on with the documents and the drawings that we saw during the design phase. We went after energy efficiency in the design very, very hard. And it was a tough sell here on the Eastern shore because doing the building the right way costs money upfront, but we were able to argue that over the life of the building, it should more than make up for that cost in energy savings. And I think we're beginning to see data that indicate that. The building has been up and running for just under a year now.

I'd like to take you through the design phase, show you where we started, and then take you through some of the building envelope components of this building. Next slide please.

So in the lower right here is – it's amazing that Google can you find you anything, but this is an old postcard of the original campus, 1967, 1968. The building in the yellow circle was a pool and some associated – sorry, gymnasium and associated office space. We added a pool in the early 70s, and we tried to do things right even back then. The original pool building had a large solar hot water loop on it, but by the time I came to campus in 2003, the pool was just about at the end of its useful life and the building was really a terrible, terrible energy performer. We know that the pool component alone costs us about $65,000 a year in energy costs. So we received permission from our support counties in the state of Maryland to do a building renovation to the structure, and what that really meant was that we had to keep the roof and we tore the rest of the building apart and added another 60,000 square feet to it. That allowed us to bring home to campus our health professions, the nursing programs, our dental assisting program, our radiation tech program, all of which had been off campus at a local hospital. So next slide please.

So here's a view from the inside of the building now. It is absolutely beautiful and we've gotten rave reviews from both support counties and from students who are in the space every day. Lots of natural daylight. There's just a really warm feel to the inside of the building, and the building is a real testament to what you can do with good design. In addition to all the natural light, we're using daylight harvesting technology and LED lighting and proximity sensors and things like that. The building envelope itself is also engineered for high performance.

So we start with the windows, they're high performance, double pane glass. They are integral ceramic shading and especially in parts of the building where we know there's high incidence in sunlight. And then the building itself is engineered with passive solar in mind so that we get sort of incidental heating of those spaces in the winter time by solar insulation, but then in the summer time when the sun is very hot, we don't want that energy inside the building, the building actually shades out those windows and you get indirect light only.

The other thing that was a really great part of the initial design is when the architect designed the extension for the new part of the building, they actually cloaked it right around the existing structure, which allowed us to effectively use the new building to insulate the old one and that actually did a great job on protecting the thermal mass of the entire building. There are also lots and lots of shade components on the outside of the building. Again, most of them by way of passive solar design in the structure of the building itself, which allows to shade some of those windows, much like what you saw in Dr. Pallin's part of the talk. Exterior walls are in 18 insulated and there's a metal rain screen over some parts of it and a terracotta rain screen over other parts. Next please.

You'll have noticed from the overhead photo, the aerial photo of the campus, that there is a lot of roof space on this building but it is high reflectance. It's a white color, and the roof is well insulated, minimum R-25. The HVAC system to the building is truthfully complex. As I understand that there are 220-some geothermal wells that support the HVAC system, which gives a real great boost in efficiency. Groundwater temperature here in Maryland is something like 55 degrees year round. That's almost perfect. And on the Eastern shore there are no rocks, so drilling the wells was really easy. We are using almost complete heat recovery, so all the make-up air for the building is provided through energy recovery ventilators and heat wheels. And then for us, it's been a little bit of an exploration but our energy building management system is integrated into the overall campus energy management system and that allows us to sort of use this building to optimize the performance of the whole campus, which is really kind of neat.

The energy use intensity number for this building – I'll show you on a future slide, but we're just about 30 kBTU per square foot, which is a really, really low number for our campus. The point of comparison for us is that we have a library building across campus that's 44,000 square feet that uses slightly more than twice as much energy as this health professions building does at a 101,000 square feet. So this is a tremendously efficient building and it's been really, really great. The other metric I like to point out is that we brought this building back online, and for the calendar year in which we did so, we saw a new increase in our carbon footprint from purchased electricity, which is really fantastic. Next slide please.

So the next couple of slides are from our Better Buildings Challenge Partner Project page. So here's our overall campus commitment to 20 percent reduction energy intensity. I think we'll probably make that this year. We just haven't submitted data yet. Next slide please.

And so this building shows as our showcase project for the Better Buildings Challenge, and let me draw your attention to a couple of numbers on the slide. The first one is a bottom left number. It's still a gog a little bit at this figure but we go back and we recalculate and we reconfirm once a month when the meter data come in, the building is running about 84 percent more efficient than baseline building code would have it do, and that's over the empty box, ash tray model. So this is – it's just a fantastic performer for us. My CFO couldn't be happier. We think it's going to save us something like $130,000 over what we might've expected over the course of a fiscal year for us. That number fluctuates a little bit based on fluctuations and energy cost coming off the grid. But still, even if we missed the 134 and end up in the $85,000 range, but still, for our operation, that's a significant cost saving for us. Next slide please.

So that about wraps for us at Chesapeake College. I'm happy to take questions later on, but we just wanted to use the building as a living testament to the fact that good design really can save you an awful lot of money on energy cost down the road, and we've gotten great reviews for this. We think the building is LEED Platinum rated. We did the check sheet a couple weeks ago and have submitted it. So fingers crossed and we'll let you know what happens. Thank you again.

Caroline Hazzard: Great. Thank you so much again, Greg. We really appreciate it. So before we run this poll, I'd like to remind everyone if you have questions, go ahead and chat those in because after this poll we will be going to those questions. So we do want to hear from you and get a dialogue going here. So let's go ahead and open up those polls. Which of the following resources would help you in moving forward with energy saving envelope project? And I believe you can click more than one this time. Would they be technology, performance check guidance, decision analysis tools such as calculators, simulation tools, et cetera, demonstration opportunities, case studies, insulation guidance? So go ahead and cast your vote. Still some active participation going on here. Give it a few minutes. It's really great how everyone is participating. I really appreciate that. Exciting to see. So why don't we go ahead and close that out. We're about 70 percent of you have voted. We can go ahead and show those results. We've got a fairly even split, although there is some leaning towards the decision analysis tool. So we'll need to drill down a little bit more about which types of decision analysis tools are needed, but that's great to know. Technology and performance specifications are also important to you as well as the other three categories. So very appreciative of that feedback. So why don't we go ahead and start to look at some of these questions that have come in. I'm going to pose this first one actually to both Greg and Simon to take a turn at answering it. We have question from one of our participants wanting to know about what are the most cost-effective environmental retrofit technologies for existing older buildings. So maybe, Simon, you can take a crack at that, and then, Greg, you can talk about how you review the different options that were out there and what made you choose what you chose. Simon?

Simon Pallin: Yes, I'm here. I had problems with my phone. Can you please just quickly repeat that question for me, Caroline?

Caroline Hazzard: Sure, sure. Simon, why don't you tell us what are the most cost-effective envelope retrofit technologies for existing or older buildings?

Simon Pallin: It obviously depends on I mean what you have to work with. If you have down any other retrofits or what you're looking at, usually I would say windows, there's a lot of energy savings potential in windows. So that could be one. The other is there are ways to improve the air tightness of the building. If I will have to pick two, those are the two that I would say, in general.

Caroline Hazzard: Okay, great. And Greg, maybe you could speak to how you figured out what were cost-effective options in your envelope technology list for your building retrofit.

Gregory Farley: So I'm going to admit upfront that I was only tangentially part of that discussion but I did have a great conversation with one of the lead engineers on the project, and he was of the school of thought, and I want to echo something Simon said, that air sealing was probably – for this region, we have pretty good winds in the winter time here. He thought air sealing was of tantamount importance for us. And then I'm a huge, huge fan of the geothermal HVAC systems. I know that performance on those varies by region and then by ground water temperature, but at least here in the mid-Atlantic region and I suspect sort of along the same latitude band, that the ground water temperature is just really perfect for the kind of heat transfer you need for our systems, and I think we've done that now for I think there are eight buildings on campus that have geothermal HVAC systems and those have all been good investments for us.

Caroline Hazzard: Great. That's very helpful. So we have a question specifically to you, Simon. There's a participant who's curious about how the energy wheel and heat recovery ventilators came in to the team's radar screen, and what was the decision process around those, and if you can speak to that a little bit.

Simon Pallin: The energy recovery wheel?

Caroline Hazzard: This is actually a question for Greg. I don't know if I –

Gregory Farley: Yeah, yeah, exactly. That sounds more like a building-specific question. It's all right. Again, that's not information that I really can speak to all that well. I was not part of that set of design discussions. I know that our engineering firm for the project was very keen to make sure that the building was – the mantra is build it tight and ventilate right, but beyond that I don't know very much, and I apologize.

Caroline Hazzard: Sure. No problem. That's very helpful. Jordan, we have a question here from the municipality perspective: are municipalities allowed to join the Better Buildings Alliance or Challenge?

Jordan Hibbs: Yeah, there's a new division of the Better Buildings program called Better Communities, which I believe is where they're recruiting municipalities and other local government. So the person that wants to know that, we can definitely get you in touch with the right folks to learn more about that program.

Caroline Hazzard: And sort of on a related note for either you or Melissa, we did get a question in, could architects join?

Melissa Voss Lapsa: Jordan, do you want to speak to that?

Jordan Hibbs: Yeah. I think it depends and I think it may be a – it's not a specific audience that we have been able to pull into Better Buildings at this point, but if there is interest, we definitely want to speak to whoever is interested and see where exactly architects would fit into Better Buildings. I think it's just a new topic that's coming about because of our new *[break in audio]* – excited about so *[break in audio]* – would look like.

Melissa Voss Lapsa: Excellent. So if that inquirer could just send me an email at LapsaMV@ornl.gov, I will work with Jordan to get an answer back on that.

Caroline Hazzard: Great. So Simon, we have a question about some of your pie charts specifically. And I believe it's referencing your first pie chart with the primary energy consumption for commercial buildings. One of the participants is wondering what is in the Other category. Three is the one that has 21 percent.

Simon Pallin: Right. I don't have that document in front of me, and if I recall, the document is not – it might be a very specific on that topic. But can we go back to that slide, slide 14 or 15? It's referenced from a DOE roadmap. So I would encourage whoever asked that question to read that document. It's really good. Slide 13. I see now, yeah. So windows, Building Envelope Research Development Roadmap for Emerging Technologies. In this document, you can read more about these numbers and where they come from.

Caroline Hazzard: Great. So I'm going to kind of adlib on this question because it kind of gets a little weedy, but we have one of our participants asking a question about how to deal with pitching opportunities around air barrier technologies and perhaps other envelope technologies when you are in a multi-family or split-incentive decision-making process, how do you address air quality issue concerns and moving forward with different technologies? Simon, can you maybe speak to that?

Simon Pallin: Yeah, yeah, absolutely. I'm trying to figure out if I understand the question correctly. So if the owner wants to improve the air tightness of the building and in this case a multi-family building, the issues of maintaining a good indoor environment quality? Is that the –

Caroline Hazzard: Mm-hmm. Yep.

Simon Pallin: Yeah, so again, we, today the focus is building envelope, but building envelope is very much related, also connected to heating and cooling. And that's – in general when we improve the air tightness of our building, we also need to think about – like Greg talked about here, when they decided to heat recovery wheel, because what we do when we reduce the exchange of air between the indoor and outdoor environment, so it might be that we need to consider how can we maintain the indoor air quality, and like for Greg's case here, they decided to do heat recovery ventilation to be able to exchange enough to maintain a good indoor quality, but at the same time try to use that energy in the conditioned air before letting it exit to the outside. So I would say that sort of give a general answer to this question, you need to see the whole picture, have a holistic approach.

Caroline Hazzard: Sure. Okay, great. Greg, do you have any perspective on this?

Gregory Farley: Yeah, that's an interesting question. I have friends here in the local sort of region who are trying to do this, and they're working for a local utility. The pitch here in Maryland, and this may be true for other states with an aggressive renewable portfolio standard, is that any bit of conversation that we can do at the community scale gets a little bit closer to a higher proportions of renewable energy on the grid just so that they don't generate as much. And so that was an argument that was sufficient to convince a local municipal utility to try and help insulate and in some cases wrap entire buildings that were low income, multi-family housing units, and it was an interesting approach to the question because it forces you to think about the whole system, not just about the building.

Caroline Hazzard: Right. Very helpful. So I think this question here is for Simon and the envelope tech team here. There's a question here, are you looking into wall thermal bridge cladding attachment calculators? I guess this participant has some clients who would like help in making decisions using data like that. Can you speak to that at all?

Simon Pallin: Again, I would like to – did you say wall cladding?

Caroline Hazzard: It says wall thermal bridge cladding attachment calculators.

Simon Pallin: There are several tools out there which can help anyone to put together their wall assembly, and then study the thermal performance. And some of these tools we have put on the website that we presented today, so I would encourage to look at the tools that are available there and see if one of those suits their need, and if not, please contact us and I will try to help further locating such a tool.

Caroline Hazzard: Sure. Great. Let's see here. Getting to my questions here. We have a question here, what are some of those important specification that will build an energy efficient – let me start over. What's the most important specification that will build an efficient building energy management system? I'm not sure if that's for Greg or for Simon, buy maybe both of you can take a crack at that.

Simon Pallin: Well, I've talked a lot, so I'm going to let Greg talk now.

Gregory Farley: So I'm not sure I understand the nature of the question. Is the question kind of what's the most important variable to have building energy management system monitoring? Is that sort of in the right ballpark? I think I need a little bit more explanation.

Caroline Hazzard: I think maybe this person is trying to get at is what are some of the foundations that you consider in putting together your energy management plan; what specifications became the most important thing for you to be looking at and following in your plan for the college? I think that's the way to kind of tackle it.

Gregory Farley: Okay. Well, so two parts then: one is at the building level, this is not the first building renovation we've done. So we had some idea that the building envelope was going to be pretty important to how this building was going to perform. Because we've done some other retrofits on campus where we didn't really pay as much attention to that as we did to other variables, and we haven't seen those buildings perform as well as you might like. We knew we wanted a lot of windows in particular because that just sort of helps the architecture on campus. So for us, that was a primary consideration, and we really went after efficiency in the windows. At the whole campus scale, actually the biggest variable for us has been human behavior and I think that's something that good design in the building can help address. We can automate some things that people have traditionally done like light switches and proximity sensors and things like that, but the other thing is to build the buildings so that people don't need to use the energy to light the space, so they don't need to use the individual thermostat in their office to feel comfortable. So I think for us the envelope obviously has been a huge part of it, but the human factors engineering has been equally important for us. Does that sort of get at the question?

Caroline Hazzard: Yep. I think that's great. So we're running close on time. Let's go ahead to the last two slides and I'm going to cue you up, Melissa, here with a question that I think gets to your slides here. One of the participants would like to get the specific goals of what our tech are and kind of speak to where are we going with the tech team.

Melissa Voss Lapsa: Great. Excellent questions. Thanks, Caroline. So for this year, we have some activities and parties that we're going to be focused, but we want to hear from you on that and get your input and feedback along the way because, again, these resources are to help all of you, and we want to help move energy saving, envelope technologies into retrofit projects and new construction projects for commercial buildings. So we're going to be looking at demonstrations of newer technologies like R-5 windows, variable sealant technologies, envelope air sealant strategies. We're going to focus on case studies, fact sheets, performance specification documents. We're going to hold some more webinars. There's so much information to cover as you could tell from today. So we'll do that, and we'll also look at installation guidance and heat and moisture analysis. Next slide please.

So as our final slide, I would encourage all of you to get involved with our envelope team as Jordan articulated earlier. You can join the Better Buildings Alliance or join the Challenge and enabling you to participate in our envelope tech team meetings going forward. You can collaborate with us on demonstration projects, provide input and feedback in our activities, and access new tools and solutions; and with that, I've got my email address on there and look forward to hearing from as many of you as possible with any questions, comments, and hoping that you'll join the Alliance or the Challenge. And in conclusion, I wanted to thank all of our speakers and participants for joining us for this hour. Speakers all did a great job and counted 94 participants on the webinar today for our kick-off tech team meetings. So I appreciate everyone's time, and with that, I'll conclude the webinar. Thank you.

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