

Adam Hasz:

Hi, everyone, and welcome to the 2021 Better Buildings, Better Plants Summit; a virtual leadership symposium. Thank you all for being with us today for our session on Easy as ABC: How Advanced Building Construction Creates Efficient, Affordable & Appealing Solutions for Low-Carbon Buildings. We have a wonderful session prepared and some fantastic speakers I'm going to introduce in just a moment. Next Slide, please.

Before we dive in, we have two housekeeping points I would like to cover. Please note today's session will be recorded and archived on the Better Building Solutions Center. We will follow-up on today's recording when Slides are made available. Next, all attendees are in listen-only mode; meaning that your microphones are muted. Should you experience any audio or visual issues any time throughout today's session, please Send a Message in your Chat Window located at the Bottom of your Zoom Panel. Next Slide.

My name is Adam Hasz, and I will be your moderator for this session on Advanced Building Construction – or, as we call it, ABC. I'm a technology Manager at the Department of Energy Building Technology Office. And I worked on the Advanced Building Construction Initiative at DOE for the past three years. I'm excited to share insights from my colleagues, working directly with the ABC approaches to construction renovation during today's session. Next Slide.

And after concluding this introduction, I'll provide a quick overview of the ABC Initiative and collaborative work happening through DOE. Then we'll listen to three dynamic speakers and have a facilitated discussion about their work. Finally, you – the audience participants – will have a chance to ask your questions directly to our expert panelists. Next Slide. During today's session, we will be using an interactive platform called Slido for our Q&A as well as for some polling.

Please go to [slido.com](https://www.slido.com) now using either a mobile device or by Opening a new Window in your Internet Browser. Today's event code is #doe. Once you enter #doe, please Select today's session title in the Dropdown Menu; which, again, is Easy as ABC: How Advanced Building Construction Creates Efficient, Affordable & Appealing Solutions For Low-Carbon Buildings. If you would like to ask our panelists any questions, please submit them anytime throughout the session in Slido. I will then Select and ask your questions near the end of the session.

We're about to launch a Poll to collect your feedback from you on your specific sector. If you haven't already, please go to [slido.com](https://www.slido.com), enter event

code #doe and Select Easy As ABC as your session. Now for the Poll. What sector are you from? Please, again, go to [slido.com](https://www.slido.com), enter #doe and Select Easy as ABC. You see that we've already got some results coming in. We've got some folks from government, from state and local. We're got some nonprofit sector participants. We've got multi-family housing, industrial and manufacturing.

We've got a bunch of people from other. I'm curious about which specific types of buildings or which types of organizations that represents. Then we've got a pretty good mix here. If you have not yet, please go to [slido.com](https://www.slido.com), #doe and Select Easy As ABC as your session and then let us know which sector you're from. Right now, Other is leading the pack. But now, we've got government, state and local – again – in the lead with good representation from the nonprofit, multi-family, industrial manufacturing and higher education sessions as well. If you haven't yet, you still have the chance to enter the Poll throughout the session. But we're going to move onto the next part for our presentation.

So thank you, everybody, for participating there. Again, you can go to [slido.com](https://www.slido.com), #doe and then enter Easy As ABC at any point during the session to answer that Poll as well as to ask questions to our panelists. Now, what is Advanced Building Construction? Over the past few years, the DOE Advanced Building Construction Initiative has worked with our partners to define what solutions fall under the category of Advanced Building Construction.

And we came up with this list. ABC refers to new construction and Retrofit solutions that offer superior energy efficiency and low-carbon performance; two, are cost-effective for developers and consumers; three, provide faster and less disruptive on-site deployment as compared to traditional construction and renovation techniques; four, are appealing to owners and users with added value, which can include improve in our air quality, better comfort, improve resilience, reduce maintenance costs or other added value sources; and finally fifth, these solutions are compatible with new business models that enable market transformation in the construction industry.

This specifically can include vertical integration, but it can also include a lot of other models to scale up the productivity of the construction sector. Next Slide. Now, for Advanced Building Construction a lot of the solutions we talk about have some relationship to pre-fabrication or off-site construction. However, what really ties together ABC is that they can have innovation and improvements across the entire value chain for construction. They are ABC solutions that range from design to materials

to components to manufacturing and, finally, to the installation of different hybrid solutions.

And through the innovation across these five stages of the supply chain, Advanced Building Construction technologies can improve construction sector productivity and help the most difficult building types to reach carbon neutrality. So that's really what ABC is about. And I'm very excited to hear from our panelists today that are demonstrating what ABC solutions can look like in the real world. Okay. Next Slide.

So today's panelists include Christina McPike from Wind Companies, Tim Kohut from the National Community Renaissance, and Lucas Toffoli from RMI. We now are going to go into each speaker's sessions. So first, I want to introduce Christina McPike from Wind Companies. Christian is the Director of Energy and Sustainability at Wind companies, which is a 50-year-old, multi-family housing owner, developer and manager.

Since she joined Wind's Energy and Sustainability team in 2013, Miss McPike has managed over \$30 million worth of energy efficiency upgrades across Wind's portfolio. Under Miss McPike's leadership, Wind Development successfully integrates high-performance design in every project, from occupied moderate rehabs to historic adaptive reuse projects to ground-up new construction. Miss McPike leads Wind's DOE Advanced Building Construction Team, teaching new and innovative ways to develop, scale and finance Deep Energy Retrofits. Thank you for being with us, Christina. Looking forward to your presentation.

Christina McPike:

Thank you, Adam. I've got to say I'm not used to being called Miss McPike. *[Laughs]* But really happy to be here. Like Adam said, my name is Christina McPike. I'm the Director of Energy and Sustainability at Winn Companies. Wind is a 50-year-old family-founded and operated affordable housing owner, developer and property manager. Sustainability Is not new at Winn. Our in-house energy division, Open Market ESCO, was established more than a decade ago and has since facilitated more than \$30 million in energy efficiency projects.

We've developed nearly 3 megawatts of solar PV, and we've integrated green building series across our development pipeline, including rehabs, reconstruction and historically adaptive reuse. And despite all of these experiences and success, there's still a major disconnect in the industry about how to decarbonize existing buildings. While we've seen enormous progress in recent years with new construction closing the gap between aggressive stretch codes and Net Zero or FIA certification levels of performance, as an industry we've only touched a small percentage of the

existing buildings and with marginal impacts on carbon emissions.

We know as a large portfolio owner that we need to be at the table solving this problem. So what do we do about existing buildings? Oh, it sort of Clicked ahead but that's okay. So what do we do about existing buildings? To start, I'm going to point out an obvious fact that...well, definitely housing is incredibly diverse. That's why my job is so much fun. Across this portfolio alone, we manage around low-rise town houses, rentals, condos, mid-rise buildings, high-rise towers, buildings constructed in the 1800s and mixed use campuses.

They're new and old. They serve families, elderly households, formerly homeless veterans. I think you can imagine that this is an obvious statement, but there won't be one-size-fits-all solution for de-carbonizing these buildings. And not only do we have to consider different physical components like the images here whether it's brick and block or concrete or stick-built, these properties also present operational nuances behind the skin. Take the property in the Upper-Left corner. Master metered, market rate, expensive utilities outside of Boston and a failing façade; an ideal deep energy retrofit candidate right there.

On the Left, these are town homes in Connecticut. Every resident pays their own utilities with individual in-unit gas, heating and hot water systems. But how do owners and landlords justify the cost of a Retrofit there? The site in the Bottom-Right is also master metered. It's heated with electric strip heat to boot with through-all AC units located outside of Rochester. Like my first example, this one you would think – myself included – it would be a home run. It'd make for a great Retrofit project.

But it's thereby a menial electric provider and pays about 5 cents a kilowatt hour for hydropower. A project won't happen based on energy cost savings alone. Okay. So we clearly have physical and operational nuances to overcome. There are also disconnects socially and in terms of policy. The reality is, most existing building renovations are following level one code minimum compliance requirements who will continue to do so without accelerated market transformation through all the work that we're talking about today technology development, social change, strong policy and new financial solutions. Next Slide.

Because Wind's portfolio consists mostly of affordable housing, I quickly want to speak to how these projects are typically financed. LMI or low or moderate income is primarily funded through housing subsidy programs, including the low-income housing tax credit program. The LIHTC along with how subsidies really drive high-quality affordable housing today.

These types of properties are renovated in accordance with various state-driven requirements typically. They're often ministered and defined in what's called a qualified allocation plan.

Every state we operate in differs, but for the most part existing buildings are expected to follow a course of action that I think all of us are familiar with. Student energy audit. Commit to some level of energy saving if you can and implement upgrades that are practical to do and align with capital needs. That's what we as owners and developers are asked to do. IT's what we're incentivized to do. And that is the normal business-as-usual process for integrating energy efficiency into affordable housing.

And it's also not a – these challenges I've probably been harping on for too long, looking at the time...bring you to the part where I get to reframe challenges and opportunities. And despite maybe my daunting preamble here, I'm extremely optimistic and excited to be collaborating with incredible partners and leaders in our industry to transition from what I would call the business-as-usual to a new, Advanced Building Construction normal. And the time to do so is now.

So next Slide. Wind was Selected by DOE to lead an ABC project focused on transforming affordable housing through deep energy Retrofits. We're working through an integrated performance-driven design process to develop a financeable Retrofit solution consistent with the Rocky Mountain Institute's Realize Initiative for demonstration project in Boston. The project seeks to identify technical, constructive and financeable solutions to developing deepening Retrofits that can be scaled and replicated at the portfolio level.

So Easy as ABC. So our project – so it was on Eva White Apartments, which is located in Boston. Eva White owns, and Boston has the authority today and will undergo a rad conversation effectively privatizing and preserving the community while unlocking capital The project seeking LIHTC financing and plenty of comprehensive renovations; kitchens, bathrooms, common areas, windows, grooves, boilers...you know, the business-as-usual approach.

We think that leveraging that approach in the long-term financing that it unlocks, it's critical for integrating high-performance goals and ABC techniques. So upon being Selected for DOE basically funding, we began fully vetting design strategies to reduce energy use by more than 50 percent in the building. Two primary goals have driven the design process to-date. Firstly, we want to utilize a pre-fab unitized, insulated panel that could be installed simply and quickly, reducing on-site labor and cost

while also improving overall performance.

And secondly, we want to avoid tenant destructions as much as possible; implementing the deep energy Retrofit with residents in place, particularly challenging in the last year-and-a-half. While we're still in schematic design phase and really just pushing now into construction documents, Eva White's initial cost estimate is about \$3 million; we're projecting a model savings of 65-percent reduction in site energy use and \$34,000 in energy cost savings. Next Slide.

Today, we worked through schematic designs and pricing. I'm just showing a little throughput here. But we're advancing from the schematic design to construction-level documents. Like I mentioned, I'm excited to be doing so. As we refine and optimize our conceptual design goals, we've been able to get into much greater detail in design development, which means the hard work is really just starting. After working closely with different panels solutions and manufacturers, we have Selected Tremco's DR Panel with an integrated new PVC Window.

We're working through specific panel details now, including corner connections, attachment possibility, construction tolerances, hairpin SOFIC connection details, duct work integration, window-flashing details just to name a few. Beyond the envelope, full electrification of building systems is also a project goal. The building is currently heated with the gas boiler plant, gas hot water heaters, window AC units in each apartment to provide cooling today.

Our project includes new central equipment, including a VRF, air-to-water heat pump for domestic hot water and central ERV's for ventilation. In order to avoid tenant disruption as much as possible and due to series space constraints inside the apartments, including very low ceilings in small apartments, we're actually reusing some of the existing distribution, including the exhaust duct work. New MEP distribution is going to be installed outside of the existing façade within the new cavity that we'll be creating between the existing and the new skin.

Nothing like this has been done yet in Massachusetts, and we're early-on now in conversations with Boston's inspectional services department among other city agencies to ensure that we're considering and integrating replicable – excuse me, replicable code interpretations that we think will be important for scaling such projects. As I mentioned previously, initial pricing is coming in around 60,000 per apartment, which is not insignificant.

We know cost needs to be compressed, but also expect that early demonstration project such as Eva White will come at a premium. We plan to progress with construction documents through the second half of this year and – fingers crosses – start construction in early '22 pending financing. So stay tuned for more project efforts there. Next Slide. To ensure more projects like Eva White become the norm, we're working closely with the state and federal level evaluating utility incentive programs and thinking through ways in which we can better value non-energy benefits, including the social class of carbon which is just one of many.

In addition to incentives, the LIHTC program that I mentioned before will continue to be critical to supporting affordable housing redevelopment efforts. As such, we're emphasizing the creation of a new deep energy basis adjustment for LIHTC projects pursuing super-low carbon standards. Creating a new basis adjustment will help generate additional capital for affordable housing projects seeking deeper savings.

And I'm confident, I know, that similar creative and impactful funding and valuation efforts will be needed to support market transformation beyond affordable housing. Let's bring the luxury condo developers to the table. So as we work through and learn from Eva White, we're already thinking bigger and more broadly. Demonstration projects need to become normal projects. It won't be easy, but thanks to initiatives like ABC I think we can make Better Buildings the best buildings over the next decade. And I'm excited to I think pass the baton back to Adam for more presentations. Thanks.

Adam Hasz:

Wonderful. Thank you, Christina. I always enjoy talking with you about creative financing with LIHTC. I think the basis adjustment, if you include deep energy Retrofits, is a really interesting idea and hopeful it's something that we will be able to continue to explore together. Next up, I want to turn to Tim Kohut from National Community Renaissance or National Corps. Tim is an AIA-accredited architect and is Director of Sustainable Design with National Community Renaissance. A national developer or builder of affordable housing.

Tim works with design teams, construction teams and subcontractors to understand and implement strategies aimed at high performance and energy efficiency with a current focus on de-carbonization. He is a certified energy analyst, CEA, a home energy rating system – HERS rater – and a building performance institute – BPI-certified – analyst. Tim has spent more than 20 years designing, building and consulting on affordable housing projects throughout Southern California, and he's been involved

in design and construction on more than 2,000 units of high-performance, multi-family housing. Tim, over to you.

Tim Kohut: Thanks, Adam. Can you guys hear me okay?

Adam Hasz: Yes, we can.

Tim Kohut: Great. Thanks. All right. Really quickly, I'll give you a little bit of background of who National Corps is and then talk about a case study project that we're working on right now with the support of a lot of very talented collaborators including RMI. The project is Corona del Ray, one of the projects in our 90-plus project portfolio her in Southern California. Next Slide, please. So National Community Renaissance is a developer/builder of affordable housing. We are the fourth largest in the United States. I think we are the second largest in California. Next Slide.

We developed, you know...we're out there looking for new deals, looking for opportunities to acquire possibly expiring use affordable housing. We have a general contracting team in-house who I work for. And then, next Slide. We manage and we provide supportive services. So we are all-in when it comes to affordable housing. We never walk away from our projects. We are joined at the hip to everything that we do with an increasing focus here in California on Zero Net Energy and now decarbonization. Next Slide.

A couple real quick tidbits about National Corp's commitment to sustainability. We were named a power builder by the US Green Building Council, the only affordable housing builder named to that. We've had it two years in a row, and it demonstrates US GBC's recognition of those who are going above and beyond just building lead-certified buildings. We sort of pushed the envelope with this process, new construction and existing buildings. We are also the first non-architectural entity to sign onto the AIA 2030 commitment which commits to Zero Net energy for all of our buildings newly-constructed, anyway – by 2032. We are closely tracking that, and we use that as a tool basically to push our design teams to higher standards. Next Slide.

Like Christina, we spend a lot of time looking at our existing portfolio. WE benchmarked everything. We are constantly staring at the data. This is a snapshot from We Go Wise, which we use on a daily basis to capture how our buildings are performing. You can see on the Left we are spending, you know, somewhere in the area of \$1.2 million a year on common area electricity, \$700,000 in natural gas. Those are two real big targets for us when we're going through our portfolio and taking about

energy Retrofits. Next Slide.

So the new construction and even, you know, the low-income housing tax credit funding projects, when we do major rehabs, are really easy for us to deal with. But we were challenged by RMI and AEA who came to us with a realized grant initiative funded partially through the State of California. And it's forced us to take another look yet at how we might approach a lot of our vintage buildings in our portfolio. Next Slide.

So this is brand-new to us. And so, I as an architect and somebody who's done a substantial amount of rehab in my career...there is a business-as-usual approach to doing this even when it comes to trying to make the old building new, trying to get insulation into cavities where it isn't trying to update energy systems. Looking at pre-fab was something brand-new and foreign to us and something that we are still adapting to and trying to fully understand.

So the opportunity came to us, and we had studied what had been done in other parts of the world, other parts of the country, and we decided that we would just take a plunge with one of our projects, Corona del Ray. Next Slide. Welcome to Southern California. This is a project in Corona inland, San Bernardino County, East of Los Angeles. This is a 40-building project; 160 units. All fourplexes, two-stories and – as you can see – a flair of probably 1990's vintage post-modernism kind of screaming at you. This is what I would call the Southern California dingbat, and we have a lot of this in our portfolio. Next Slide.

Originally, rehab through low-income housing tax credits in the 1990's way before anybody really cared anything about energy codes, National Corp acquired the project. It was distressed, economically disadvantaged community. And we did just enough rehab to make them habitable. But we were really constrained because there is Asbestos in the exterior stucco. There's Asbestos in the interior drywall. There's Asbestos just about in everything that you would want to touch in this building. But we own it, we operate it. The Asbestos kept the original team from putting insulation into any of the walls or the ceilings.

So even though design heights are going to hit 102, 103 degrees out there, there's no insulation anywhere. Windows are single pane. So I listed a couple of the challenges there and a couple of opportunities, including our push to install rooftop solar State of California is very aggressive right now on funding solar on multi-family affordable housing. That's the rebate program SOMAH.

And we are leveraging about \$20 million going through our entire existing portfolio to drop PV onto existing buildings to make them Zero Net energy and Corona del Ray is one of those. You can see there's a lot of deferred maintenance, things like that, that when we start talking about panelized solutions might really be appealing to us because the alternative is ripping off stucco and re-stuccoing buildings. It's very expensive. Next Slide.

So the two projects that we're – the two buildings that we're actually going to do is part of this grant are Up in the Corner; the Northeast corner of the property. They're all identical. And then, at the same time we're desperately trying to piece together the financing to do Retrofits of the rest of the site. So the goal with these two projects is to do pre-fab insulated panels, pre-fab roofing panels and then a pre-fab HVAC system which I'll show you in just a bit.

And the rest of the site, we're going to try to do what we normally do, which would be drill and fill insulation, patch the stucco, probably don't have enough money to abate the Asbestos. So we'll try to make do with the funding that we can find. Next Slide. So when we look at the case studies on this, we look to Europe to see what's going on. And we realized that what works possibly in the Netherlands doesn't necessarily work in Southern California.

So even though they might look similar in scale, they really are different animals. You know? And ours is wood-framed in stucco, and its pre-size makes – so there's seismic implications to what we do. And we've got to deal with this aging and now deteriorating stucco in other portions of the building. Not necessarily as easy as what we would do if we were in other areas like the Netherlands. Next Slide.

So the panels that we're landing on are going to be a little bit thinner, lighter, easier to attach to a wood frame building. But we hope we're going to help us resolve some issues like, you know, lack of building paper, disintegrating building paper behind the existing stucco now, push the new weather envelop to the face of the building, introduce the insulation, the level of insulation, that is not in the wall and at the same time pre-fab the Retrofit window insulation.

So very light-weight compared to what you see on the right, which is the European model, which are structural panels and really are beefy. But their building stucco can accommodate this much better than ours can in Southern California. Next Slide. Designed to be handled by a couple guys on a couple ladders. You know, the idea is it's a very nimble system and

very lightweight and easily deployed and quickly deployed. Fedderlite does have under development larger panels that might be sort of craned into place but still sort of adjusted by hand. This is what we have in mind for our project. Next Slide.

So this is the transition that we'll see the existing buildings...we will do some demolition. Sadly, we'll lose some of those post-modern features. We'll try to create a new vintage style a little bit more grounded in the 21st century. We'll add the panels and the windows, then we'll install the new panelized roof, and then the last thing is we're going to land a whole lot of rooftop PV on these buildings throughout the neighborhood. Next Slide.

One of the interesting things that we're looking at is, because the buildings are uninsulated, the mechanical cisterns are way oversized. They're 2.5 or 3 times larger than they need to be because the HVAC systems have to make up for the lack of insulation. So we're looking at this pre-fab kit which will be a high-performance HVAC system and has economizer ventilation tied to it. It has a lot of smart controls.

This would sit in front of the building or on the patio, and it would connect to a pre-fab duct system and an indoor air handler. This is another part of a different grant that we're hoping to use in the same project. Next Slide. And this is what that HVAC pod would look like. So we're excited to see this kind of go in concert with the panelized system. And if everything is done correctly, if we can really pull this off and prove that this works, we've got a really great marketplace for doing this in the rest of our portfolio, and maybe some of our projects can start to really turn a corner and really give something back both aesthetically and performance. Next Slide.

And this is what we hope it looks like, you know, in the end. This is what we're hoping to get to at the very end. It'll be slightly out of character with the rest of the neighborhood. We still have to figure out how we're going to tie the aesthetic together with the other 38 buildings, but this is what we hope to see out of the realized grant. Next Slide. One more shot of the front of the building. You know, thankfully we've got talented architects involved. David Baker & Associates is really, really creative with the stuff. Challenges for us.

Low-income housing tax credits are really competitive. Hard to get those funding's. We are 0 for 3 a the last three rounds. If you don't have local funding available, which this city does not have, it's really hard to get those funds. And so, "How do you cobble together your financing to make these things work?" Trying to put together enough incentives and

leveraging those incentives in a way that they work in concert at the same time.

And then, we struggle with things like split incentives. So if we can't recapture the investments in this because the benefits go to our residents and we're left with the gap without being able to recoup that, it's a real challenge. Next Slide. And next Slide. Those are our partners. This is – there's a lot that we want to do going forward, and we're fortunate to have a team of collaborators included AEA, RMA, David Baker & Associates. And there are a myriad of other collaborators behind-the-scenes working with us. Last Slide. Back to you, Adam.

Adam Hasz:

Great. Well, thank you so much, Tim. I really appreciated all of your efforts on the project in Southern California. I think I've learned a lot from what you and RMI and all of the other partners have done in trying to translate the energy response model from the Netherlands to California. You know, there's a lot of things that don't quite translate and then the ways that you've been innovative in trying to figure out how to make that work. So I look forward to the future progress of the project. Finally, we have Lucas Toffoli from RMI.

Lucas is a manager in RMI's carbon-free building **extractives**. He is the Project Lead for the Advanced Building Construction, or ABC, Collaborative, launching with the support of DOE. Previously, Lucas has supported RMI's development of New York State's carbon-neutral buildings roadmap with MBI and NYSERDA. Before joining RMI, Lucas worked for Cummings Properties, a vertically integrated design, build, manage real estate development company in the Boston area. There, he led sustainability in energy efficiency efforts across the **Ferns** portfolio in addition to performing various operational and construction management roles. Lucas, over to you.

Lucas Toffoli:

Great. Thanks so much, Adam. Can you hear me all right?

Adam Hasz:

Yes, we can.

Lucas Toffoli:

Great. So thanks again for the introduction, and thanks to the Better Buildings folks for having us all here today. I'm going to take a step back now and talk a little bit more conceptually. Christine and Tim are hard acts to follow with their great project details. I'm very thankful to have developers and portfolio owners like them at the table as Christina put it. And I'm also honored to be on this panel together with them today. So I'm going to give kind of a quick overview of the ABC Collaborative and what we're trying to accomplish with that.

And then, we'll have some time for discussion with all of us. So what is the ABC Collaborative? Well, what it kind of gets at is that the name of this panel today is Easy as ABC. And that's the vision, but we're not there yet. And so, ABC is trying to enable the action and connect the stakeholders and build on the power of relationships to do what's needed so that we can mainstream ABC so that we can get to that Easy as ABC idea. So our mission is to enable the de-carbonization of the US built environment by bringing together a range of stakeholders across the building sector.

So construction, real estate development and all of the adjacent industries and organizations to that sector and to bring those actors together to drive the uptake and scaling and, again, mainstream adoption of what call ABC, or Advanced Building Construction, which Adam introduced earlier today. And this is both for new construction as well as Retrofit. So we are looking to synergistically address critical challenges that face the construction and Real Estate industries, and that requires systemic change and systemic change requires collective action.

It has a greater chance of success with a wide input and participation from this universe of stakeholders from the demand side, the developers, the owners, owner/operators, the supply side – which is the whole value chain – the research and development side that is providing innovation and innovation pipeline that goes into the market. And then, the market enables who are all the various actors who help to kind of write the rules and write the checks for this building sector.

And the ABC Collaborative is a market facilitation hub that touches all of these and helps to empower connections among them. So what we're going to help do is to help all of these stakeholders see that there is something to gain here for nearly everyone. And that's a good reason for everyone to get involved. With the challenges that the construction and Real Estate industries are facing right now, not doing anything is not really a real option. And so, we're trying to help everyone do something constructively here. We'll also provide some guidance.

We'll aim to accelerate sort of self-sustaining ABC market place, and I'll say a little bit more about that in a moment. Next Slide, please. So fundamentally, our goal for 2050 is shared among a lot of folks here; which is to help meet this need to de-carbonize the built environment and also touch on issues of affordability and resilience while we do that. Which are very big challenges for buildings right now.

To get there, there is a few things that we think need to happen within the next ten years or so. We think that the volume of Net Zero carbon Retrofits needs to grow to somewhere on the order of a few-million per year and that all-new construction starts also need to be zero-carbon. We think that one of the ways to get there is to have this concept of ABC, which includes industrialized construction; make that at least 1/4 of the construction activity in the US.

And we also think that the idea of market transformation and new delivery models – and Christina and Tim touched on those a little bit – are going to be necessary to help unlock the market and streamline a wider volume of projects; really open the floodgates on those. So next Slide, please. So how are we going to do that? It starts with collective action to help address major barriers. So that's kind of the Bottom-Left of this pyramid.

That's this idea of focus collaboration among stakeholders to really agree on, "What are the major challenges? What are the important intervention points," and agree to take Selected action on those. You know, Christine asked the question of, "Why is integrated or integrative design not happening?" And part of the answer to that is to identify the challenges there through this idea of collective action among stakeholders. So one of the ways we do that, or we are starting to do that, is by organizing focused working groups among participants in the Collaborative.

And the idea there is to – again – identify the maker barriers and agree to start to address those together. One of the barriers, for example, is the idea of code interpretation, which Christina also mentioned. And, "Are there ways to create best practices there to educate code officials and things like that to streamline innovative ways of building such as the Retrofit project that Christina's working on. This will also help to bring together these disparate stakeholders who are sometimes competitive and provide a kind of neutral and pre-competitive environment for these folks to work together and eventually to build towards that ABC market place that I mentioned.

On the Bottom-Right, the idea here is informed by this kind of robust network of stakeholders. Make sure that the pipeline of research and development and innovation is actually responsive to real-world industry needs and is responsive to technical challenges and barriers where those exist. And then, help create pathways so that the promising innovations that come out of the research and development side can actually have an impact on the market.

So we're working closely with DOE on that, but there's also a lot of room

for external innovation outside of kind of the DOE system. In the middle part of what we're doing is a set of research and analysis work streams, including with the national Labs that will result in industry guidance to help answer the question, "You know, I want to implement ABC, but I don't know how to do that." And to help make that easier and, again, build towards that Easy as ABC tag line. Finally, as we see more demonstrations that the ABC Collaborative can help to organize and facilitate and work with folks at the Vanguard, including – again – developers and owners who are coming to the table.

There will be more experience and more confidence in ABC sort of increasing familiarity with that. That'll also help to bring cost down, help to bring more capital into it and eventually lead to a kind of self-sustaining market place that will early-on get a nice push from us in the form of kind of tailored matchmaking and the support of transacting in the ABC space. So that's just a quick overview, and I encourage you to ask more questions about that. Next Slide, please. I think that's all from me. Thanks very much and go ahead and visit our Website. Back to you, Adam.

Adam Hasz:

Wonderful. Thank you so much, Lucas. It's been a real joy working with you and in the broader ABC Collaborative team. Over the last year or so, we've actually built and launched the new institution. And now, we're going to transition into a Q&A. So I would ask the panelists to please turn on their cameras again. Thank you, Christina and Tim. And we will start with a couple questions I have prepared. Again. If you'd like to ask questions, please go to [slido.com](https://www.slido.com), enter the #doe and Select the Easy as ABC room to join the conversation. I've already got some great questions there. You still have time to contribute your questions.

We're going to spend most of the rest of the session asking and answering those questions. So please go to [slido.com](https://www.slido.com) and enter your questions. So to start with, I have a question that's pretty simple but can be a broad range of answers. And it's for all the panelists. How do you think – well, what do you think is the most exciting part of Advanced Building Construction? What do you see as the most exciting part of the potential for how ABC solutions can change the construction market? And, Christina, let's start with you.

Christina McPike:

Uh-oh. I think these were supposed to be softballs. I don't know which one to pick. I'm in general really excited these days. And by these days, I mean maybe the last year or so. I'm just seeing leadership and innovation coming from every angle; federally, state, city, other owners, collaborators. You know, the working groups in the Collaborative that Lucas talked about. I think these problems or challenges brings together

people that aren't, you know, hypothesizing or talking theoretical's. Right?

Like, we're doers. And we are kind of done talking about it. Right? And we want to go and do it now. And so, that's really exciting. And I'm not ignoring that there are barriers to actually go and do it. It's really difficult. Even experienced owners and developers like Tim and my colleagues at Wind are facing barriers. But I'm very encouraged to see the doers coming together with a shared vision and initiative and appropriate leadership from various sectors; for-profit, nonprofit, really across the board. And I think that's kind of the magic sauce to really go and get the job done. That and it helps to have climate change policy coming out of the White House. So happy about that too.

Adam Hasz: Yeah. That last one has been a really, really great change for my work at DOE. Tim, let's go to you. What are you most excited about by the potential for ABC approaches?

Tim Kohut: I think the swiftness of how things are – how quickly things are happening is really exciting and sometimes difficult to manage. Five years ago, conversations about electrification would just have resulted in people shaking their heads and saying, "Really good idea. We don't know how to get there. You know, a whole lot of rooftop solar." And what we've seen here – at least in California where we are – is the advance of heat pump technologies for heating hot water, especially in multi-family buildings...have been a game-changer.

And when you tie that to rooftop solar, then it doesn't make economic sense not to electrify your buildings if you're looking at long-term economics. So when you tie all of this together and now you go back to like these business-as-usual solutions that we're all talking about, we tend to fall back to the business-as-usual because it's comfortable, it's predictable, we know how to deal with it. Seeing how quickly the business-as-usual solutions can change. Like, we are excited about panelized.

But right now, it's not pricing. Like, when we get there, the guys are there, the early-adapters– we look at it and just like, "Yeah. we're so damn close. Why don't we just tear the damn building down and start over?" And that's because the market place hasn't really been juiced enough yet to get more people into this and have. Other people do it. If we do it in a couple of projects, these grant opportunities we think are really terrific.

'Cause if you can start to tie all that together now, if you look at the cost of like renewable's – even though they continue to drop and make the case

for this – if you really start looking at the cost of Retrofit, as RMI has been doing for years, the cost to Retrofit building systems and energy envelope is much smaller than the renewable energy systems. Renewable energy systems are the easiest thing to do because you just strap them on the roof, you plug them into the grid and you try to optimize everything else. Let's put it all together and start tying it to these pre-fab ideas and really trying to transition that sort of part of the industry. That's what I'm most excited about. And I think we'll see a real tilt in this in the next five years.

Adam Hasz:

That's great. Thank you, Tim. And I completely agree. The electrification shift, which has really taken off in the building sectors, is very exciting. And if we compare that with some solutions like panelized envelope Retrofits and on-site PD or even community solar, I think there's huge potential to de-carbonize the buildings very quickly. Lucas, let's finish up with you for this question. What are you most excited about for Advanced Building Construction?

Lucas Toffoli:

Thanks, Adam. And thanks, Christina and Tim. Great, great answers there. You know, Tim, I appreciate the plug on efficiency. In my mind, and others have said this, efficiency is the original renewable. You know? What's more renewable than not using energy? And so, I think as the grid becomes more electrified and as renewable generation becomes less expensive, we also have to not lose sight of the power of efficiency. To answer your question, Adam, I think what's most exciting to me – and I'll take this at a high level again as I did with my presentation – is the idea of ABC being kind of applying the concept of integrative design.

And that's really what RMI was founded on. Integrative design is the idea of addressing many different pieces together to end up with something that's greater than the sum of its parts and having interventions, each of which provide multiple benefits. I think that there's a question here about – in the Slido about social equity and racial justice. I think that's part and parcel of ABC necessarily because we're addressing issues like, you know, resilience, affordability, better options for marginalized communities.

And from a kind of design perspective, what we're trying to do here is come up with solutions that are effective for the buildings, effective technically but also effective in driving positive market transformation that is supportive of a vibrant, domestic construction and manufacturing sector that's supportive of innovation and, again, that's supportive of availability of affordable housing and of Better Buildings or best buildings, as Christina put it. So that's what's really exciting to me, is all of these pieces coming together. And there's a lot of work that needs to be

done, but that also means that there's opportunity for everyone to benefit from this and to be part of doing that work.

Adam Hasz: Wonderful. Thank you, Lucas. Joe, this was alluded to you a little bit by Christina and Tim. But the next question involves the challenges to the ABC approach. And so, this again of course is for everybody. What do you see as the biggest barriers to developing the ABC market or ABC solutions? And, Christina, we'll start with you.

Christina McPike: I mean, I hate to be kind of predictable here but cost and cost and cost. So it's just expensive. The construction industry is building buildings the same way today that they did for the most part 100 years ago. And Retrofitting existing buildings has competing needs and priorities. Right? So really marrying up – and I appreciate RMI's approach and philosophy around the sort of holistic planning. But somehow, you know, an affordable housing crisis and a climate change crisis are talking different; which is competing for resources.

And those resources – when I say resources, I mean subsidies and money...they're not talking the same language. And that's a big barrier that we have to overcome and figure out. We don't have the answer yet. But obviously, more projects, more demonstration projects, more proof of concepts, more manufacturers in the space, more technologies that work in cold climates and more technologies that are for low-rise and high-rise buildings and so forth.

All of that is going to be in the cost-down. We need significant workforce development. You know, I can call eight contractors in Massachusetts, and maybe only one of them has time enough to look at what I'm talking about; whether or not what they understand what I'm talking about is another question altogether. So all of these kinds of problems roll up into cost. If you don't have an adequate workforce, you're paying the premium. If you don't have the technology and you're trying to sort of fit a square peg in a round hole, you're going to pay more to do that.

If you've got housing dollars trying to create affordable housing – which we need more today than ever – that doesn't really prioritize using that money for high-efficiency improvements and outcomes, you're competing with those needs. So this sort of misalignment of needs and I think missed opportunities sort of undervalued outcomes is the barrier and the barrier that I think us owners and these industry players need to be thinking about. Even more so than R&D and product solution development.

Adam Hasz: Thank you for that very thoughtful answer. And know that we are working a lot of those challenges that you named. Some in partnership with your ABC work. But, yes, there's a lot of different pieces to solve that way to the high cost we're seeing now. So actually implementing these solutions. So, Tim, let's go to you. What do you see as the biggest challenges to implementing ABC solutions?

Tim Kohut: Well, Christina covered a lot of ground. and she alluded to, you know, problems in workforce development and technology and pricing. But, you know, for me I think that the biggest challenge is trying to negotiate the split incentives. You know, because what we own – and the Slide that I have, we have \$1.2 million worth of common electricity spent; doesn't talk about what our residents pay for electricity.

So for me to go into Corona del Ray and do this project, I've got to cobble together the subsidies to go in and help people because I'm not allowed to touch – under current California regulations, I'm not allowed to touch the utility allowance published by the housing authority. Which in Corona is somewhere in the area of \$125 to \$150 per unit. And strapping on a lot of insulation on the exterior of the envelope and onto the roof and then throwing in a PV system...we'll get their utility bills down to \$10 a month; the metering fee.

But the rent needs to be maintained so that the \$750 unit also allows for \$150 utility allowance. So we're only allowed to charge \$600. So I can't tap into that, so there's no incentive for us financially. The economics drive everything that we do. And I can do Z&E, all-electric, carbon-neutral, new construction until the cows come home because I can sell that and wire it in, and I can get the utility allowance down to \$10 a month, which allows us to buy more stuff.

I can't do that with existing buildings. And that is a real frustration because in the midst of this, now you have this great divide; the people who are living in the newly-constructed Zero Net energy houses will have their energy costs fixed for 30 years. I mean, if you get to see any...they're going to be paying \$10 a month, the sun's going to shine and they're going to get a lot of benefit from that.

But the people who are tied to these vintage projects, you can't go and do the efficiency upgrades because there's not enough incentive to allow you to do that and reap a payback because you can't adjust the utility allowances. That is the biggest obstacle. And I think everybody we talk to, whenever we're talking to something, I'm like, "Do you want to change one thing? Let's change the regulations when it comes to Zero Net Energy

and the utility allowances. Allow us to adjust those and really reap the benefits of investing in those things that are going to help our residents and get their builds down to \$10 a month.

Adam Hasz:

Thanks, Tim. Really insightful answer. And I'll add that in the Netherlands where you referenced the energiesprong program, they did exactly that. They were able to transform their regulations in order to include the payback of the installed technologies in the rental payment. And they get a single rental payment rather than a separate rent and energy. And so, that was how they were able to get around it and finance a lot of the upfront cost for the solutions. So I hope that we can all work together to figure out from our state and federal regulations how to encourage that type of creativity and allow for those benefits to go to residents of these buildings that could really use the upgrades. So, Lucas, let's wrap up with you this question. What do you think are the biggest barriers to advancing ABC?

Lucas Toffoli:

Thanks, Adam. I'm going to build on some things that both Christina and Tim said, which is this idea of excitement around these new solutions around doing things differently but a need to align, a need to take what are sometimes competing interests or competition for resources and try to reconcile those. To Tim's point, there is these competing interests of tenants and tenant rights organizations who may be resistant to a change in the utility allowance regulation because in the past attempts to make changes to those kinds of ostensibly protective regulations have been a way to exploit vulnerable residents.

But of course, what Tim is trying to do is completely the opposite of that. He's trying to save them money and give them greater certainty in utility costs as well as creating better buildings, giving them better comfort, air quality and that sort of thing. So bringing together and reconciling that points-of-view – that's just one example, is the kind of major challenge in my mind. You know, there's room for different approaches for trying different things. But at the end of the day, we need to be kind of rowing to the kind of overall having unified ultimate goals.

And the ABC Collaborative is trying to be a part of doing that; of aligning those goals, aligning those strategies and putting stakeholders in the same room who maybe normally wouldn't be in the same room so that they can actually have those conversations. I think another challenge, which I don't have time to get into...but is the idea of value versus cost and, "What does cost-effectiveness mean? And are there ways to capture the additional value that ABC provides beyond just fewer dollars on your utility bill?" I think there's a lot of opportunity there, but it's a complicated question that touches on a lot of different things.

Adam Hasz: Great. Thank you, Lucas, for that very thoughtful answer. So turning to some of the questions we've got from the audience, the first question looks like it can be answered by all the panelists. How do you think state and local governments can best support the development of an ABC market in the ABC industry? So I'll let whoever wants to answer first enter.

Lucas Toffoli: I have a general response and then I'll let Tim and Christina probably speak to their more specific experience. But one thing that we've heard a lot is, it takes a full-time job or more just to navigate all of the different opportunities between tax credits, utility incentives and gap funding...whatever might be available in a particular jurisdiction. And so, I think – again, coming back to the idea of alignment – having more clarity and more simplicity in those funding opportunities so that it's a bigger pool of dollars that can be more easily accessed for the projects that are really going to make a difference. To me, that would be a great point of intervention at the state and local level.

Adam Hasz: Thanks, Lucas. And, Tim, you wanted to say something? And then, Christina, it sounds like you want to say something too?

Tim Kohut: I think the key is, you know, whether it's – at the federal level, I think they're talking about this...I've heard discussion about this at treasury level. Like, trying to come up with some pool of funding that could be fused into the market place to help with initiatives like this. If we're really going to cut our CO2 emissions by 50 percent before 2030, you've got to be able to unlock the funding for this. So at state level, it'd be great if there were – you know, if it's a bond measure or if there are other funds available.

Because at least in California right now, there's such a scarcity to build new construction with the desperately-needed new affordable housin. Not many people are thinking about how you go back and actually create a little bit of equity with the vintage buildings that are making up probably 95-percent of the affordable housing stock in most stats. Unlocking that and then, "Hey. We don't want this for free. We'll pay you back very low interest rates. You know, we'll do more than residual receipts if we need to."

But the end of the road for us is, you know, we don't get our low-income housing tax credits. We don't compete. There's no local funding for it. And now, we're just cobbling together what we can do to fix the plumbing, putting in new kitchen cabinets and paint the building. And then, the families get to live in those buildings for the next 50 years. And I know on

a 105-degree today that it's going to be 90 degrees when you sit next to the wall or the window because there wasn't any money to allow us to put in any insulation in the walls or improve the HVAC systems. And that is about equity. It's about job creation. And it's about really – if you want to hit these targets, it's all about unlocking more access to funding.

Adam Hasz:

Thanks, Tim. And I'll note quickly that our secretary as well as President Biden has been championing money for affordable housing and energy upgrades as part of the proposed American jobs plan. And so, those that want to look that up and contact your representatives and senators in support of that, that is certainly something that folks can do. So, Christina, let's follow with you. What do you think states and local governments can do to help advance ABC?

Christina McPike:

Yeah. I think a focus on new resources, creative financing like Tim was saying is the key. And it can't really be existing housing subsidy. We can't overly rely on housing dollars. We need energy and carbon money – right – to do these kinds of projects. I don't think Tim was exaggerating when these projects are barely able to fix up a 40-year-old kitchen and bathroom and fix a crack in a facade. So to ask owners to think about that type of renovation and then Zero Net renovation – I mean, it is like night-and-day. And without aligning and bringing resources together that are really going to pull the industry in that way, it's I think going to be stuck where it is. I will say there is power in policy. I can't sit here and advocate for unfunded mandates.

But carbon emissions, ordinances and requirements of cities like Boston and New York City and DC and filling elsewhere I think have the potential to really move the needle in states similarly implementing more stringent standards and mandates for reporting energy usage and actually doing something about it. Inevitably, that's going to push the market in one direction. We just cannot support mandates without resources to get them done; particularly for affordable housing with restricted or limited or no cashflow and limited replacement reserves and so forth. So there's really great ideas behind some smart policy, but we need to back it up with the financial resources to get it done.

Adam Hasz:

Great. Thanks, Christina. So a question that is related but is a little bit more forward-looking. How do you see these projects eventually getting to the point where they don't need subsidies to be financially liable? What's the pathway for market development such that we could make this cost-effective potentially even without subsidies? And I know I've talked with Lucas quite a bit about this, and I know Christina and Tim have talked quite a bit about this as well. But anybody is welcome to answer.

Tim Kohut:

Yeah. I'll jump in. You know, what we see in California right now where Zero Net energy is built into the energy codes, it goes back to AB32 and state goals to hit our carbon reduction policies. We've hit those goals and gone beyond it. And now, – what I said earlier – doesn't make sense not to go Z&E if you're looking at the long-term cost of electricity. We hit grid parity; the cost of which point it's cheaper to buy the electricity from your roof than it does from the grid.

We hit that about three years ago in California, and it's not California interstate commerce that works everywhere where the sun is shining. So when that happens and you see this transformation and it is driven by capitalism and the market place...when this starts to happen, you really see a shift. So what we need to see is, you know, ten years ago a rooftop solar was probably pricing at \$4, \$4.50 a watt. And now, we just bought a project under \$2 a watt. It's crazy.

If we can get enough of this going on – if the federal government, if we can really build this into infrastructure and say affordable housing and existing housing stock is part of the infrastructure – if we can wire this in there and do the job creation that Christina alluded to, now you can really start to get this out in volume, get people competing against each other. And in five years, you could really see the cost driving down. And then, why would I ever consider demolishing and replacing my stucco when I could do a façade Retrofit with pre-fab? Why would I do a re-roof and drill-and-fill if I could do that?

Now I've got an option other than what's available, which is a 10 to 15-year solution. And then, I've got to think about another rehab. What if I can get to the 30-year solution and the price drives me in that direction? That's where I think this is going to change, when we get more of this happening. But it's going to come from, if they really want to encourage innovation, they've got subsidize innovation. And it's not just, "How are we going to pull carbon out of the atmosphere?" It's also, "How are we going to do deep energy Retrofits to keep the carbon from going into the atmosphere in the first place?" And that's precisely what we're talking about here.

Adam Hasz:

Great answer, Tim.

Christina McPike:

I can't add anything. I mean, that was a perfect answer. Yeah. I think I just want to keep reminding people...and the more that we can integrate health and equity into the conversation as additional values doing these types of projects and being able to afford and pay your energy bills every

month...like, that needs to be part of the conversation. Carbon is important. Cost is important. But the social justice piece of improving the places where we spend all of our time – not just in COVID but buildings where we work and the buildings where we live, they're maybe one and the same. It's a human right question that we need to pull up to priority number one down from where it is now.

Adam Hasz: Thanks, Christina.

Lucas Toffoli: Yeah. Great answers, Tim and Christina. You know, to Tim's point I think something along the lines of – you know, it doesn't need to be subsidized forever, but robust feed and tariff or that kind of an analogue to that has been very successful in other industries; most recently in solar. And, Tim, I used to do solar kind of small to mid-commercial scale when I was back in the Boston area where the sun doesn't shine quite as much, and I can tell you that the last project that I did – which was a few years ago in that job – was less than the number...actually, quite a bit less than the number that you just said in terms of cost per watts.

So those numbers for solar have come down so far. I think there's the opportunity for something similar to happen with deep energy Retrofits and also with some high-performance new construction. And to Christina's point about capturing other value, health and equity, obviously I has tremendous traditional value to people who are experiencing it. But it also has additional value to other actors in the market place to help insurance companies, Medicare, Medicaid if you are decreasing the amount of respiratory issues because you're dealing with indoor air quality; things like that. That has real value.

And the CMS centers for Medicare and Medicaid have a lot of experience finding ways to incentivize and capture behaviors that help. And I think some of that can be carried over and connected to the building space. I saw a Comment in the Chat about resilience. You know, you think about what happened in Texas recently and what's happened elsewhere.

You think about the lifetime of the building, most buildings are going to – in their lifetime are going to run into at least one pretty severe event where having the building be higher-performing and built better is going to result in much better outcomes there. And yet, that kind of value is not captured when you're thinking about, "What am I going to get for the cost of this Retrofit or for the cost of this high performance?" So I think that those factors will help to kind of narrow that gap in terms of getting us to not leaving subsidies.

Adam Hasz: Great. Thank you, Lucas. And one more quick question before we wrap up. It's a question asking, "How do you include tenants or particularly users in your planning for this project?" So, Christina or Tim, do you want to comment on that very quickly?

Christina McPike: Yeah. I mean, it's a great question and something that I think there's probably room for improvement. You know, the RAD program actually has some pretty useful guidance and requirements related to tenant involvement and resident feedback. The Eva White Project is actually not a Wind-owned project. This is a tenant organization nonprofit that will be the majority owner of the project. So Wind is supporting them in the acquisition and rehab of that building. And that's something that we've done on a couple of occasions. At Eva White, we've actually been working with the tenant organization.

We did one-on-one interviews and surveyed every resident who lives in the building today to understand what their priorities are, what concerns they have, what they want to see out of the rehab, "How do they think about energy today? Do they think about energy today? What temperature do they think is comfortable, and what do they think their apartment is today?" There's no thermostats. There's no controls. It's just, the heat's on September 15h and turns off on June 15th. Right?

So we've been collecting a lot of information like that and seeking feedback so that we can try to integrate their priorities and goals into our project planning and ultimately in the rehab when you're in someone's apartment for eight days in a row and changing a community that's looked the same for the last 50 years, it's very important to have the person who lives there and is actually going to be operating your energy pod every day understand what it is that you're doing. So that's kind of a unique aspect of our ABC project and something that I'm really excited to replicate at our future projects. But I will say I think it's not gone or thought about enough in the cog of three to five-year planning process for affordable housing projects.

Adam Hasz: Thanks for those insights, Christina. Tim, do you have anything quick to add?

Tim Kohut: Yeah. I'll make it quick. The feedback loop for us...you know, because we own so many properties, always starts with the last project that we finished. Because in most cases –at least for new construction – we don't know those people yet – but we're constantly instrumenting our buildings to figure out what's working. Where we fall short is getting enough information back from the tenants. So we're actually working on some

pilot projects now to kind of reach out and use our resident service component to get feedback from our residents, "How well is this working for them?"

We feel that if we focus on energy efficiency and drive down the cost of utilities, make it more affordable for them in everything that we do, that there's not a whole lot of room for opportunity for buy-in for the residents. Yeah, they're going to heat with gas or heat pump, hot water heater. "I don't care as long as my bill is low."

Where we do get feedback and want feedback is, "What else can we do? Can we electrify transportation? Should we be doing bike share at our projects? How can we connect to regional transit? What other resources can we connect to?" Those are the information loops that we really like to close, and it's all tied together. The front-end stuff is really trying to go out there and trying to keep the energy out of your building in the first place, lower the cost and then build from there.

Adam Hasz: Thanks, Tim. Lucas, do you have any final thoughts on this question?

Lucas Toffoli: Just going to give a quick one. Which is that I think obviously collecting that feedback is really important I think. Regardless of how much of that you do, you're always going to learn by doing. And to me, that really emphasize the importance of demonstration projects and of this idea that is fundamental to industrialized construction, for example, of having a robust and active feedback loop that then ties back to your design or engineering; your connections with your installers and experienced field staff who are actually going to be doing the work in place and having that feedback loop just from a conceptual process design level is fundamental and, again, is well-informed by having real-world demonstrations and having those demonstrations being supported by folks like DOE and others.

Adam Hasz: Wonderful. Well, thank you all for being on this panel. I learned a lot from listening to your insights. And really appreciate your time and generous contributions. So let's go to the final Slides to wrap up this session. So for some additional resources, you can go to the Advanced Building Construction Initiative Website listed here as well as the Advanced Building Construction Collaborative Website. We will Send out – let's say it's for Wind companies and National Community Renaissance as well. And everybody's E-mail is at the end.

So if you want to follow up with any of our panelists, you will have the opportunity to once the Slides are distributed. Next Slide. Want to highlight that there's going to be a great Summer Webinar series from

Better Buildings. And everything from electrification to financing to waste reduction to workplace evolution in the age of COVID or post-COVID and really encourage everybody to sign up for these. There's going to be a lot of great information presented, and I hope that you can participate.

And finally, everyone's contact information is located here. I want to thank everybody to joining this session on Advanced Building Construction; Easy as ABC. We hope that you will join the broader Advanced Building Construction community. There's lots of opportunities to engage; whether it's from the Department of Energy, from the Advanced Building Construction Collaborative or supporting real-world projects such as the ones that Christina and Tim presented today. And we really need everybody here to come together to make this transformation happen.

As we said, this is so important from a carbon standpoint, from an equity standpoint, from a health standpoint, from a construction productivity, economic competitive standpoint. All of these things really come together for Advanced Building Construction, and I look forward to working with all of you to make it happen. So thank you again for attending this session. Thank you to Christina, Tim and Lucas for being panelists. And please stay in touch. Our confirmation's here. And please enjoy the rest of the Better Building Summit. Thank you, everyone.

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