

Josh Geyer:

Hello, everyone and welcome to the session Maximizing Performance in Affordable Housing in New Construction. My name is Josh Geyer. I serve as the multifamily sector lead for the Better Buildings Challenge and I'll be your moderator today. We have a few housekeeping notes before we get started. We are recording today's session. You'll be able to find the recording and slides on the Better Building Solution Center in the coming days. Your audio lines are on mute for the session and we'll be asking you to use the chat box for your questions and comments. More on this in a moment.

When we were planning this summit earlier in the year this topic rose to the top because of all the truly innovative work on building performance our partners have been doing. The panel will focus on lessons learned from all electrification in new construction and fuel switching in multifamily retrofits as well as cutting edge standard for multifamily new construction projects. Speakers will present on standards and frame works including Passive House, Enterprise Green Communities and Lead. Now to help us feel comfortable with the chat box I'm going to turn it over to Leslie Zarker of ICF who will be facilitating our Q&A sessions today. Leslie?

Leslie Zarker:

Great. Thanks, Josh. Since as you all know we can't meet face to face this year we're gonna try to make this session as interactive as we can within the Zoom virtual platform today. So I encourage you to use the chat box throughout our time together and to keep it open throughout so you can see what others are saying. You can find your chat box by moving your cursor to the bottom of the screen and clicking on the chat icon there in your dashboard. As panelists are speaking, when you hear something that say really resonates with you go ahead and share it in the chat box.

Of course if you have questions for the panelist please write them into the chat box at any time. We'll try to get to as many of your questions as we can. As we've done, if you've been in our multifamily meet up on Monday or perhaps earlier in our multifamily session today, you may already know this little exercise we've done to help us all feel comfortable using the chat box. We have a chat box icebreaker we're gonna ask you to do right now.

So please go ahead and write into the chat box your name, your organization, and where you do – where you work most frequently from at home, what part of the house do you work most frequently from? Your office, your kitchen table, your bed. I'm gonna say my name is Leslie Zarker from ICF and I work almost exclusively

from my living room sofa, which is my office now. I have everything spread out around me.

Let's see what you guys are saying. You work from your home office. That's awesome. Studio apartment, patio, and living room sofa. Wow. These are going by so quick. It's hard to read them. Carl from the spare room at your home. Kitchen table from Sam at Mercy Housing. Crystal Lynn, dining room table, awesome. Thank you so much you guys. Desk in the bedroom. That's handy, Tally. That's double purpose there.

All right. So let's move on. We know that with technology, despite all of our prep, things don't always go as planned and that's okay. If you're having technical problems please do type your problem into the chat box. We'll do our best to help you. And by the way, in the chat box there is a dropdown menu where you can choose to individually message certain people or you can message everyone. So let's go on. We encourage you to share your experience on social media today. Here are the Better Buildings Twitter hashtags and Linked In URL's. Back to you, Josh.

Josh Geyer:

Thanks, Leslie. I work from all over my house because my partner and I sometimes both have to do phone calls and both of us have to hide from both of our kids. So it really depends on what's going on and when. Today we'll hear from three panelists with deep knowledge of high efficiency new construction projects in affordable housing. We'll have a question and answer period following each speaker. So please enter your comments and questions into the chat box as they speak as they come to you. Our first panelist is Krista Egger from Enterprise Community Partners followed by Ruchi Shah from Tenderloin Neighborhood Development Corporation and Michael Hindle from Passive to Positive.

Slide, please. Our first speaker today is Krista Egger. Krista is vice-president of National Initiatives at Enterprise Community Partners with more than 15 years of experience leading energy efficiency and healthy housing initiatives with affordable housing stakeholders. Krista manages Enterprise's national sustainability efforts. She leverages Enterprise's Green Community's platform, climate disaster response work, and cultural resilience programming to deploy equitable climate resilience solutions across the country. Thank you, Krista.

Krista Egger:

Thanks so much, Josh. I'm really honored to be here today with Ruchi and with Michael and with all of you who have committed

your time and energy to creating excellent housing. I'm gonna be sharing with y'all today an approach to maximizing performance in affordable housing that we have codified in our 2020 Enterprise Green Community's criteria, which we just released this January. It builds upon a 15 year tradition of designing construction strategies that can make Green Building practices standard practice in the affordable housing sector.

So over the next several minutes I'll share a little bit of background and then highlight the various strategies that are at your disposal from that criteria. Everything from site amenities to energy use, water quality and consumption, and practices that promote healthy living environments. And I hope that all of you leave this part of our time together with a commitment and understanding to address your buildings holistically rather than focusing solely on energy performance, for instance, also really encourage you to consider how to promote your residence's health outcomes through your building.

And I hope that all of you all leave this part of our time together with a commitment to implement at least one of the strategies that I'll touch on today if not the program in full. And before going on I just wanna mention that in planning for today's session, Josh, Leslie, Ruchi, Michael, and I were reflecting on 2020 as a milestone year. It's a year that many of us tied to performance goals whether that be reducing portfolio energy consumption or admissions by a certain percentage or committing to transform our property operations practices in significant ways or ensuring that by this year, by 2020 all of the properties in our portfolios would be enrolled in utility benchmarking.

Now in the midst of COVID-19 we're seeing that the affordable housing communities that we serve have been disproportionately impacted both in how they're experiencing severe illness and through economic devastation. So I just really wanna reflect on what a year this is, 2020, to reset goals and set our ambitions higher for the next decade to really maximize performance in affordable new construction. And I'd encourage you to listen for elements throughout all of our remarks this session that resonate with you, listening for what you might like to implement or achieve in the next decade or two as we look to build excellent and affordable housing that's designed to ensure that the people who live there can thrive in harmony with our changing climate.

So we can move on to the next slide and I'll go ahead and share with you all a little bit of context about my organization and

program. So Green Communities is a program of Enterprise Community Partners. Enterprise Community Partners was founded in 1982. We're a national nonprofit based in Columbia, Maryland and to date Enterprise has created more than 660,000 homes, invested nearly \$53 billion, and touched millions of lives in the Affordable Housing Sector. Our vision is that one day every person will have an affordable home and a vibrant community filled with promise and the opportunity for a good life.

We develop programs, deploy capital, and advocate for policies to create opportunity for low and moderate income people through affordable housing and diverse thriving communities. Our program, Green Communities, was launched 15 years ago to answer the question of can green affordable housing be built in a cost-effective way. And when I say green affordable housing, I mean healthy, efficient, environmentally responsible housing. And I think we could all say that together we've demonstrated that it's not only possible as a concept or as a demonstration project here and there, but it's really possible at scale.

So over the past several years we've been focused on reducing barriers to make these best practices become standard practice and you'll see our vision for your programs here on the slide. I'll just lift up the last part because as a community of housing providers we really have an opportunity to make this vision of having abundant green affordable housing possible by addressing today's affordability challenges in our changing climate. So with that we can go to the next slide. I'll just share that thanks to you these goals and ambitions hasn't just been a pipe dream, but we've had a lot of impact.

So Green Communities is required or incentivized more so than any other Green building program through QAP's and in the map that you see here, the darkest blue states are one where the QAP's either incentive or require these of Enterprise Green Communities and then the lighter blue states are the ones that don't have those incentives and policy, but do have projects that are active on the ground. So I just wanted to share this and some context for making it clear that the adjustments that we make to our program, technical adjustments we make for the program, have ripple effects across the country as different state housing finance agencies incentivize this program's use with their allocations of tax credit.

So we can go to the next slide. And you'll see the criteria, which is the hub of what we're doing with these eight categories. So as you're thinking about practices to maximize performance I'd

encourage you to think in these different areas. We start at the top with integrative design which is ensuring that you have a well-rounded perspective considering unintended consequences before you finalize your design and taking time during integrated design process to lift up the prospective and voices of the impacted community that you're looking to serve.

Then we go to clockwise. It's a location neighborhood fabric which is about site selection, then site improvements, things like irrigation and landscaping and storm water management. We go to water, consumption, and quality, energy usage down at the bottom, over to material selection and your building and material disposal, then a slew of practices about improving how your living environment is impacting the health of the people who live there, and then wrapping it up with practices to influence how you operate and manage your building, which hopefully also will provide lessons learned that can go into the integrative design stage of your next project.

So I'd encourage you to think about this frame work as you're thinking about your project. Moving from our last version of the criteria to this 2020 version, some of the significant changes were developing strategies to drive down carbon emissions through path to zero in more significant ways, doubling down on practices to improve residence health and well-being, broadening our bridge to water and strengthening strategies related to property resilience. So now I'm gonna introduce you to the content in a little bit more granular way, but in the meantime I'm going to add a note to the chat box just in case you would like to see some of this content that I'm gonna be talking about in real time. You can go to that web address that I just put in, the chat box. We'll also have it up on the final slide in case you miss it in the chat and wanna get to it later.

So we can go on to the next slide. I'll just share a few highlights for each of the eight categories and then wrap it up with time for question. So category one, integrative design, we have a new mandatory project priority survey that's embedded in this category. That is really designed to shape project goals with resident input and with data about publicly available published data about how the community inputs your building, addresses different issues of equity and different issues of resilience, and different opportunities that you have given the fuel make up of your grid to reduce carbon admissions of your project.

So there's a lot of rich information here. If you wanna check out one thing, I'd encourage you to check out the project priority

survey to really guide your decision making, your project to response the needs of your residents. So we can go to the next slide and this one is about category two location and neighborhood fabric. So here we've really lifted up a new approach to addressing projects that are in rural or tribal locations.

We've eliminated requirement for access to public transportation for those projects because it is not largely feasible. And instead we've replaced that with requirements for access to broadband and actually just earlier this week we modified criteria in this section allowing all projects, urban or rural, to gain points through the program to actually have broadband service in their properties given what we're seeing with the COVID-19 pandemic and how critical it is to ensure social connectivity and access to telemedicine, access to schooling, and more. So we're taking a broad approach there.

This section also has a lot of traffic resources on sensitive site selection and development. If you check out the first criteria in this category you'll be able to see more information about ecological resource protection zone and how to easily add that lens to your project to address environmentally sensitive development practices in regards to wetlands and sensitive habitats and more. We'll go on to the next slide, which is about category three site improvements. I'll just highlight in this category – I direct your attention to some strategies that will enable you to really amplify your approach to storm water management given the expectation of different storm events that we expect over the next 5, 10, 15, 20, 25, 30 years.

So there are some explicit practices there for you all to take advantage of and design your projects, your buildings, and your site to be able to handle that amount of water that we'll have in the future. Moving on to the next slide I'll highlight category four, water. Water quality and conservation practices impact our health and well-being, the property operating expenses, and it's a limited precious resource. So we have new water quality criteria in the program that you'll find in this category that address lead and legionella and nitrates and nitrites for properties that are served by private wells.

So the criteria in here address some of these most critical aspects of water equality head on. The quality of drinking water in the U.S. is regulated tightly and is generally safe. However, there are homes with people at high risk. There are vulnerable populations with frequent exposure to sources of lead. For instance, lead free, officially labeled lead free plumbing fixtures were permitted up

until 2014 to contain up to 8 percent lead by weight. That's a high percentage. Today the allowable threshold for that label of having a lead free fixture is .25 percent. But this is just one example of how lead might be showing up even in your newer building and this category has strategies that you can implement to reduce risk for the people who live in your property.

We'll go on and move to the next slide, which is about category five, operating energy. So within this category we're really lifting up a new feature, which we're calling the path to zero. So you can move on to the next slide, which highlights – has a diagram of this path to zero with different criteria and different number of strategies that we've included in this category that can help you get from where you are today eventually to net zero energy or net zero carbon. So this path to zero guides teams from basic energy efficiency measures to certifying your building to Energy Star, for instance, to going above and beyond that.

So all projects following this program are required to meet mandatory criteria in 51. There's a different version of it depending on if you're new construction or rehab, but there is stringent thresholds there and all projects will report out on their energy use intensity and their projected admissions. Then projects can choose how much farther along this path to zero they would like to go. So they can do so by further reducing their energy usage. We have strategies about that or by installing renewables either for your common spaces in your building and multifamily properties or to cover all the energy use in your building or – and/or by going electric.

And if projects are designed to be near or net zero energy they'll receive our highest level of certification, which is certification plus, and we're going to be highlighting those projects progress in real time. I'm happy to share that at least one state QAP, Wisconsin, has recognized certification plus for their _____ projects. So we're excited to see that lever moving here. So if you go to our website you'll find more information about these including calculator that you can use to easily calculate your projected emissions and more.

There's a wealth of information in here and I just think it's so critical for project teams to consider not just what level of performance they wanna have today or tomorrow, but what level of energy performance they wanna have 20, 30 years from now when we're experiencing more effects of our change in climate and we wanna ensure our buildings are still comfortable and have

reasonably priced utilities for the people who are living there. So next we can go to category six. So this is all about material. Taking a help in an environmental lens and purchasing, installing, and disposing of building materials will improve those conditions in the property.

So we have a new approach to healthy building materials here that includes transparency and optimization criteria for avoiding chemicals of concern. And we have a new approach to environmentally friendly building materials including considering embodied admissions and looking at the global warming potential of steel, concrete, and insulation in your properties. But I'm going to move on to category seven with the next slide, which is about healthy living environments. Design construction and operation strategies all contribute to how your buildings will positively or negatively impact the health and well-being of the people who live there.

So if you go to the next slide you'll see a list of the different criterion that are included in this category. This first section is about reducing exposure to environmental hazards. Many of you all on the line will be very familiar with the strategies here. They're tried and true, but extremely important. In the second category here in managing the indoor environment some of these are a little newer and not as standard practice as what occurs in that first bucket. For instance, we are certainly recognizing that as we look to reduce energy usage in our building, how much more critical it is for us to really consider dehumidification practices depending on the climate zones that our projects are located in.

So we're looking to build some of these dehumidification practices at scale across the country and would be really interested in your experience with that. Then the final part of this category includes three different strategies that are all about promoting health through design. So these are all active design and the beyond universal design measures are updated from what we've had in the past and this one, healing-centered design is a brand new criteria for us that we're really excited to offer and experiment and learn with you all about.

It's based on emerging best practices and trauma informed design and has a number of different ways that you can go about creating a healing-centered and healing promoted space for the people who are living in your properties. Then just to wrap up this section and just share that, with the 2020 criteria we've partnered closely with hundreds of organizations around the country to get input. One of

those organizations was the International Well Building Institute, IWBI, and given our close partnership with them over the criteria development and practice where we used to share that all projects certified to the 2020 Green Community criteria will also automatically earn Well certification. Well is a leading tool for advancing health in building. So wanted to call that out.

Let's move to the next slide, which is about the last category, category eight, operations, maintenance, and resident engagement. This category includes best practices for how to set your property up during a design and construction process for excellent operations once it's placed in service. So this includes templates and guides for operations and maintenance plans that highlight best practices and sustainability. And we've updated our utility benchmarking guidelines in the criteria in this section to align with DBC protocols actually and some learnings from Better Buildings Challenges partnership with HUD. So you'll be familiar with what you see there.

So we can move to the next slide and I'll just recap that the criteria is based on these eight categories and really to maximize performance in new construction or rehab. We can really encourage you all to take a holistic approach because the opportunities for investing in new or rehabbed affordable housing are rare. So let's take the opportunity to maximize those investments to improve conditions for energy water and health.

If we go to the next slide, which is the last slide, I'll just highlight some of those web addresses for you at the bottom if you'd like to find out more information about the program later and just share in general that while we've all made tremendous inroads in creating efficient and sustainable, affordable housing around the country, our journey is far from over. Given our affordability challenges and the impacts we anticipate from a change in climate creating affordable green homes is more imperative than ever. Thank you. I'll stop there and look at what questions we might have.

Josh Geyer:

Thanks, Krista, so much. We'll now turn to your questions, participants. If you have questions for Krista, please go ahead and type them into your chat box now. We'll try to get to as many as we can. Leslie, do you have any queued up?

Leslie Zarker:

Yeah. We have some queued up here. First of all, I think it's – what aspects of your – rather which aspects of your design elements are applicable to existing properties and major renovations or all of the

design elements applicable to existing properties and major renovations?

Krista Egger: I'd say nearly all of them are equally applicable to new as well as major renovations. We do have slightly different thresholds that we would hold projects accountable to depending on if they're new or rehab. For instance, some of the site issues we have more stringent standards for new construction, but we allow alternative methods of rehabbing an existing building that is located in a perhaps not so ideal site. We also have slightly lower targets for energy performance for rehabs and for new construction just because of the associated costs with achieving the same level in rehab.

Leslie Zarker: Got it. Thanks. Has Enterprise and other multifamily residents, managers, looked at PPA's with solar or community solar subscriptions?

Krista Egger: Yes. That's a great question. We're seeing that pop up more and more in different parts of the country that have favorable regulations and utility partnerships to allow those to – to allow communities solar agreements to happen, for instance. We've been most deeply involved in those types of engagements in Denver, in DC, and New York City, but I'm really encouraged to see more affordable housing projects take on solar.

Leslie Zarker: Got it. You mentioned access to the Internet. Many rural communities are restricted by law to offer high quality Internet. Are you aware of this and do you know of movements to alleviate that restriction? And then this attendee provided a link to a recent story about it, which is in the chat box.

Krista Egger: Oh, interesting. Thank you. I'll have to go take a look at that link. We partnered with a few different organizations in the development of the criteria to develop guidelines around what type of access or what type of guidelines around creating broadband ready building would be most applicable for rural projects, especially those which are located in jurisdictions where the economics just don't pan out for major service providers to bring their offerings there. So thanks for the additional information. I'll take a look at the story.

Leslie Zarker: That's great. All right. Here's a question – or a request. Please comment on the history of building problems discovered long after they had been built, for example, lead in paints, sick building syndrome, and how we may not know what problems we are

building into current construction unless the construction itself is evidenced based.

Krista Egger:

Yeah. That's a good principle to keep in mind as you're going through your design practices. There are certainly the significant issues that the commenter brought up in terms of lead in paint or asbestos in insulation or a number of different issues. Then there are also more – there are also other maybe less dangerous impacts that are also negative unintended consequences that could be avoided. I'm thinking of installing any new technology that hasn't been installed previously in your building type, you're not going to know exactly how that will pan out.

So what – the approach that we try to take with Green Communities is really recognizing that there's not much of a margin for error in the affordable housing sector. Installing a technology that isn't tested or going with a construction technique that hasn't been tried out in your building stock before could be dangerous just in terms of what it might cost later on to replace or install. So that's one of the reasons why we emphasize so much the design strategies that we looked up in category one, integrative design, because the more people, the more perspectives that you have involved in the design process, the more likely you'll be able to anticipate the consequences of your design decisions and to ensure that they're worthwhile. So thanks for bringing that point up.

Leslie Zarker:

Yeah. Here's a pretty simple question, not quite as involved. How many facilities have started using 2020 criteria?

Krista Egger:

Oh, that's a great question. So we released the criteria in January and then in April we enabled our certification portal with a 2020 criteria so that people could actually start using it. And then this coming October, October 15, is going to be our transition date. So all new projects certifying to our program will have to use the 2020 criteria after that date when they're starting new projects with us. So right now we have several dozen projects in the planning stage with the 2020 criteria and we're starting to do long workshops virtually in different parts of the country to help practitioners understand really how to apply this to their projects in detail so that as we work up towards that October date we'll have a good background for success.

Leslie Zarker:

Okay. One more question before we move on to the next speaker. Do you have standards regarding embodied carbon in your materials as well as circularity in materials?

Krista Egger: So we grappled with that question a lot about how to address embodied carbon in the 2020 criteria. Because our program is national and because it addresses all types of affordable housing, it was a real challenge for us to look at what sort of threshold should we put in place that are feasible and meaningful and achievable in all parts of the country. So we ended up just including one criteria about embodied carbon and highlighting and specifically looking at that with concrete steel and insulation. So looking at evaluating the global warming potential of those three components of the building.

That is an area that we really hope to build out in the next version of the criteria after more teams across the country are able to do life cycle assessments and after there is more consistency amongst the product information for manufacturers about the global warming potential and about embodied carbon that's in the material so more informed decision making can be made. So we took baby steps towards addressing embodied carbon in 2020 with concrete steel and insulation, but we have a lot more to do to really scale those practices. The Carbon Leadership Network is fantastic and if anyone is really interested in the topic and would like to learn more, I'd encourage you to join that learning network.

Leslie Zarker: Thanks for that, Krista.

Josh Geyer: Awesome. Yeah. So thanks, everybody, for those questions and thanks, Krista. Our next speaker is Ruchi Shah. Ruchi has over seven years of experience in sustainability across real estate and consulting sectors, helping companies reduce operating costs, and manage climate risks. Currently Ruchi is a senior sustainability manager at Tenderloin Neighborhood Development Corporation, one of the largest multifamily affordable housing developers in San Francisco and also one of our multifamily sector goal achievers. She leads sustainability in the built environment initiatives for a portfolio of over 50 buildings. Under her leadership TNDC met its water and energy reduction goals for the Better Buildings Challenge. Ruchi is a lead Green associate and a Fitwell ambassador. Thanks, Ruchi.

Ruchi Shah: Thanks, Josh. And good afternoon, everyone, or good morning if you are on the west time zone. Really excited to be here and just wanna echo all the things that Krista mentioned because you are gonna hear that again and again in my slides too. I want us to take a quick second and focus on the building that's on your screen. If you were passing by the street would you think about this building

as an affordable housing site? Maybe. Maybe no. When I showed this to my husband he did not believe it.

So really what I wanna stress here is that we are building better than before. Definitely in terms of aesthetics we wanna make sure that when you get a key to this home or your apartment in this building you don't feel like it it's a traditional low income affordable housing building. I wanna take this philosophy also in our new construction thinking about sustainability because our goal has to be better than before. We have to target for higher energy and water efficiency and in general sustainably standards.

Next slide, please. Before we dive deep into our strategies on new construction, wanna give you a quick glance of who we are. So we have currently 43 buildings in our portfolio that are being operated and managed by us. We have 11 more in new development. So that's our real opportunity to focus on high performance buildings. We operate in eight neighborhoods in San Francisco. Most of our buildings are midrise to high rise construction because we are in an urban dense environment.

To give a quick sense of who we serve, we serve families to seniors to formerly homeless population in the city. More than 80 percent of our tenants make less than \$15,000.00 a year. Imagine surviving at that income in San Francisco. Currently we have in operations close to 4,000 units and surveying close to 6,000 residents across these different sectors. Beyond housing we also believe that housing is a basic human right and our work should not end there. So we operate in after school programs serving close to 300 kids, giving them tutoring free and also providing different activities. We also have a people's garden in the community, which does a fantastic job especially in this time giving out fresh produce at no cost to our residents and the community.

Next slide, please. So as Josh mentioned in the introduction, we did achieve our goals on energy and water efficiency as part of BBC, but we decided to not stop there, but rather extend it. So we have another goal set for energy and water reduction, 20 percent by 2029. We also understood given our impact of our buildings and as we were looking at our cost in different areas of sustainability and operations, we wanted to set a goal around waste management. That's a critical aspect for us in our buildings. We pay for waste and in San Francisco compost and recycle are a key component of sustainability strategies.

We also decided to not stop at energy and water, but further take it to carbon admissions reduction. So we have a 50 percent combined scope one and scope two reduction goal in that same time frame and then as you saw in this slide, we have 11 new buildings in development and we might have a few more in the next few years is think about certification. As Krista shared some of the great approaches and how these standards does in some sense ensure that we are building better than before. It's still a maybe for us. We are exploring different approaches and I'll be sharing that here in a second.

Next slide, please. So the way we look at green and healthy building standards is we look at baseline standards. For us that has been Green Point rated, which is very similar to what Krista mentioned with Enterprise Green Communities. This is more of a California based standard. It is free. Of course there are costs associated with getting the consultants who can help us get to meet the standard. And then lead, lead traditionally in affordable housing. We do think it could cost more, but we have identified ways that it's either cost neutral or given our higher design standards in San Francisco with the building codes. We are able to pursue that.

We are also starting to look at more active and integrated design approaches by looking at Fitwel, well-building standard as Krista had mentioned, and then living building challenge. They are very aggressive standards in terms of focusing on health and occupancy features. We have one pilot building going through Fitwel and a lot of lessons learned on that front. And for the other standards here, we are not quite there to completely adopt it, but what we are doing is we are looking at all the standards and details and thinking about what aspects we can take from each of this to up our basis of design.

At this point we have an intern for the summer who is helping me in this effort and we have been talking to a lot of our architects to understand what's realistically feasible for us. Next slide, please. In terms of other strategies, when I frankly joined at TNDC our understanding was that some of these things are really expensive and we cannot do it. But we took an approach of focusing on what the local jurisdiction mandates or what the funders care about and then came up with meet the code approach. We just don't wanna meet the code, but think about how can we expand our work and sustainability that aligns with different stakeholders that we work with.

And fortunately, now as Krista also mentioned in her presentation and tax credits, QAP points, people are increasingly recognizing the value of this standards. So I encourage if you are facing similar barriers in affordable housing use that to your advantage. One of the key aspects has been stakeholder engagement. There were a lot of myths around building standards and the way we overcame was talking to architects, having a lot of discussions, and getting behind from project managers who are actually leading these new construction projects.

In my shoes my goal is to tell them what to do, but then it's up to them on how they follow it. So the more buy-in we get from all the teams, the more chances that we adopt this across our portfolio. Next slide, please. So in terms of our progress, I'm happy to share that 40 percent of our portfolio has a Green certification. Nine of them are LEED. The one photo that we saw earlier was a LEED platinum building. So more and more our teams are getting comfortable with lead being adopted. Another big win for us was in our new construction pipeline out of 11, 7 buildings are already plan to be all electric.

In San Francisco we don't have an ordinance yet that mandates us, but we know that might be coming our way. So we wanted to be prepared and also we figured out that in the next slide I talk a bit more about the costs, but there was again, a lot of myths around it will be expensive, but it was not the case for us, especially in San Francisco and given high costs of construction. In addition to that, we made a lot of progress on solar features on our new construction, either PV or thermal now more of it all electric we are adopting PV rather than solar thermal just because they don't work that great with heat pumps, which is one of our key technologies that we use on new construction.

Also in California the grid itself is relatively – it has more renewable content than other parts of the country, but because we have a carbon reduction goal we decided not to stop there, but to take advantage of the option. In our local jurisdiction we have a community choice aggregator called Clean Power SF. So we are procuring 100 percent renewable electricity from them. It's a bit cost premium at this point, but when we analyzed our portfolio and how we can quickly achieve our carbon goals, this was one of the cost effective and faster ways to do that.

Next slide, please. So as I mentioned, all electric can be challenging in different parts of the country, but I wanna share our experience that it wasn't expensive for us. We mostly build

multifamily either midrise or high rise. In terms of construction cost, in most cases it was negative, slightly negative per square feet, or cost neutral, which really helped us get buy-in from our development teams because like it or not, they do care about first cost in construction.

Next slide, please. Yeah. So from our lessons learned, what I really wanna highlight on the fact is what not to do if you want buy-in from teams that aren't electric is talk about this later in the design phase, but rather talk with the teams really up front even before schematic design phase. We share that we wanna build this so that they can optimize and do value engineering on other aspects of building construction and then in terms of what to do, it's really – in my experience it takes a village. So it's really about getting the right consultant on board who have familiarity with heat bombs or whatever other technologies you are looking at for your projects.

Then really highlight the fact on commissioning. Again, none of our all electric building is fully built out yet. Many of them are in later design phases and will be breaking ground end of the year or so. So we are tightening our standards on commissioning because we wanna make sure all of our design assumptions are actually true when it goes into operations. Next slide. Other strategy that Krista did mention in her presentation was embodied carbon. It's such a broad area and a lot of research is coming out, but given that we have 11 new buildings and we don't wanna miss out on that opportunity, so we are taking baby steps too. Embodied carbon in a sense is the carbon footprint of the materials that go in building design and construction and let's watch a quick video to get everyone on the same page on why it matters.

[Beginning of video 0:48:15] Let's talk about climate change. Now people think, "Hey, aren't we getting the solar panels and wind mills to be a lot less expensive and isn't that helping reduce greenhouse gases? And the answer is absolutely, but there's a lot more to do than just taking electricity to zero missions. There's a variety of things that generate greenhouse gases. We have a lot of sectors in the economy like manufacturing that are emitting greenhouse gases that aren't talked about as much. Manufacturing, everything we make, even a cute little squishy like this, that's emitting 21 percent of the greenhouse gases. The number of buildings in the world is going to double by 2060. We're gonna build a new New York City every month for the next 40 years. It's a gigantic amount of materials. Steel, cement, wood, all emitting greenhouse gases. We're gonna have to figure out how to make all these things in a different way. So we're gonna need a lot of

change, a lot of innovation to bring the emissions from all those areas down to zero. [End of video 0:49:34]

I hope you all feel the same after watching the video, that new construction is an opportunity that we really have to grab on and we all are expanding pretty quickly and the admissions associated with that just because we don't have metrics right now or lack of information does not mean we cannot act on that. So based on our engagement with Carbon Leadership Forum as Krista again mentioned, there are a fantastic resource if people wanna learn more on embodied carbon. What we are trying to do is tackle the upfront aspects of embodied carbon because most of the work that I shared earlier and what we have been doing with Better Buildings Challenge is on operational carbon, which is energy efficiency and reducing what happens after a building goes in operation.

Next slide, please. So our baby step has been first to understand what are the areas of up front embodied carbon in terms of global warmer potentials. We have not done full like cycle assessments on our buildings, but based on the research we are focusing on the big categories on the pie chart, which is concrete, especially in our buildings. Given the type of construction we do it's mostly concrete based. We are not using that much steel and wood compared to concrete.

Next slide, please. We took up a small exercise to understand one of our latest affordable housing project, 1036 mission. It's 83 units in San Francisco. How our current copied approach is fair in terms of embodied carbon impact. So we work with the consultants to look at our concrete mixes and talk to our structural engineers to understand what went in that building. We looked at different aspects where concrete went in such as foundation, slabs, walls, and we realize that by not doing anything, just virtue of design we had a 14 percent reduction come back to a similar baseline building.

And the key source behind this analysis was environmental product declaration data, EPD, that again comes down to the point of how can we make sure that we are getting this data up front. So it's about transparency in these materials. Even though our current building is 14 percent less in terms of embodied carbon for the concrete aspect, we realize there was a lot of opportunity we did not take advantage of and we could fix that by typing up our concrete standards.

Can you go to the next slide? So this is a draft and I would be happy to share as things get more solidified. We work with our structural teams to figure out what can we do for better embodied standards in terms of embodied carbon. So just to set the baseline, when we talk of concrete there are three big things that come into play. That is cement, water, and of course aggregate. It's all about different proportions that we use to reduce embodied carbon. And cement, as you can imagine, the emissions associated with extraction, manufacturing, is the biggest culprit here.

So for example, on the table here slab on grade we are recommending now 70 percent SCM, which is supplemental cementation material, which means that we only use 30 percent cement and 70 percent will be the other components. This is still a work in progress and it's a baby step, but we feel given the type of construction we are doing, this is a good, good first step in the direction of reducing embodied carbon. Next slide, please. As you're thinking to start this conversation in your organizations, I think you can start with some basic questions on what to even ask for.

The table that I shared focuses on the question of can the amount of cement be reduced. The answer, when we worked with our structural teams was that yes, absolutely. Again, our fear was would it cost more. If you think about it, technically it should cost less because we are using less cement or maybe cost neutral if our challenge is with getting the right amount of supplemental materials. Again, engaging with structural up front and even just sharing that we want to reduce embodied carbon can help them think to reduce the overall mass of concrete in the project.

Can we use other materials? So we are starting to ask these questions and in no way or form these are the questions that it's a final list. It's a growing list, but having these conversations is helpful. Next slide, please. We sort of built out this chart with our consultants so that it was clear for our design teams on what the approach should be and how they should talk about embodied carbon and concrete. Traditionally this has been a linear approach. There is a design team. There is a construction team.

We as owners sometimes bring them together, sometimes we don't. Especially when it comes to carbon reduction strategies it's important if we are talking about embodied carbon and concrete that structural engineers talk to the entire construction team and there is a lot of open communication that should happen to achieve

this. Next slide. So with this I wanna end my talk by saying that it is scary.

We are embarking on a lot of new approaches and pushing our envelope beyond energy and water efficiency, but I feel like just being hopeful isn't enough. We have to start somewhere and take action. So I hope this has given you some food for thought and happy to talk more on any of these topics in more detail. Thank you.

Josh Geyer: Thanks, Ruchi. So we're going to start calling out questions. We had quite a few of them. Leslie, you wanna start out?

Leslie Zarker: Sure. Ruchi, given the high performance, the nice look, and community programs of your buildings, has this garnered any support within San Francisco for additional affordable housing and rezoning in the city?

Ruchi Shah: Absolutely. Yeah. We work a lot with our local agencies and the fact that we are focusing on these approaches, I don't know how, in terms of points, do we always get more weightage because many aren't doing some of these things as we get points for it. But in general it's about reputation. I think that's important for our development teams to understand that we are being trusted when we try out these things. So yes. In San Francisco I feel like TNDC has a reputation that we are trying to push the boundaries in terms of sustainability.

Leslie Zarker: Wonderful. Has your firm used or are you planning to use pace funding on retrofits?

Ruchi Shah: No. We have not used and to my current knowledge we are not planning to. In terms of how we – I think the question might be on how are we affording these things. It's the fact that if we are focusing on many of these things up front we are able to do value engineering across several categories like, for example, I was talking to a consultant on a project where we are putting in better windows, which are costing higher – more money up front, but then just by doing this we are reducing the amount of heating and cooling load. We are saving some bit on how big of a heating and cooling system we put in the buildings.

Leslie Zarker: Thank you. Are they all electric cost figures from your own portfolio or from public studies?

Ruchi Shah: This is from San Francisco study. As I had mentioned earlier, the city is planning to pass an ordinance. So they have been doing a lot of research on affordable housing. We – the slide here is more of a generic number. We have data from one of our site that I mentioned is breaking ground this year. The numbers were pretty similar.

Leslie Zarker: If you're able to discuss, what is the cost for using less embodied carbon concrete materials?

Ruchi Shah: Yeah. Like I said, again, we are trying out and taking baby steps. But based on our conversations with engineers and concrete suppliers on – we are testing out these standards on a couple of projects. On one project my understanding is that it's not costing anything. It was just a matter of talking to them and increasing the standards. On second project because they had to do some change and who the supplier will be and who can get us to meet those standards, we had a slightly increase in cost, less than one percent, and the building was able to afford it.

Leslie Zarker: Great.

Josh Geyer: I'll take the next one. Ruchi, what was the biggest driver of capital cost savings for you when going all electric?

Ruchi Shah: I think one was definitely efficiency because by doing all electric we are selecting systems that are more efficient than compared to a steam boiler or a hydraulic boiler. Then second, in San Francisco, and again, I think our development team might know more, but the cost associated with getting the gas infrastructure was also pretty high. So by going all electric we are avoiding that cost up front and our development team is happy that they have to deal only with one utility.

Josh Geyer: Sure. Okay. So it looks like we're ready to – I think that that's it for now for questions, but there will definitely be another opportunity to ask all of the – or chat with all of the panelists after all the presentations. So again, thanks very much, Ruchi. Our final speaker is Michael Hindle. Michael became a Passive house consultant early in 2010. He is owner and principal of Passive to Positive, a passive house and zero energy consultant practice and co-owner and principal of CommONEcology Design Company. Michael has consulted on Passive House Zero Energy and living building challenge projects from New Hampshire to Washington DC.

His first multifamily project, Weinberg Commons in Washington DC won the PHIUS 2017 Affordable Project of the Year award. Michael has served on the board of the Passive House Alliance of the United States in the Passive House Institute US. Thanks, Michael.

Michael Hindle: Great. Thank you for the intro. I'm really, really humbled and impressed with the prior presentation. So thank you both Krista and Ruchi for everything you've done. So what I offer here then is offered with great humility as just one small player. But I will try to push forward a vision that I think is essential. I'm gonna mainly just talk about projects that are underway.

So next slide, please. When we prepared to do this presentation we were discussing that it'd be really great to talk about simplified replicable high performance and there's a tendency in the industry to talk about this as a bit of a unicorn, a mythical creature that is beyond reach. I think I hope that our projects will demonstrate that this is not necessarily the case. Simplified, replicable high performance is achievable and the one thing that I could point to that would make this – that would bring this within your grasp is the platitude that it is all about your team. And I know Krista and Ruchi both mentioned this. Ruchi mentioned bringing in innovative consultants.

You need to bring in people who are really oriented towards this work. So it's not just a platitude. It is all in the attitude of each and every player. Next slide. So it's all about the team. What does that mean? The only question I can come – the only answer I can come up with to that question is do they want it? Do all of the team members want to change the course that we are on, which is a rapid drive towards the precipice of catastrophic climate change. Do they consider it their goal, their responsibility, their personal mission? Do they care?

Next slide. When I say do they care, I mean do they care in their bones? If you look at this terrifying picture from Paradise, California and then you look on the chart at the bottom, the map of the United States, a high emissions scenarios, the yellows are under 10 days over 100 degrees a year and the dark oranges are 120 days or between 90 and 120 days over 100 days per year. Now Vermont and Maine are about all that's left that is not suffering serious overheating drought or monsoon type weather. So the entire breadbasket of the United States can turn into a desert. The central valley of California where we get most of our produce is

essentially desertified. It's destroyed. Now is their peace or social justice in a world with no food?

Next slide. So since we're talking about buildings primarily, though I know Krista is absolutely, critically correct in talking about a broader, more holistic perspective, and I hope to address that as well. Buildings play a huge part in what is already the worst per capita performance in carbon emissions in the world. The United States is the worst and buildings are 44 to 50 percent depending on who you ask and what's being measured. Next slide. So I started with Passive House. I was an art professor. I started to volunteer for an architecture firm and I was like, "No. I got to go all the way or I'm just wasting my time."

So I went and got Passive House certified. I first tried to invent it and obviously didn't know how and then realized it existed. So this graphic by Richard Pedranti is a beautiful illustration of yes, we can reduce operational energy demand to a fraction of what it was before you even put on the solar panels. Next slide. So we have to reduce operational energy demand. Now how do we do that? Passive House is focused on energy performance and the building envelope. Simplified, replicable high performance assemblies require that team that you've pulled together to be committed, as I said before, and truly collaborative.

So integrated design is not something that Krista says or a box you check off. She's trying to get you to actually do it and that means that everyone, from the developer and I'll mention several that are really playing ball with us, doing and leading the way, from the developer, the architect, the structural engineer is critical. The interior designer is critical as Ruchi showed the carbon intensity of the interior finishes can be very high. In any case, you need everyone at the table sharing this goal from day one and the people who set the tone, generally the developers, the owners, have to, rather than be saying, "Well, it'd be great if it doesn't cost too much," they have to be saying, "This is what we're doing. You're my team. Find the way and work together and work it out."

Next slide. So it really is collaborative. This is Gilford Knolls III, the first Passive House multifamily in New Hampshire, which we worked on. And this used – next slide. This used basically off the shelf assemblies. It's just two by eights. Everyone said, "Well, you need to have continuous insulation in order to do Passive House particularly in a cold climate like New Hampshire." I said, "No. Let's model the building before we draw that conclusion." We found that we could build with two by eights. We over

compensated a little bit in the slab in the attic, but these are simple assemblies that people, like the framing crew, already knew how to do this building. There were a couple of nods to airtight continuity and sequencing that we had to clarify early, so we did and we did not have a problem. And it was a low bid – New Hampshire is a low bid state. So going off the shelf as much as we could was really critical.

Next slide. Right now we're working on several projects in Washington DC and in Pennsylvania. Preservation of Affordable Housing is the developer on this project, in particular the leadership of Julie Klump has been incredibly important to this project. To date we have three buildings. We can go to the next slide. That one you're looking at now is I believe 108 units. This one is 134 units and the third one, next slide, is oh, 208, 250, something like that. I'm sorry. I'm forgetting the numbers off the top of my head. But in any case – oh, 196. In any case, we've got three large buildings that are all targeted Passive House. No questions asked, just do it. And they're gonna be a strip of – there's gonna be a group of row homes as well in this neighborhood eventually. So by setting the tone POAH has said, "This is the new standard. We can achieve this. Now team, get down to work and do it."

Next slide. So you really have to thank them for their leadership really in all of this. Now the assemblies in this are actually, again, very simple. It's two by eight construction with a vapor open sheathing to allow for outward vapor migration and some of the walls we have a furring_cavity inside to protect our airtight layer, but we've subsequently modified that and it's not necessary everywhere. We're also able to go with a simplified and prefabricated model using – currently we've been talking to Blue Print Robotics. The picture on the right is just a shot from their factory.

Next slide. So this assemblies are really simplified and the performance is great and there are no thermal bridges in the upper structure of the building. And this – well, this picture got kind of mess – at least on my screen. This is a section showing all of the thermal bridges. Forgive the distortions, but each of those circles is a thermal bridge and the ones that are most numerous are on the right side of my screen. It was formally on the bottom of the page, but the podium is just for a Passive House person. I'm sure there are other people out there who have tried this. There are thermal bridging nightmares and as Ruchi and Krista have both already pointed out, concrete is incredibly high carbon intensity.

Next slide. So we spent – I have three relatively poor screenshots of over 100 thermal bridge models we did to try to assess just how we deal with the podium. We've actually gotten there, but it took a while and a lot of that was because we needed to have direct communication, really direct between the architect, the structural engineer and myself or my team. If you say, "Okay. Here's what we need," and it goes to the architect and the architect goes to the instructional engineer and the instructional engineer comes back to the architect and then it get back to you, you've lost an incredible amount of time and an incredible amount of simple, direct solution providing in real time in person or virtually as it is now.

Next slide. So we've already talked about this. So I'm gonna go really fast through this, but the bathtub is our atmosphere. It's filling with carbon. The drain is carbon being drawn out by the oceans and plants. We don't wanna acidify the oceans and destroy the coral reefs though it may well be already a done deal. But we can start to find ways to draw carbon out of the atmosphere. Next slide. So and this has already been discussed as well, but the embodied energy versus the operational carbon, the embodied energy of the yellow bars, the operational energy are the gray bars, and you can see accumulatively the amount over time.

To 2050 is when we are theoretically at least, probably optimistically going off the cliff into catastrophic climate change. But you'll see by 2030 embodied energy is the majority of the energy. So if we're gonna address climate change, and even by 2050 it's still 50 percent of the energy carbon emissions. So if we're gonna address climate change we simply have to address embodied carbon now. This has already been discussed. So we can move to the next slide. And Ruchi has already described some different strategies and showed you different materials, but this is from Jacob Racusin and Ace McArleton and Christopher Magwood at the NESEA conference a couple years ago.

On the top chart, first scenario, they built – the study was a carbon – a typical code-built home and you can see the embodied energy is low. Each of those little red ticks is operational energy per year. The purple is the total aggregate carbon emissions by 2050 and you can see this building is responsible for 84.8 tons of carbon emitted by 2050. Bad. That's really bad. Now you do a zero energy or a high performance building with heat pump, but you use carbon intensive materials like lots of foam, concrete, steel, et cetera, whatever. I don't know the exact prescription they had, but the embodied energy is very high and the operational energy is

negligible, but the total carbon emitted by 2050 is 91.9 tons. In other words, by doing a high performance building, as many people in well-meaning Passive House communities have been doing with lots of foam delivers a worse carbon outcome by a good margin. This is even worse than our first scenario.

Our last scenario is what Jacob and Ace practice up in Vermont. They were using biogenic carbon sequestering materials. They built the building. This is theoretical. I'm sorry. This is a model, but they do this in real practice as well. They build the building and it sequesters a whole bunch of carbon and then they have very low operational energy demand. At 2050 you've still stored 8.9 tons of carbon. This is what everyone needs to do now. Now it's easy to say and I used to say things like, "Oh, incrementalism is death. We're never gonna get there."

Then that is not – that lacks humility because obviously the work that Krista has been doing and Ruchi is doing within her organization and so many other people that are on this call – you can go to the next slide – are doing incrementally has been proving the concept and making it possible for us to envision the green image on the right. We have the same building built four different ways and this building can be an asset to the environment. Not just less bad. This is the mantra. Not just less bad. Actually become an asset, an improvement to the environment you're working with.

Next slide. I'm talking fast because we don't have much time here. Podiums, I said they're thermal bridging nightmares. True. We can resolve it, but it's still hard and they're carbon intensive, but do they have to be either of these things? Next slide. The answer is it's all about the team and it's all in their attitude. On the next slide we see a project also in DC with a group called Summerset Development and this project, the developer and the architect and the structural engineer all said, "Okay. What if we try" – next slide. I suggested mass timber instead of concrete for the entire podium structure. So they said, "Well, I'd love to do it. Let's try it." And no one on that team wasted our time by arguing with us that we couldn't do it.

Now I know there are sometimes very legitimate reasons why you can't do things like this. So please don't misunderstand me. But since everyone had the positive attitude of, "Can we do it? Let's find out," with a hopeful attitude and orientation towards that goal, we solved it. We got rid of all the podiums. There wasn't much in this project. It's not as extensive as on some other projects, but we

also looked at the masonry stair tower and elevator shafts and they're gone as well.

So now this project is going to be all made out of dense – I'm sorry – mass timber and CLT for those critical structural elements, which otherwise would have been concrete. They're still concrete for the foundation, retaining walls and such, but the percentage as per Ruchi's point, the percentage of concrete in the project overall has been dramatically reduced. Next slide. So we have to be building with regenerative materials. This is Martin Lentmire from Blue Print Robotics that we've been working with with POAH and with Summerset and this is just a couple of shots of their walls.

The wood fiber insulation on the exterior can be a net carbon sequestration. The wood timber in their sharp is sustainably harvested. Unfortunately, they have to go to Europe to get it. So the carbon footprint reduction isn't as great, but we can put pressure on our respective industries to get there. Next slide. All of these solutions are here now, every single one of them. We have to choose to find the way to employ them.

Next slide. I have cork on my house. We're talking to some people about using hemp on a retrofit project. I'll get back to that in a sec. In this chart on the left you see operating emissions for new construction. Ruchi is absolutely right. Every project has to be the highest ambition we can make it. Operating emissions for new construction is a tiny fraction of the overall carbon emissions sources. Embodied emissions of new construction is higher, but still relatively small. Well, look at the operating emissions of existing buildings. It's because there are a lot more of them. Most of the buildings already exist and they're very poor energy performance.

Now every time I drive into DC for a project meeting I see all of the buildings going up around me are carbon nightmares, both operationally and embodied. You cannot build your way with low carbon materials out of the carbon crisis. We have to retrofit our way out. So if you look on the large chart, large, heavy buildings are responsible for embodied carbon emissions, a very large amount. Small light buildings less so, but renovations are the lowest still. So that means that are lowest embodied carbon solution aligns with our greatest operational emissions challenge. There you have opportunity aligning with the need. So we must retrofit.

Next slide. This is Weinberg Commons. It was mentioned before. This next slide was a deep energy – exterior deep energy retrofit of brick and block housing projects buildings. Next slide. I don't have time to go into the details, but I'm happy to answer questions. This is North Negley Ave. We're working on this project with Beacon Communities. We are – they were going to tear down all of this, save the portico as a relic because the builder and the architect said, "Well, it would be cheaper to building it." These buildings are precious. This is part of the cultural fabric of that community and the embodied energy sunk into this project already is enormous.

So we convinced them to take a look at it. They are now preserving the entire building. Now certain things like a collapsed roof or water damage plasters coming off, there's still mediation, but all of the building, the main structure is being preserved and we're building two new stories. Next slide. So you'll forgive this rendering that's coming up because this was just a sketch throughout that one of our team did to represent the idea that Krista has suggested is important, which is an entire regenerative neighborhood or community approach. So we are using all carbon sequester and construction materials. We have gotten all foam out of all of these projects. We are doing the deep energy retrofit of both parts of the building. The residence is a LIHTC project.

Again, if it weren't for Courtney Koslow, the development director, none of this would be happening because I can kick and scream and stamp my feet and wave my hands and say, "I'm a Green guy. You got to do these things. You got to listen." No one is gonna listen to me. It's got to be the leadership. So I can help make suggestions, but your Green consultant needs to be backed up with solid concerted leadership from the ownership team and development team. We are gonna be doing regenerative agriculture on site, et cetera. So that's more to Krista's earlier point about integrated holistic design, but we don't have time for that right now.

So next slide. I'm almost at the end here. Just okay. So we can use draw down materials and draw down community development practices and actually create carbon negative communities and this is the goal. Next slide. Bit of a lag here. We are – we have to understand that form follows fuel. You cannot build what is shown in this picture without massive quantities of fossil fuels and it is completely unsustainable. Next slide. So we have to recognize that there are limits. We are not a perpetual growth society. It's not possible we're destroying the planet. So you have to follow your fuel source, which is the sun.

Next slide. You'll see that there are attractive ways to understand that the sun is an asset and when it's beating down on your building and you don't want it, you have to have shading. So you have to be creative designing wise. Ruchi showed a nice picture with a window – there were rectangles around the windows that provided excellent shading. You can even see the shading in the picture. Next slide. So form follows fuel, not just function. The great news about this is this is our house post retrofit. Our son is thrilled that solar panels are there. If you do the Passive design first and the deep energy retrofit of the envelope, then active generation is – this is the path to both zero energy and resiliency.

Next slide. I'm wrapping it up, I promise. This is Weinberg Commons in the model with the heating and cooling – the heating system turned off in the middle of winter. The temperature never dropped below 60 degrees. We could power this building with the solar panels basically for critical loads and never need heat because we actually just don't need heat. Now it's a little colder than people like it, but it's not a risk to the community. So resiliency could be a very real thing if you focus on passive design and the envelope.

Next slide. I think we're very, very near the end. This is just an example if you add solar and some storage, the sun comes up, which is the yellow line. The blue line is the battery charge and the battery discharges overnight. Boom, the sun comes up again. This building in the middle of January in New Hampshire, this building was – next slide – was self-supporting for critical loads, mind you, not all loads, but critical loads with just two electric vehicles plugged in as batteries. Bidirectional charging is coming. So that will be cool. This is good grid citizenship. If you haven't heard of the duck curve you will soon and you can look it up. Basically in August this battery system never goes down. This building is completely off grid.

Next slide. So this is a far better investment. Everyone is gonna say, "Well, what does it cost?" This is a far better investment whether the markets know it or not than the \$1.5 trillion to \$2 trillion we're gonna spend updating the infrastructure just to maintain a destructive system that we currently have in place. Think of what we can do with that investment. Next slide and I think I'm done. Remember, reduce operational energy. Reduce carbon emissions. Capture and sequester carbon. Reduce embodied toxicity. We didn't even talk about that, but phones basically a nightmare.

Next slide. We need to get to resilient communities and regenerative land use. We don't have time for that today, but my last slide, my last message is this is all about you. I'm sorry. Go back to the planet. That's inspiring. This is all about you. It's all about me. It's all about every one of us that drives a car or owns a house or does anything. We all have impacts. We all have to make the commitment now and we have to lead. Thank you.

Josh Geyer: Thanks so much, Michael. Thank you. We'll now turn to questions. I know other presenters have been popping into the comments and addressing questions, which is great. We're gonna see if Leslie, do you have any to pitch Michael?

Leslie Zarker: Yeah. Sure. From David Nuccio, he says, Michael, he's spent years listening to architect, Eric Cory Freed, on the topics you're speaking on. This year he listened to him talking about timber construction. Can you give us some detail and comparison from timber construction compared to steel and concrete in relationship to the carbon differences?

Michael Hindle: There's no comparison. Steel and concrete are a horrible nightmare and timber is vastly better if, if it's sustainably harvested. There's a great book. I don't have it within my reach right now – yes, I do. *The New Carbon Architecture* by Bruce King and the Carbon Leadership Forum, that was mentioned twice before already at least. This guy is really great and a lot of the people in that forum are contributors to this book. He has plenty of charts in here about how, oh my gosh, concrete is horrible. Steel is horrible.

Wood is really quite good if it's sustainably harvested, but if it's not sustainably harvested it can be almost as bad as concrete. Clear cut forestry is awful because it destroys the soil and the soil holds a lot of carbon. So this is absolutely – this takes that integrated holistic perspective that Krista refers to a step further if you cut down a tree and it's in an unsustainably harvested slope. You have destroyed an entire echo system, water shed, carbon sequestration of the soil. It must be sustainably harvested wood. We're just trying to get some wood podiums built and then we'll quickly turn up the heat on anyone who is involved to make sure that they're doing sustainable harvesting.

We have no time. So we've got to push hard on this. I can't give you anymore specifics right now in the time we have, but please get this book, *The New Carbon Architecture* by Bruce King and go to the Carbon Leadership Forum and they're all a lot smarter than I

am. I'm just trying to catch up – keep up. But there's a lot of wonderful scholarship being done.

Leslie Zarker:

Great. Thank you. All right. We have a comment from Zoe Coffman. "Thank you for the distinction between operating emissions versus new construction operating emissions. We feel like the statistic is being conflated a lot recently to argue against the need to address embodied carbon." You feel like commenting there?

Michael Hindle:

Yes. So new construction operating emissions is only a very small fraction of the operating emissions. So we do have to tackle existing buildings. So as one of the questioners to Krista said does this stuff apply to existing buildings? Everything has to apply to existing buildings to whatever degree we can. We have done multiple deep energy Passive House retrofits and I'm just not afraid of them. Now every member of the team has to be on board. The builder has to understand that this is a new skill set. They can't put it through their estimating process in the same way. People have to think and act differently, but it is very much possible.

I've even found that on an old church hall here in Baltimore that I was consulting on and they said, "Oh, Passive House is gonna be too expensive," and they took it out. And they came back to me later and said, "Can you make sure our wall won't rot and grow mold?" It turns out that I reran the model reducing the insulation, didn't horribly increase the operating energy emissions. The embodied emissions were going down and it ended up being more about building science. Is the building gonna be safe over the long term? So all of these things are integrated. I think I've gone off topic, but yeah. Operating emissions of both old and new buildings are critically important.

Leslie Zarker:

Okay. We have a couple more questions if our Zoom host will indulge us. Michael, for scenario six, the best case, how do you ensure that the sequester carbon and construction materials isn't released at the end of life, like when the building is demolished?

Michael Hindle:

That's a great question because we have very little control over that unless we create a society in which the economy is circular. Now the fact that you – or does the building need to be demolished? I've worked on a whole bunch of buildings including these brick and block buildings where they're unlivable. They're uncomfortable. They're unsustainable. Now this building that we retrofitted it now could be very, very durable if the building science is done right and we pride ourselves on doing that. We certainly hope it has

been done right. That building will not need to be demolished. It'll be in service for a very long time.

Now if it does come down, if you're using materials that are easily recyclable, then we're more likely to have a more circular outcome. This, again, if you look at Bruce King's book and at the good work that Chris, Ace, and Jacob have done in their presentations and research, there is the whole after life part of the cycle. Our construction, the production of the material through the construction of the project and the operational life of the project, that's like three quarters of the circle. The last part is reclamation and reuse. So your question is very much to the point we need to build a whole society based on regenerative material use and reclamation.

Josh Geyer:

Okay. So that's all the time we have for answering questions, but thank you, Michael, and thank you to everybody who submitted questions and to our panelists for answering them in there expertly. We'd like to invite you to attend our Better Building Summer webinar series starting in July. Partners will discuss some of the most pressing topics you're facing and share best practices and innovative new ways to approach sustainability and energy performance.

To register go to the Better Building Solution Center and click on the 2019-2020 webinar series. I'd like to, again, thank all of our panelists today and also a big thank you to our Zoom host, Becca Curry and Marissa Schatz. If you have any follow-up questions please reach out to our panelists. Their contact information is listed on the screen. Before we go we're going to play a short video on the Better Buildings Challenge Solution Center.

[Video playing, 1:31:40 to 1:32:28]

That concludes today's session. Thank you, everybody. Have a good rest of your day.

[End of Audio]