**Sarah Gray:** Great. Welcome everyone. Thanks for inviting me to this session.

We're gonna have a conversation today. Again, questions at the end, but my slides will be basically I would like to say maybe nothing new to this crowd. I think we're all on the same team, so to speak. We want to engage with energy efficiency work, hence the name Efficiency Canada.

And I expect a lot of us are working in the deep retrofit sector for existing buildings. I've attended a few of these sessions over the course of the last couple of years, and we were provided with a list of sort of similar presentations. So our goal today is not to rehash what you may already know regarding deep retrofits, but we wanna talk about these common approaches and unique challenges.

We have some case studies, but I'm not gonna go through all of the gory detail. We did this and this at all of these buildings. But we're rolling up these lessons learned to again, spur some conversation, maybe communicate some new tips and tricks, that sort of thing.

Looking forward to some great q and a following a few slides that I do have. So given that hopefully we're all engaged in the same space, I think that we could probably all agree that every building and existing building needs a deep retrofit plan. We have many thousands, millions of square feet of existing building here in Canada and certainly in North America.

That has a lot of embodied carbon that we want to realize and not throw away, but there's a lot of operational carbon and greenhouse gas emissions. Emitting from these existing buildings that should be mitigated, reduced, or potentially even eliminated with clean fuels, as we could attest.

So with that hopefully some folks on this call have worked with existing building owners to create these retrofit plants from RDH's experience. We have worked with several ownership groups and government levels to create retrofit plans at both the single building level and also at the portfolio level where we bring more scale to thinking about existing retrofits so that we can really pull a big lever in reducing greenhouse gas emissions.

Most folks may be familiar with this graphic that was published by the Rocky Mountain Institute and their Zero Over Time guideline. It provides this really clear process, 1, 2, 3, 4, 5, and 6, which is a great roadmap to creating and implementing a deep retrofit on an existing building or portfolio of buildings.

Steps one, two, and three are that planning stage, understanding the goals that the building owner or portfolio owner would like to achieve in terms of greenhouse gas emissions or other improvements associated with a retrofit, baselining, the existing building or buildings and then planning the projects to either happen in the short, medium, or maybe even the longer term, depending on the age and condition of the building.

And then step five is where the meat hits the road, or the pedal hits the metal. Whatever metaphor you wanna use in really doing the projects. That's where we all get really excited and after those projects are done, then we can move to step six in tracking the project progress and the reductions of energy or carbon use.

Today I'm not gonna talk about renewables, generation, or storage. I'm sure that there are other experts that can speak to that topic quite well. I mentioned one of the first steps after communicating and documenting goals for a deep retrofit project, and that's really the baseline building assessment for any folks that have started to look at retrofit plans.

Hopefully you've implemented this and are familiar with these steps where we wanna take existing building documentation such as the original construction drawings or architectural drawings looking at previous condition reports or maybe energy audits and understanding the current state of the building.

That work may also include or should include a visual review of the building elements, including the mechanical systems and the building enclosure systems. And we also may, depending on location of building, want a look at the structural and seismic condition of the building because when we do deep retrofits, those can also facilitate any seismic strengthening or seismic retrofit that may need to be done.

And beyond the physical building condition, we certainly wanna analyze the utility or energy data for the existing systems. How efficiently are the mechanical electrical systems running? What kind of use, is it in line with similar buildings of a similar age? Is it way high, is it way low? Just understanding the building as it's operating in its current state.

So that's the baseline assessment. From there RDH has found that there's typically a formula for the deep retrofit plan, regardless of building or location. Of course, there are custom pieces, depending on repairs that have already been done or systems that are in place. But the formula for the deep retrofit is typically as followed.

We find that we typically need to retrofit the building envelope as one of two first steps because if we improve insulation values, reduce air leakage through the windows and wall systems we can reduce the loads that the mechanical systems have to supply. So this building envelope work is pretty hefty, but it's addressing the passive system to enable a better performing mechanical system or a more efficient mechanical system.

So that's the next piece is looking at energy efficiency measures, which could include LED lighting. Tweaks or optimization of the heating and cooling system and looking at ventilation that's currently provided. As part of a smaller scale retrofit, we could recommission those systems to perform better using the current equipment. That could be a short term step on the road to a deep retrofit.

The big step, however, as most of you could appreciate, is decarbonizing the fuel system. So that's what we typically call a fuel switch from gas, a natural gas or oil, even to an electrified system. Owing that some grids in Canada are still quite dirty and hopefully there are plans in place in those jurisdictions to make the grid cleaner.

Ultimately, we expect that many or most systems, depending on location, will get fuel switched. You may have seen ground source heat pump, air source heat pump, VRF systems or other, high efficiency, typically electric systems to get us off the gas, reduce those greenhouse gas emissions.

So that's the bundle of systems. I mentioned renewable energy, we won't go in depth today, but really the point of renewable energy is, one, a resilience measure. If we're generating electricity at the site, we're not dependent on what's going on at the grid or other systems, and we can also further offset our greenhouse gas emissions or energy use by generating our own electricity on site.

And then the final piece of some deep retrofits, again, depending on all of the other four buckets is to purchase offsets to get to a net zero carbon, net zero greenhouse gas condition. Okay? So hopefully that gives you a very high level view of what a deep retrofit plan typically consists of at a high level.

Drilling down a bit for enclosure, building envelope retrofit options. Again, as I mentioned in that first bucket, we're looking at the cladding, which typically means an over clad to provide more insulation. It could be a full cladding replacement where all of the existing cladding is removed, stripped down to bare bones and reinstalled with a high performance system, and there may be some thermal bridges such as balcony slabs or exposed floor slab edges that need to get over insulated to reduce those thermal bridges. Windows, if we have a fairly good window system, we could string those along a little bit by adding weather stripping or sealing. But ultimately, we expect that windows would need to get replaced with a double or triple pane IGU system or even quad pane glazing.

In some far north climates that are more severe jurisdictions are starting to allow fiberglass frame windows that provide a bit more performance than aluminum frame systems do. And certainly there are passive house window systems that are coming to market. A bit tricky, getting those from Europe up to here. But we certainly do know of projects that are using passive house rated windows systems.

Roofing typically would be dealt with at the end of service life and typically looking at adding insulation to the field of the roof to provide better performance. That approach does depend on whether the building form. If we have a tall, skinny building with a fairly small roof, it may not make sense to add insulation to the roof. So that's one of the pieces that we'll wanna assess during our information gathering step of the retrofit plan.

Underground parking garages. Typically we wanna look to insulate the soffit or ceiling space under the occupied building footprint. You typically see that in new construction, but older construction may not have that insulation.

With all of those pieces, there are many considerations. I won't talk through all of those, but you can see those on the far right hand side. We also need to think about fresh air supply when we are retrofitting the building envelope. Why is that? Because with an older leaky building, we're getting free ventilation or free infiltration exfiltration, but as we tighten up that building envelope with a new air barrier and cladding, we're taking away that free ventilation and we need to add it back mechanically.

Speaking of which, mechanical electrical retrofits that we typically see. Again, not every step or every feature for every building, but this is typically what we're seeing and hopefully you guys do too. Again, for heating, we're switching from electrical resistance or natural gas fire to an electrified heat pump that has better controls to help that system run more efficiently. And thinking about domestic hot water and how we can recover the heat from the drain water to preheat a hydraulic heating system.

In terms of cooling, we find that many older residential apartment buildings in Canada do not currently have cooling. That's true. Across the board from the Atlantic, Canada to the buildings I work with in Ontario and also buildings out west, they just don't have cooling in. Because our summers are getting hotter, more intense and unfortunately with Alberta dealing with wildfires and British Columbia in the pus, you can't always open your windows for free cooling and ventilation. So that's triggering. The addition of cooling in many situations, we talked about ventilation and fresh air. Certainly those pieces should have recovery energy or heat recovery to make those more efficient.

We're also finding that many older buildings need a full electrical service system capacity upgrade at either the building level and/or the utility transformer level. Which is a major piece of the puzzle and one of those implementing, enabling measures that will need to get done if we're adding electrical load at the building. And we talked about some energy efficient measures.

So let's talk about that typical retrofit package, rolling that all up together. The first three bullets are that building envelope retrofit package. The next is space heating, switching to probably a heat pump type system or possibly other options depending on the specific building case.

Looking at domestic hot water, again, moving to eventually a heat pump system, possibly with a solar heat preheat system depending on the jurisdiction. We talked about drain water recovery. And then that ventilation upgrade in suite or central HRV or ERVs control upgrade as well, and that solar piece. So as that package is put together for the building, there may be various timing changes.

You may not do those first three enclosure bullets first. Maybe your envelope is okay, maybe you're gonna address space heating and drill cooling first because the boilers are 30 years old and are 80% efficient and those need to get dealt with from a service, life and efficiency point of view first. There are a lot of options and it's a team effort to work with the consultant team and also the ownership and building management team to create a plan, an order of plan implementation that makes sense for the particular building. So I 'm not drilling into specifics further on this, I could give you oodles and oodles of examples. I think all of us may have a picture of generally what these pieces mean.

I think we could all agree as well, that the ultimate goal is that we conduct not only a retrofitted scale, but we would have panelized over clad at scale. We would have off the shelf mechanical systems at scale that we can plug in. Maybe even part of this cladding overfit. This is a photo from the Energy Sprung website.

We have not yet, we, meaning RDH specifically, have not implemented a panelized overhead over clad at scale yet. I wanna congratulate Ottawa Community Housing. If any folks from OCH are on the line, they are starting to really look at this and implement this. They have a great case study of a townhouse lowrise site.

Where they had site-built wood frame to panel cladding that they provided onto the walls at their existing building while residents were remaining in place. Which is an important feature of this. But as I will explain, and you can see at these photos, there is not a one size fit all panel over cladding approach for every building.

The two photos on the left are two projects in British Columbia that RDH is working on. We are within, or almost at the end of the design stage for both of these buildings. These are exposed, concrete, clad, sort of brutalist brutes, if you will. With many service life renewals coming up. So we've created a retrofit plan and we're starting that design process, and we'll talk about some of our lessons learned on those two projects.

So they look fairly ripe for panelization, but as our team design team dug into the details, there are a lot of unique pieces of the building that did not facilitate a simple panel over clad approach for these particular buildings. Not to say that it's not possible, which just wasn't possible or efficient at this point in time with the maturity and progress of the deep retrofit market here in Canada.

The two buildings on the right hand side are certainly lower rise, three or four story apartment buildings. Again, have a lot of service life replacements that need to happen. We're working with them to develop the strategy. There are a lot of repeating elements. You can look at those photos and visualize how we could panelize the system.

However, there are a lot of other moving parts on these buildings, and it's particularly for a low rise right now. Right now panel over clad is not as efficient of a system. So we're anxious to hear more lessons learned from other partners here in Canada and certainly the European partners that do have some experience.

As I mentioned, one of our lessons learned here is that one approach for retrofit does not fit all buildings and. Why not? That's the question that we all like answers to. First is location. Canada is a big country, many climate zones. The deep retrofit approach needs to consider climate.

 Is it a very cold climate? Is it more temperate, such as lower mainland BC? Do we have seismic issues that need to be addressed? For example, in British Columbia or even in the Ottawa market that need to be layered into our deep retrofit plan and the electrical grid mix now and in the future, as I mentioned. And then certainly, does the building itself have electrical system capacity?

Then zooming into the site itself, how is the building located? We're finding in Toronto and bigger cities, many of our older residences, mid-rise or high rise are on, very tight sites, which is great for urban density and a rationale for retrofitting our buildings.

But we have a situation where it's very difficult to add insulation to the outside without triggering site plan approval, zoning bylaw amendments, other sort of jurisdictional approvals that need to be made. Not to say that we can't go through those jurisdictional hoops, and in some cases we are going through those. It's just another layer of complexity to these deep retrofits.

The building form is also a consideration for the approach. Is it a flat box, lowrise, midrise or highrise that may lend itself to an at scale panelized cladding approach or does the facade have a high level of intricacy that really necessitates a bespoke manual sort of hands-on retrofit approach?

And then of course, we have funding and incentive demands and requirements. I know that the CIB has been to some of these sessions. I'm not gonna tackle funding and incentive, however, on the projects that RDH is working on. In BC we are hand in hand working with funding and incentive providers, and those particular programs have specific requirements and exclusions.

Again, meaning that it's not a one size fits all retrofit approach. We have to customize the plan and the details to meet that building's requirements.

 And finally, is this an occupied building or an unoccupied building? I think in most cases we will be retrofitting occupied buildings. I'll speak for Toronto. We do not have enough housing as it is. We don't have space to kick folks out to a swing space or another building in order to do a retrofit in place with no occupants.

So in many cases, we're working on an occupied building. Which does not necessarily mean we can't do work. We will have to do the work, but the inside system renewals, mechanical, electrical, possibly plumbing, seismic, fire code is more challenging when we have residents in place. Likely not new ideas to many of the folks on this call, but I just wanted to highlight these intricacies.

So I have touched on a few things, but I wanted to put a stake in the ground in terms of some of the lessons learned so far. Retrofits are complex projects. We hope to get to an at scale replicatable model soon. We're not there yet.

I wanna talk about project team. Retrofits are a team effort. We could have utility or funding clients, the building owner who's possibly paying for these projects or, cost sharing with an incentive program. And then we have a consultant team of designers and engineers, architecture, building envelope, structural energy modeling, maybe various mechanical consultants, electrical consultants, and specialty consultants.

So all of this team has to come together to be on the same page. Not to say that the size of the project or team makes it complex, but one could imagine getting everybody together for meetings, getting everybody together in terms of deadlines. It takes a village. So at the beginning, we wanna, identify and enable a team lead, potentially a single point of contact that can work with the design team and then also the stakeholder team to serve as a clear line of communication. And as I mentioned, engaging regularly with the client and project team. Weekly meetings, biweekly meetings to make sure that progress is being established and everybody is moving down the same path towards the same goal.

The next piece of complexity is the design process and iterations. Retrofit projects have a similar project timeline as what a new construction project, meaning we have that assessment phase.

In a schematic design phase what do we want this, these pieces to look like? And then once there's agreement at the schematic design level, over clad, new mechanical, new electrical, fire safety, those sorts of things, then we dig into the details and develop the construction documents. At some point either DD or CD, were hitting that building permit application stage, which could trigger a significant layer of review and design clarification or design changes. And then certainly going to tender to get the construction team on board to do the implementation.

Just to give an idea of the complexity related with the design. On one of our projects, we had the question, does this building need cooling?

So to answer that question, we modeled the potential for overheating. We said, yes, the building does need cooling in the future state. That decision impacted some ventilation and HRV design situations, made us look more closely at the heating and cooling system overall. And how big the cooling system needs to be.

There was some iteration related to that. And then we went through the design options and some really fine granular design detailing that needed to be done around that cooling system. So this is just one facet of the design type questions and answers that need to be accommodated within the design process.

So you can imagine many other questions coming out related to heating, electrical, plumbing, enclosure, roofing walls, windows. It's not just as straightforward as improve the building envelope or improve the mechanical systems. And lots of coordination, several packages not quite as straightforward, always as a simple DSD construction documents packaged. There may be variations within that theme and within those phases so that all pieces are coordinated and approved by the building owner who's buying this design.

Another big lesson is to let the building lead the design. Again there's not always that one size fits all approach. Each building will typically have its own peculiarities.

One of the pieces that we found is we have to put all of the new stuff somewhere in the building. So that includes HRV packages and the penetrations that go through the wall or the roof. We mentioned heat pumps. Those have to go either up on the roof or somewhere on the side at grade. That's out of the way.

And we have in suite units. Typically new in suite units that will have to be placed somewhere and serviced with electrical or piping. It's all gotta go somewhere. This is a screenshot of a roof plan on one of RDH's retrofit projects. The red blocks down towards the bottom are new solar preheat panels and the green is where we landed on putting the new heat pumps. So every building design team will need to look at a similar plan to understand where all the stuff goes. Looking on the inside, I know the font is tiny here. This is just the mechanical schematic. Where are we gonna fish through all of this stuff?

Through the height of the building to service the suites to deliver the new heating, cooling electrical systems. It is a puzzle. I will tell you. The other piece that maybe some folks don't think about cuz it's not as glamorous is thinking about how the facades will be accessed for the retrofit itself and for future maintenance.

So looking at wall or roof anchors and fitting those roof anchors or wall anchors within all of the other new stuff that's going onto the building. Another layer is the enabling measures. This is just one snapshot of a building that we're gonna over clad with thicker insulation and new cladding.

We have existing balcony guardrails that will have to get removed so that they can accommodate the thicker walls. We'll have to do new tie-ins between the balcony waterproofing and the new sliding glass doors, and we'll have to repair all the holes left by the previous guard when we put on the new guard.

So this is really zooming into granularity, but you can see that it's not always a one size fits all solution. Tons of other things to think about. Maybe some folks on the call haven't hit these roadblocks or hurdles, fire sprinklers, fire stopping. You open up a wall on the inside or the outside and you discover what may have not been done during original construction.

Certainly our older seventies and eighties buildings could have hazardous material, particularly ACMs. So there's a layer of abatement that will need to happen before the fun retrofit can occur, and I mentioned seismic retrofit previously.

We want the whole team to be solutions oriented. What does that mean? Of course projects of this complexity could die in any manner of things. The project could get bigger as we uncover unforeseen conditions or things like hazardous materials. There can be contract issues between the owner, the consultants, the owner, the contractors, permit issues with the authority having jurisdiction.

Tons of technical challenges that I mentioned, and of course many of us now are dealing with the fact of inflation and escalation. We may have budgeted a chunk of money a couple of years ago, but that chunk of money does not buy us the same thing today. Also dealing with supply chain issues, shortage of the labor market.

The project could die, but it takes that team of folks to be proactive. To foster a positive attitude to work through those hurdles to help the project get implemented. That may mean a redesign or a phasing change or approach. But that's okay. Let's bring those ideas to the table to help keep the project alive.

Certainly we wanna treat the client as part of the team. We need input and information and decisions from that client team to help move us along through those design and construction phases. Developing a detailed schedule early helps. If you have it, you can change it. If there's no schedule, it can become a big unknown and a roadblock down the line.

And I mentioned already regular meetings during design and construction to engage, problem solve to keep these projects alive. So I'll leave the discussion here for now. And just looking forward to some q and a to drum up some more ideas.

**Allison Mostowich:** Amazing. Thank you so much, Sarah. There was an incredible amount of information you went over and I'm sure it was the tip of the iceberg as you mentioned.

Before we get into q and a just a quick question for you so we have lots of questions in the background, and would you be okay if people, if we don't get to their questions today, if they were to reach out to you?

**Sarah Gray:** Absolutely. That's why I have my email address on the slide here. Perfect. So I'll keep this up for a few more minutes if folks wanna jot that down.

You can also find me through the RDH website, but certainly happy to take questions or understand specific ideas. Absolutely.

**Allison Mostowich:** Amazing. Okay, so let's get into the questions cuz there's lots, I'm gonna start existentially and then we'll kinda get down into the technical details. And I think even a couple questions that we're pondering here to Efficiency Canada.

The first one is, what are you finding as key drivers for building owners to undertake deep retrofits? I think that's something that we are all struggling with.

**Sarah Gray:** One piece is service life issues. So we have buildings built in the seventies, eighties, or even the 1990s that are now coming at that 30, 40, or 50 year timeframe.

It's time to replace the windows. It's time to repair, at least repair the clotting. It's time to get a more efficient heating and or cooling system in place. So service life. Definitely folks are also seeing the writing on the wall in British Columbia, and to some extent in Toronto where the jurisdictions are saying no more natural gas in the near future.

Meaning in British Columbia, you won't be able to buy a gas fired heating device in the near future. Okay, so that means I have to do electric or fuel switch, but I don't want a huge electrical bill, so that means that I need to provide a better building envelope so that my heating bill is not huge.

In Toronto, we are saying all buildings new and existing net zero carbon by 2040. So if you look at the clock, It's ticking. We have 17 years. That approach is not yet legislated with teeth. But in general, Toronto City Council has acknowledged or said, yes, this is where we wanna go.

So folks are saying, oh, I've got 17 years. If this becomes enforceable legislation, I don't wanna get caught short. And then the third camp are investor groups. Pension funds, European owners that have ESG. Goals or aspirations. They wanna reduce their carbon emissions, reduce greenhouse gas, be more efficient, show their investors that they are doing the right thing.

I don't know why I put that in air quotes, but, moving towards a more sustainable, resilient future. So the those investors are saying, I'm not going to. Further invest or give you money unless you improve your building portfolio. So those are the three trends we're seeing that instigate the deep retrofit.

**Allison Mostowich:** It's interesting we've been starting to talk to some of the big builders, construction companies and they're saying very similar things, and that they can also not lease to large companies that have net zero ambitions, which without doing this work to their building. So kind of part of that investment component.

Yeah, that's interesting.

**Sarah Gray:** I don't wanna liken it entirely to lead, but in the, early days of lead and even still today, some folks won't lease if the building's not lead, certified, lead platinum or a higher level of lead, or well, or fit well or living building challenge. So there's that desire by tenants to be in a better workplace.

So I think that's the, a piece of the puzzle as well.

**Allison Mostowich:** Yeah, absolutely. I think a lot of the clients that are coming to you have deep retrofit in mind. And I'm curious, on two levels. And this I think, wraps a few of the questions up into one. How do we, and maybe this is the silver bullet question, but how are you doing or convincing people that weren't thinking deep retrofits to do deep retrofits?

Is it bringing in all those factors you just mentioned? And then what market are you seeing that's not really looking at deep retrofits? Like I think big buildings you said are seeing writing on the wall, but where are the markets that need to see more of the writing on the wall?

**Sarah Gray:** I don't want to point fingers or put a spotlight on one market. I will say that the federal government is doing a lot of work in this space. They are doing deep retrofit or GHG option analysis studies on all of their buildings. Whether they've already got them, they're doing them now, or they will soon be doing these studies.

They know that they have to have these plans. I'm also working with privately owned multi-unit residential building portfolio owners that are doing these because of the three factors that I talked about, including basically service life renewals that they know they need to do and investor demands or constraints.

Overall in Canada, I will overgeneralize here, but it's great that we have the argument here, carbon price. Folks are seeing that if they don't fuel switch, they're gonna pay paying big carbon tax bill. Within their natural gas bill, and if you start doing the math, in many cases, we're gonna reach a tipping point where you're gonna pay more in carbon tax than your actual natural gas usage.

When I say that to folks, they're like, really? Oh my gosh, I didn't realize that. It certainly could be different for every building. I don't wanna give a specific date or a timeline, but it's coming soon because the carbon price is increasing and even in the federal government, they're looking at the $300 per ton carbon price.

That's huge. We're at what, 65 or something dollars a ton now? So in the future, as that carbon price continues to escalate on its current trajectory, if it does remain on the trajectory that's, I'm gonna pull many people onto the road of retrofit. I would say.

**Allison Mostowich:** Fantastic. That's incredibly helpful insight.

Okay. Next question is getting one level down. So I think you have mentioned most of the buildings and one of the challenges is that the buildings are occupied. So can you just share some of your experiences about how that's gone with different occupants, how you've communicated with them and what's worked better?

**Sarah Gray:** Yeah, and my specific experience has been with the social housing provider here in Toronto. Again, I mentioned there's no space to move folks to other areas. So it's been in place and it's a lot of tenant engagement. Having town hall meetings at the building level, showing them the why.

Why this work has to be done, the rationale, and they typically see it, they want a better building as well. Better indoor air quality, newer finishes, better looking on the outside, all those things. And in many cases, the social housing provider and the design team are working together to put a couple of options for the new look of the building in front of the residents to get them excited and allow them to vote on the look. Of course, those looks are pre vetted by the client, but gets some buy-in with the residents. So that's step one. No matter what it's difficult. I have a project where we're just replacing the windows, so no mechanical systems, no exterior clotting.

And it's really challenging because of, resident rights to refuse entry, hesitation to allow people into their suite, particularly during the covid intense years that we've had over the past couple of years. It's tough. For sure. The added layer of difficulty is when we have to go in to do abatement work.

Typically folks will need to move, be moved out of their suites to say a swing space unit within the building or a hotel space because certainly you can't do that abatement work with tenants in place, so that's really difficult. You just have to make the hard decisions and the cost to physically move folks floor at a time or a suite at a time to get that done. There's no way really around that. The other challenges with people in place, regardless of abatement, is any duct work or line work that needs to be done for HRVs, ERVs, heat pump line sets, that sort of thing. And again, it's about explaining and informing and communicating to residents as a whole and each individual resident.

This is what's gonna happen. This is what it's gonna look like. Your suite is scheduled for May 12th, 2023. You can expect the contractor to come in at nine o'clock and leave at five o'clock. Communication is key for occupied buildings.

**Allison Mostowich:** So it sounds like having a contractor or a group of contractors that are really well versed in communicating with occupants is very important.

**Sarah Gray:** Yeah and appointing a communivation manager or communication boss or liaison or whatever you wanna call that role. It could be a full-time job. I bet for occupied suites retrofits. Yeah.

**Allison Mostowich:** Yeah, I bet. Awesome. Thank you. Okay, so a question about program design. I think a lot of our audience are program designers, program delivery agents. So a really good question to consider. What is the one thing you would recommend for future deep retrofit program designers to consider or allow to ensure that their programs achieve intended objectives? Not an easy question, but I'd love your thoughts on that.

**Sarah Gray:** One of the pieces that is, currently a challenge and a roadblock for many of these projects getting off the ground, devising a plan, costs some money and some time, but fairly cheap.

When you're looking at a multimillion dollar project, the question becomes, how am I gonna pay for this? So again, I mentioned there are funding programs at the local level or the federal level. CMHC has funding for social housing for residential buildings. Canadian Infrastructure Bank has their program for financing, but it's really about finding the money.

It's the one layer of complexity to do all the design work and all the challenges that I talked about today, but it's getting the money to do it. There are some building owners that don't have that challenge. They have a luxury in that regard, particularly because they have set aside money for those service life replacements.

So then they just have to fund or finance that sort of premium to go the extra level. Which is by no means a small premium but they have the pot of money ready to go add some more money on that, achieve the deep retrofit. So I think funding is a big piece of the pie. And that's what needs to be in place to implement the projects.

So hopefully that answered the question.

**Allison Mostowich:** I will tell again, not the silver bullet.

Thanks Sarah. A question about embodied carbon. And I think this is really timely because Toronto just passed requirements about embodied carbon. Do you typically consider embodied carbon in the projects that you're working on?

**Sarah Gray:** We are starting to, because programs are asking for that. Either, City of Toronto, I think zero carbon, projects with CHA BC are going to start doing that if they haven't already. I apologize. I don't have the specific details for the new version. So it's key and that's one way to show the benefit of doing the retrofit versus demolition and new construction.

So we are starting to do those LCA analysis with both embodied and operational carbon.

**Allison Mostowich:** Fantastic.

And I know there's quite a bit of work going on at Enercan too to study the different sort of amounts of embodied carbon in certain construction materials. So hopefully that comes right later than later.

**Sarah Gray:** Yeah.

**Allison Mostowich:** Okay, so question about just the state of professionals, you know able to do this work? So just a question about your reflections on the state of professionals, contractors, and trades to deliver this work and to carry out these projects. Are you finding more equipped to tackle these projects efficiently and with a strong set of experience, or do you feel like there is still quite a bit of learning to be done?

**Sarah Gray:** There's a lot of learning to be done. We have in many jurisdictions we have good or great trades. There's just not enough of them. There's enough existing building and or new construction happening in many jurisdictions of cost. Canada contractors that I've talked to are not starving for work. In fact, they're very busy.

We need more trades persons. We need more training. We need to help bring high school grads, college grads, university grads, into the trades at any level. From actually doing the work to managing the work or leading the work. We need more people. Again, the ultimate nirvana goal would be to have a factory produced panel or system that gets plugged on to the face of the building or inside the building.

We still need people to work in the factories to produce those panels or box systems. I expect that it's not necessarily a material problem. I think it's a human capital and labor challenge that we have now.

**Allison Mostowich:** Yeah, I agree. I think we're hearing the same thing. And unfortunately, chat GPT is not gonna.

**Sarah Gray:** It won't solve all the problems. It'll make some things easier AI and robots a hundred percent for it. But we still need people to do a lot of the work to date until we figure it all out with the robots.

**Allison Mostowich:** So unfortunately we have come to time we're actually a little bit over and I apologize to everyone that we didn't get to your questions.

I know there was so many questions in the question inbox, but like we mentioned before, please reach out to Sarah if you want to chat with her about those questions. Thank you so much, Sarah, for attending. This has been absolutely wonderful. Really great information and just, I think a step into the space where maybe we can start to pull people together and talk more about deep retrofits and share lessons learned.

I'm really interested in doing that, so if anyone else is interested in that conversation, get ahold of me. My information is on the Efficiency Canada website and we are really interested in having that conversation. I'm just gonna share Sarah's email again.

**Sarah Gray:** Yeah, I'm type up typing it into the chat as well. Yeah, there you go. Okay, fantastic.

**Allison Mostowich:** So thank you so much Sarah, that was wonderful. We really appreciate your time and all the information and thank you everybody for joining us today. This presentation has been recorded, so it will be on our website in probably about a week's time. If you want the slides in particular, I would get ahold of Sarah.

She can navigate that and thank you. Happy Friday. Enjoy the rest of your day and your weekend.

**Sarah Gray:** Thanks so much.

**Allison Mostowich:** Take care. Bye-bye.