Mahabir: So, here we are live. Good morning. Good afternoon, everyone. Welcome to our webinar, Leading by Example, Benefiting Communities with High Performance Envelope. Next slide, please. My name is Mahabir Bhandari. I'm senior R&D staff at Oak Ridge National Lab, and I'll be your moderator today. Next, please. So, most of you here are already familiar with the Building Envelope campaign, but just for a quick reference, Building Envelope campaign is one of the Better Buildings technology campaigns, such as you can see some of the current campaigns like a smarter small building campaign and integrated lighting campaigns, and a few of them were already in the past.

So, the goal of the Building Envelope campaign, similar to others, to accelerate the adoption of high performance building envelope and besides developing the technical resources and providing technical support we wanted to recognize leaders who are implementing high performance building envelope. So, today we are here to recognize our third and final years award winners and hear from two of them. Two of the award winners are here with us, so we'll go with them, and they will talk about what their project is about in more details. And next slide, please.

So, before we reveal our award winners for this year, I would like to give big thank you to our organizers, the American Institute of Architects, International Facility Management Association, and International Institute of Building and Closure Consultants. You may know them by AIA, IFMA, or IBAC. So, their contribution was invaluable to this campaign, and they guided us throughout, helped us with communication with the communicating to their members or other members about the campaign and how to implement high performance building and envelope. Next one, please.

As I mentioned earlier, we are here to recognize our year three award winners. So, this year we have six buildings which were awarded the building envelope campaign awards in different categories with 850,000 square foot of conditioned floor space, 9 million kbt in annual savings just based on the envelope performance and these buildings were from the different categories. We had office building, multi-family building, we have a laboratory building, offices and also an industrial facilities, and these buildings were in different climate zones in the U.S. and also included both retrofit and the new construction. Next one.

Here are our award winners today. So, if you look at that building envelope performance, they would call BEP we had, and some of

you, if you haven't known about the BEP, we had already few presentation on that, how we're calculating. So, these are our different improvements from baseline to different categories. The first one, for example, Retro Honorable Mention, they were very close to 30 percent savings.

We had award categories. In retrofit building 30 percent savings, then you get a retro. Honorable, they were Novel 40, and we have all the way to Novel 50. So, one of the building was 70 percent more improvement than the base. It's a new building, so at the base code that time. Next one, please. So, we'll show now from here some of the awardees who are done, so please enjoy the videos and slideshow.

Anas: Hello, my name is Anas Al Kassas, founder and CEO of Innerviews. I'm here to present Creekside 5, a non-invasive facade retrofit project we did recently in Portland, Oregon, where we transformed the first floor double glazed windows into high performing triple glazed without removal or replacement. First, I'd like to thank the DOE Building Envelope Campaign and Oak Ridge National Laboratories team for the recognition. This project was a demonstration of our patented insulating glass retrofit technology and exterior secondary windows, and it was done in collaboration with Capital Land and the Northwest Energy Efficiency Alliance, NEA, who sponsored a full measurement and verification study as part of their field test program for commercial secondary windows.

Creekside 5 is not a unique building. About 70 percent of all buildings in the U.S. have energy inefficient facades with obsolete single and double glazed windows that are responsible for up to 40 percent of buildings energy loss. The problem is re-glazing building facades and replacing windows is cost prohibitive for most building owners as it requires a capital investment with an unrealistic payback period. To solve this problem, we've developed non-invasive lightweight secondary glazing systems that provide similar benefits to indoor placement, but at a fraction of the cost due to the significant reduction in the resources needed to fabricate and install these systems.

And the result is up to ten times faster payback and higher ROI. Here I'll show you two examples of secondary glazing systems. On the left, this system attaches directly to the existing glass, and when installed, it creates a tightly sealed, desiccated thermal cavity like in a factory made IGU. On the right is a breathable secondary window system that can attach to the existing glass or to the

window frame from the interior. Here are some photos showing those two secondary glazing systems and how they're installed. The top images are for the exterior IGR system, then the bottom images are for the interior SWR system.

Now in Creekside 5, which is a typical pre-2000 office building with electric heating and cooling, an exterior IGR system was used and installed over the existing non low E coated, double glazed window walls on the first floor. The IGRs transformed 114 5 feet by 6 feet panels into low E coated, triple glazed windows. The installation was done in about two weeks without disrupting normal building operations and occupants, as you can see here. People continue to work normally. Now, at the beginning of the project, we did a cost saving analysis using a calibrated energy model and studied the impact of multiple glass options and low E coatings to identify the best option.

In addition to performance and costs, preserving the look of the building was an important aspect that played into the selection of the glass that was used with the IGRs. After the retrofit, the independent one year M&V study by Energy 350 showed that the secondary windows have met or surpassed the estimated 8 percent total energy savings and 10 percent heating and cooling energy savings. It's also worth noting that exterior IGRs increase the condensation index of existing IGUs. In this case for Creekside, this means they extend the lifespan of the 30-year-old double panel insulating glass units.

This was validated this past winter when over 20 percent of the IGUs on the second and third floor, which were not retrofitted, started showing internal ponging and condensation and had to be replaced. While none of the IGUs behind the secondary glazing on the first floor had that problem. Lastly, I'd like to highlight the significant impact of secondary windows on buildings sustainability and decarbonization. For example, at Creek Site five, a 3,200 square feet of exterior, secondary glazing installed on the first floor are expected to reduce this building's CO2 emissions by over 600 tons by 2050.

This is equivalent to the emissions that results from burning nearly 700,000 tons of coal. And keep in mind this retrofit is starting with double paned baseline windows, and it's for one floor in a small building in a relatively mild climate. So, imagine what the impact would be if we upgrade the single glazed buildings that represent about 40 percent of the existing building stock. Even more imagine what the impact would be if we integrate some of the more

advanced glass technologies with secondary glazing systems. As a cost effective low carbon energy conservation measure, secondary windows can unlock the path to decarbonization in existing buildings and accelerate the transformation into a sustainable future. With that, I'd like to thank you once again for highlighting our work and for the opportunity to present a unique type of secondary glazing systems.

Caroline: Hi, I'm Caroline Lobo, Principal of Soil Architects. This is a story of the design of the Grand Canyon Education Office building in Phoenix, Arizona, that is predominantly in a hot and dry climate. We will briefly share some insights into strategies that were integrated into the building design right from the get go. So, every project for us here at Soil Architects is really a reminder that our design intervention is a spatial symphony of form, function, material, texture, scale. proportion, shade, shadow, light, darkness, rhythm, movement, which is really in a nutshell, the impact of the local climate.

And for us, it is important that we are respectful of nature and what we leave behind as a legacy for future generations as an implication of our design strategies. So, this project designed in 2015-2016 on a three-acre site is part of the Grand Canyon University extended campus. This Christian university has grown from a mere 100-acre physical campus to a 400-acre campus for about 25,000 students and it continues to grow. The building was commissioned to house all employees in a central location and revitalize the West Phoenix corridor that was once known to be a hotbed of crimes.

The established goals and vision for this project was simple, create a 325,000 square foot vibrant, flexible office space that houses all of Grand Canyon Education employees that were once dispersed at various locations in the valley. As with the design of any project, we as a design team sought to integrate new corridors to surrounding mountains, particularly to the famous Camelback Mountain to the east. So, the design of the building is based on the basic principles of passive solar design. The siting of the building is based on optimum solar orientation, which for us is the first line of defense for good environmental design.

Capitalizing on daylight opportunities for every space within the building and blurring the boundaries between indoors and the outdoors was the next critical thing in the design process. The juxtaposition of the building blocks is carefully orchestrated to create these outdoor shaded courtyard spaces that provide outdoor

learning or outdoor lunch and informal workspaces throughout the year. So, our best opportunities for designing an energy efficient office building in a hot and dry climate is the reduction of daytime cooling and lighting loads. So, this was accomplished with optimizing the building geometry and right sizing the building envelope.

We did a great deal of detailed analysis with the optimization of window to wall ratio and then the depth of the floor plate to ensure that the distribution of daylight was even and reached pretty much all usable workspaces. So, the building is built as a post tensioned concrete structure with locally made masonry blocks on the first level and steel studs with anephys skin on the upper levels. We ensured that our specs included fly ash as an integral component of the concrete in a way to keep the embodied energy low. The concrete structure was integrated as an important part of the design to allow for flexibility in organizing the interior spaces now and in the future.

The exterior building skin is an R20 building envelope for the walls and R30 for the roof. The glazing in the window system is really a balance between visible light transmittance values and solar heat gain coefficient for the glazing system. We paid careful attention to thermally broken connections between different building materials, primarily masonry, steel, concrete, aluminum, and glass as these building materials react differently and move differently with exposure to heat. The building also has a cool roof system that inherently further reduces the building's cooling load.

So, through a series of energy modeling exercises, we were able to design the electrical lighting loads to be about a 0.4 watts per square foot. And as an overall building design, we were able to reduce 60 percent of the energy loads. And that's primarily due to a tight and well insulated building envelope. So, the resultant building, as you see, has undoubtedly transformed the neighborhood and is a testament to the adage good design solves, great design transforms.

This image reflects the two things that we've talked about earlier, the windows adjoining the conference rooms that have a direct view to the Camelback Mountain, and then the courtyard that really is a result of the building massing and the positioning. This project has also received honors from our local NAOP, which is a Commercial Real Estate Development Association, Engineering News Record, and several others, but we really appreciate the

recognition from Oak Ridge National Laboratory. Thank you for listening.

Mahabir: And so, hopefully you learned some of something about the high performance envelope. Yeah, so we saw that we have a secondary glazing, different air sealing method, walls and roof insulations, and passive building design, and one of the videos you could not see was also about the passive house standard and luckily, we have Jonathan here so he can talk a little bit more his project. But you can watch video later if we didn't have a time to look at it So, I would like to introduce our two presenters today. So, thank you first of all, both of us for joining us.

So, Caroline Lobo holds a graduate degree and PhD from Arizona State University. She received her bachelor's degree in architecture from Mumbai University, India. In 2013, Caroline founded Soil Architects with a vision to create design solutions that are rooted in the local environment and lift the human spirit. Her firm's work includes educational, residential, healthcare, and master planning projects that have received numerous design awards. Her firm also works on several community development projects, giving voice to those that are often unheard. So, she's also in many committees and AIA member. Thank you, Caroline.

Our second speaker is Jonathan Finewood. He is the leader of the grassroots group, Rochester Building Science. He has a skill in HVAC, residential, multifamily, commercial and industrial building inspections, building science, embodied operational carbon and passive house, quality assurance professional. He's a quality assurance professional contributing energy efficiency and renewable energy. Thank you both Caroline and Jonathan. Please go to next and Caroline, if you can be the next to present. Thank you.

Caroline: Thank you, Dr. Bhandari. We really appreciate you giving us this opportunity to share with the audience some of the insights into designing the Grand Canyon Education Office building. Most of my slides are a repeat of the video. So, I may just add on additional information that you may have not captured from the video itself. So, move on to the next. So, we are a firm of about 12 people in Phoenix, Arizona. And as I mentioned before in the video, Phoenix, Arizona is really a hot and dry climate, and so, most of the energy load is really the cooling load that we experience here in Phoenix.

And the other important piece of the puzzle when it comes to design of an office building is taking care of the lighting load, at least during the daytime, so we don't end up using a lot more energy. For us, it's important to think of buildings as people, because buildings breathe, and they have a life of their own. And so, we're always looking at ways and means in which we can really celebrate nature. Next. So, this is you can see the freeway, which is the I-17 freeway corridor and right next to it is the 27th Avenue. And right along 27th Avenue is the Grand Canyon Education building.

And once upon a time, which is not too far back in about 2014 and prior to that, this particular area was really a hotbed of crimes in the sense that there was drugs, prostitution, the whole nine yards. So, the president of the university really wanted to figure out ways in which we can revitalize not just the 27th Avenue Corridor, but this West Phoenix neighborhood in a way that it is a positive story for people that live and go to the university in this part of the city. So, he came up with the idea of bringing in all the office folks that were working Throughout different areas of the valley within Phoenix to the central location, which is the building that you see on the I want to say north east corner of 27th Avenue and Camelback next.

So, the story really is how do you start to use design to transform a location which has for a long time seen a lot of crime. And so, we were using design as a tool to really address some of the issues that we were seeing on a day-to-day basis on that intersection. Next. So, I talk through this in the video, but really for us, it was right sizing the building, making sure we are optimizing on all the spaces for this open office floor plan of the building and then production of lighting and cooling loads. Next.

So, trying to figure out, what is the optimum shape? How can we come back with areas that can be an indoor/outdoor spatial experience where we can start to provide these outdoor areas that can be used as outdoor office working spaces or cafe areas within the building. And really capitalize on getting a lot of the daylight, which we've got abundance of daylight in the Phoenix area. And so, we wanted to make sure that this building really reciprocates to the surrounding climate as well as the surrounding neighborhood and create these view corridors to the beautiful mountains in and around the 27th Avenue corridor. Next.

So, we ended up with a very simple design party and a very simple building profile. Next. And so, really our goal was to make sure

that we put all the service areas in the central core and try to get the footprint or the floor plate of the building in a way that maximizes the amount of daylight that we can get into the building, the interior of the building itself. So, the large open spaces that you see in there are where you've got all these cubicles that are being laid out, and so, it's an open office area. And so, we tried to maximize daylighting within the interior of all of these office spaces. Next.

And then also integration of these balcony spaces in a way that people can still step away from their individual work zones and step out into an area where there we provided Wi-Fi in the entire building, so people could essentially sit outside in each of these balconies, either to grab a coffee or work in those balcony shaded spaces. If you've been to Phoenix, Arizona, in the hot summers, primarily June through August, it's really unbearable heat. But we've had people using these balconies in those peak summers. Next.

So, really again, we try to maximize the floor plate for every floor. It's a four-story building. And then as a part of our design strategy, we also like to celebrate nature. What you see in those blue lines is a rainwater collection system, which goes into this kind of a channel, and then whenever it rains it behaves like a really nice rain screen, and you really see the water trickling down into this landscape trough which connects to some of the plants and trees around that area. And then we were able to with just simple design strategies, reduce lighting load to half, and then our energy costs overall were between a 50 and 60 percent reduction. Next.

And then in most of our designs that we do at Soil, we try to express the structure and also use materials that don't need an additional skin, if you will. So, expose concrete columns and then expose any elements of the structure that really don't need to be camouflaged with something else. So, that's been inherently something that we work towards as one of our primary design strategies at the office. And then again, this is just a detail of how we capture rainwater and then take it through the building skin and the blue lights for the diagram to the left. You can see that the rain screen that we detailed on as a part of the project. And again, the building skin is R20. The roof is R30 with a roof coating.

And our glazing system is to basically reduce the heat intake into the interior of the building itself. So, it's a high performance window glazing system with a heat gain coefficient of 0.27. Next. So, these are some of the construction photographs. We always pay

careful attention to when two different materials come together, because in a place like Phoenix we have to be cognizant of how materials react with the heat, and so, making sure of all those connections. How do we start to insulate and make the building breathable at the same time? Next. So, this just an overall view of the building itself, and this space is interior of the campus. Next. These are some of the interior shots.

Grand Canyon University is, purple is their color, so we try to bring in some of those college colors into every space that it's designed for. Next. And these are some of the courtyard spaces that you can see with benches, with concrete and masonry benches that people can use. This picture was taken right after the building was built, so some of these palm trees are still, I believe were just planted. Next, again, just a glimpse into some of the shaded spaces that can be used throughout the year. Next. And this is one of those windows that captures the view to the Camelback Mountains. If you're sitting in that conference room, you have a direct view to Camelback. Next.

And we just put this board in there because if you live in Phoenix and you've experienced that particular intersection, you would have known what a great transformation that this building has made to the overall look and feel of that corner. We're really proud of this project because right at the get go we wanted to make sure that it does a couple of things. It brings in people together into one location, but it also celebrates nature by being an efficient building and efficiency, not just in terms of energy reduction, but also efficiency of space and it also speaks to the neighborhood in which it is sighted. So, that's it. Thank you so much for having us.

Mahabir: Thank you, Caroline. And now our next speaker is Jonathan. So, Jonathan, please go ahead and then we'll see. Sorry, there was a mistake on the video.

Jonathan: That’s okay.

Mahabir: Yeah. Please try to present as much as this, but then we'll make sure that the video we could, we should be able to run it at the end.

Jonathan: Yeah. If I can at the end of this here, I’ll show you guys the video. So, my name is John Finewood. I'm with the Oros group. We're out of Pittsburgh, Pennsylvania, and I work remotely in Rochester, New York, and we did this project the Edgewood Senior Living Home in Pittsburgh, and I came down about every month to do site visits. I started from design. I was the original passive house

consultant on this. It was a team effort though, with Avon design group in Pittsburgh and Stangle engineering in Virginia. And so, I just wanted to show you guys what passive house is capable of.

And so, the buildings in the top left section of this of this slide are all passive houses that we've worked on, Texas, Pittsburgh, Connecticut, all over the country, and then the ones lower on this slide, the one on the bottom is a hospital in Germany, the other one on the bottom is Cornell Tech, and then the largest passive house in the world I think is the Winthrop Tower in Boston, Massachusetts. We didn't work on those three. I just wanted to show what passive house was capable of. Next slide please. So, this is the Edgewood building in Pittsburgh that we worked on. Next slide, please.

The overall R value of all the external walls was 34. The slab didn't have any insulation under it because we were able to design that out of it with slab edge insulation. We didn't need any additional slab insulation in Pittsburgh. The R value of the roof was an overall of 63. I'm going to be showing some slides that have different numbers than that. These are area weighted average R values on here. The heat recovery was 74 percent of the ventilation system. We used Ventacity in the common spaces, and we used a product called Effica, which is an all-in-one heating, cooling, and ventilation system in each apartment unit. Next slide please.

These are just a few of the slides, a couple of the details of the walls and the roof, an R value of 36. That's not inclusive of any framing members or brick ties or anything and same with the roof. It was about an R60 on the roof. Next slide please. And then this was the wall to floor detail, and I just wanted to show that we connected our exterior, our primary air barrier of zip to the Stago vapor barrier underneath the slab. And then, let's see, the pre-drywall blower door number was 0.3 air changes per hour, and just last week, I did the final blower door test, and it finished up at 0.46 air changes per hour. Next slide, please.

These are some of the thermal bridge calculations that we did. You can see that the slab edge had an FRSI of 0.879, and that's going to stop any condensation happening at that point. Sorry, the overall weighted average of the floor was 1.2. We did have 8 feet of insulation around the perimeter. I just want everybody to know that. Next slide please. And then this is the in-unit EFICA system where it accomplished heating and cooling and ventilation all in one system.

And they're highly efficient and they were given free certification on the EFICA system just pending some tests and those tests have been completed, and they're now a PHI certified component. Next slide, please. Here's some more thermal bridging that we did. We used Wythe windows, again, great FRSI numbers of 0.70. We optimized that for this particular window and yeah, this is it. So, now I believe that's the last slide and I wanted to show you guys the video of this project. So, I'm going to share my screen, and let's see, share for sound. There we go. All right.

[Video Plays]

30 plus years ago when we started doing more senior housing, we pay all the bills and try to keep grandma's rent nice and low. And so, we were committed to keep our operating expenses down. And also, it made sense from a carbon footprint and energy perspective, trying to keep all those things down. And over time, we just progressed on what we built to this level of passive house with the great envelope that it is. When you're talking about the best in class performance for the nature of what this is, I mean, did we miss a cult joint? Did we miss sealing a receptacle on the outside of the building? Maybe.

But the numbers say we hit enough of them. I think the team reacted well. I think everybody worked well together. I'm happy with the result. The passive house is not a framework, passive house is a learning curve. And what that means is that if we're able to bring in the right team that has experience on projects like this, then we can achieve these sorts of outcomes on a continued basis. And it's not a random result. You're doing this consistently.

So, having the right design team involved on the project who has experience in passive house, having an owner who has been through this a couple of times, and certainly finding contractors that are experienced in passive house helps. And again, I would just use the adage that passive house is a learning curve. And once you get through that learning curve, then you're certainly not gonna see a premium in this type of construction. At least that's been our experience

Mahabir: Wonderful. Thank you, Jonathan and for your presentation so you can stop sharing, but it was wonderful. Thank you. We have some come some questions from our audience. So, first of all, thank you both for really wonderful presentations and showing so many

technologies. So, the one question was there was your project, Jonathan, is the economic aspect of the project, right?

So, you have 75 percent almost better or efficient than other, and we're also talking about the community benefits, like how would they? So, how do you balance, and your team did mention about having right team, but if you want to educate our audiences, how do you make it cost effective for the project itself and for how do you bring it in future for other projects?

Jonathan: Yeah. We want to make sure that every house is passive house, or every building is passive house, right? And how do we get there in cost effective measure, right? So, A.M. Rodriguez is the owner of the building. They're paying for all the utilities for this building. It made sense to them because if they had a bad envelope or inefficient gas heating then they would end up paying for it in the long run. So, it's kind of like a long game for passive house. And think the payback, I don't like to get into payback 'cause I'm not a finance guy, but it's all about how the team, like the builders putting it together, are they charging extra because they're scared or something because they don't know how to build something?

That's how prices go up. The PHFA did a study between I think it's 2015 and 2020 where by 2020, they were getting cost parity between a code bill house and a passive house. And they have the data. We have slides on that. It's a learning curve for the people bidding the job and it's a learning curve for the tradespeople doing the work. And once they get that figured out then it levels out.

Mahabir: Yeah. Thank you. Because that was one of the concern and that's why we went with the building envelope campaign to see that if we just go with the payback, you will never worry for the high performance building envelope, right? In terms of now we are going for electrification, decarbonization, envelope will play more and more important role.

So, Caroline, I'd like to ask you how you are looking at that challenge to have, hey, electrification, though you already showed that how you always do holistically your projects, to our audience, you can say what they can do in their next project to say that, hey, get the maximum best envelope and then go for the other thing. And if you have to replace a natural gas with a heat pump, how are you going to do so? Any light you want to shed?

Caroline: I grew up in India and so, grew up with no air conditioning. And so, my design sensibilities always comes from the fact that you've

got to look at the building envelope first and look at how you mask the building and design it to get the most bang for the buck. I think that's the first step, right? And then you can add on systems and improvise thereafter to optimize really the building skin. So, if I had to give anybody any kind of advice, I'm really not the person to give advice, but I would say that definitely work on optimization of your building skin first, before you even start to dialogue with your consultants about the systems and what you need to do to optimize on your system design.

Jonathan: Yeah, I couldn't agree more. The way we view it and how we work every day is passive systems first. So, that's going to be your end envelope, mechanical systems second, and then renewables. And we go in that order when we're designing a building.

Caroline: Absolutely. My own house, it was a 1949 built ranch style home, and then I added on to it and built it out of ram dirt, right? And so, the same principles, passive design is the first line of defense, and then you add on everything else. In the peak of summer, our utility bills for 2,800 square foot home is less than $150.00 bucks a month. So, there's a lot to be done with just simple common sense design.

Mahabir: Yeah. And we saw this with the building envelope campaign. Every year, there were a few buildings who are going in that direction and showing in there. I also see like Jonathan, you are passionate about this kind of passive design. So, there was always challenges, right? How do you do maybe R50 roof insulation, for example, but there are all the technologies coming up, which cost will come down in that sense for everything.

But yeah, we saw so that's the reason we were thinking with this building envelope campaign we bring the thought leaders like Caroline and Jonathan here to get the ideas to the people that hey, it's doable, you know? We can have a high performance building envelope, and it has to be part of our strategy like you mentioned. So, like we saw something even the secondary glazing people are not thinking that hey, they can be that efficient. So, we had these projects come last year and this year as well here to see that yeah, we can do cost effectively these kind of building envelope, high performance building envelope.

Jonathan: And when the buildings get bigger it gets easier and you have a more dense population, right? So, you're housing more people and in one location, and it's easier to hit passive house levels. We're working on a project in D.C. right now where they don't need to

put any additional insulation in the cavity. We can reach exterior insulation levels that are meeting passive house standards. We do the international passive house standard, and even with FIAS, you're getting away with, in that climate zone, you're getting away with just using code levels of exterior insulation and you're meeting passive house certification levels.

Caroline: And to that point, I also want to add, there's an ROI on how much insulation you put in. So, some people feel like the more insulation you put in, the better building envelope you get. There's a return on investment at one point. It's like the more you add does not necessarily mean that your building is going to perform better. There's that cut point where you need to make sure that as you're analyzing the building, there's an optimum insulation level that your building needs to have and beyond that it doesn't really matter. So, why waste money on adding layers and layers when you really don't need it?

Mahabir: Yeah, that's a good point and also for the audience yes, please write your question on the Q&A box if you have any other questions, and we'll continue to discuss, and we have some more questions. So yeah, please write your question in the Q&A box. We have a few minutes to discuss and take opportunities from these design people who are day-to -ay doing this kind of work.

So, Caroline, where do you see the buildings going in? Do you see the challenges when we are seeing electrification and decarbonization in terms of a design? Do you see more and more projects going in that direction or where you see envelope playing role in achieving net zero by 2050, like that goal is?

Caroline: I think the clientele is definitely wanting to see that. I think right now our biggest challenge is not having a good handle on pricing. I don't know whether, Jonathan you're seeing that in your market, but here in Phoenix, Arizona the pricing for building any kind of building is not where it used to be. So, it's insane. You can go to the grocery store, and you can tell what's happening with inflation.

I think the appetite to do net zero buildings is there, carbon neutral buildings is there, but the price point is still not where it ought to be. But more of us that do this and collectively as we continue to push the marketplace to steer in the direction that we want to see it steer. I think it is going to be, the new norm, is going to be the way of the future.

Jonathan: So, there's places in the country, like New York City and Boston and Denver, right? Who are putting limits on the amount of operational carbon your building is producing and that's where we see our clients coming from now in addition to new buildings. But as of late, we're getting building owners in those cities who need to meet local law 97 in Birdo to not be fined and they need to have a plan of how to retrofit their building. And it all starts with envelope measures being walls, windows and roofs, right? The mechanical systems come later.

We do step planning for a lot of our customers who, they have five years to get to the level that local law 97 and Birdo are hitting before they get fined. And they don't want to get fined, and it's a lot of money per ton of CO2 E. They can do one part of the envelope and have their EUI go down a little bit and stay below that line, and then in 15 more years, when they're about to hit that that next step down from those laws they can plan to replace windows or a roof or something like that, or mechanical systems so that they can stay below that line and not get fined, and they have a plan to do it with.

So, we create an operational model as the building sits today, and then we create an optimum model. So, what's the best your building can be? And if your building is the best you can be, then you're going to be below that line no matter what. But it takes a plan to stay below the line and do smart improvements when you need to before you need to, and you can do a lot of planning that way.

Mahabir: Yeah. Thank you. Yeah, I think we don't have any more questions, but Caroline or Jonathan, if you have any final words to our audience about building envelope, a high performance building envelope, this is your opportunity. Otherwise –

Caroline: The only piece that I would add is for us, that our designers in the offices, we have software, the regular tools that are now you've got energy modeling inbuilt into these programs, right? So, it is really, it's a great tool to figure out right from the get go, whether you're doing, you're going about your design process in the right manner.

And I think everyone should take advantage of that and should start to, we should put our money where our mouth is and really do justice to our future generations to make sure that we're doing it right. We're thinking about how we manage our resources carefully. Thank you again, Dr. Bhandari for the opportunity.

Mahabir: No, thank you. And then, like Caroline, you mentioned, as you know the ASHRAE is putting effort, they're standardizing this process by, they have a standard 209, which is already published, where different stages of your modeling, your construction cycle, they have different modeling cycles where you can use for optimization, different, so yeah, that's a great point. And again, Jonathan and Caroline, thank you so much. And we'd like to thank again our organizer. So, this is our grand finale. It was the end of the campaign.

So, thank you and then yeah, we have so many other campaigns, audience, please check others, the integrated lighting. They have a smarter home campaign, smarter school campaign. Please look at the website. We'll put all this information on our website buildingdevelopcampaign.gov. We'll send the link and then all these resources will be available at that link, and we'll send it to all the attendees today. So again, thank you everyone. Have a wonderful day.

[End of Audio]