DESIGN QUAR-TERLY

ISSUE 19

Stantec

DECARBONIZATION

Targeting emissions in the built environment

DESIGN QUAR-TERLY

ISSUE 19

THOUGHTS, TRENDS AND INNOVATION FROM THE STANTEC BUILDINGS GROUP.

The Stantec Design Quarterly tells stories that showcase thoughtful, forward-looking approaches to design that build community.

ISSUE 19:

DECARBONIZATION

Buzzwords aren't always bad. Where we once talked about promoting sustainability, the conversation has shifted to decarbonization. Sustainability suggested maintenance of a status quo that didn't require much effort. Decarbonization suggests action is necessary to get something out of the system. Carbon dioxide to be precise. In this issue, we look at the drivers to decarbonize our buildings and how we can help our clients get it done.

Passive House regulations are coming. Are you ready?

Eight strategies we've learned for designing hyper-efficient, Passive House-certified, multi-family dwellings

BY BRETT LAMBERT

Northland Newton Development
Newton, MA

IT'S OFFICIAL:

Passive House standards are coming to Massachusetts.

The Commonwealth of Massachusetts rolled out ambitious updates to its Building Energy Code in 2023. The new Specialized Opt-In code will require Passive House certification for all multi-family buildings larger than 12,000 SF and make passive house one of the available compliance pathways for all other building types. Beginning in 2024, the Massachusetts communities that have opted in must design and build multi-family buildings to Passive House standards. The change is substantial, but with the right approach, passive house strategies can help our clients serve their market, while leading us to efficient, healthy, and resilient multi-family dwellings.

Building 7, Northland Newton Development
Newton, MA

WHAT IS A MOBILITY HUB?

Building 7 at Northland Newton Development features a mobility hub.

Click to find out more about what mobility hubs do.

A 22.7-acre semi-urban, mixed-use redevelopment, the Northland Newton Development project will, when completed, be one of the largest all-electric market rate passive house projects in the world. At the Northland Newton Development, our team designed four residential passive house buildings within a larger complex, helping our progressive and ambitious client to achieve Passive House International certification (PHI). Back in 2018, our client saw passive house strategies as the ideal way to achieve their own long-term goals for resiliency, energy efficiency, and high-quality building standards. By embracing an early-adopter ethos, the Northland Newton Development will enter the market ahead of the regulatory curve, with valuable gained experience in this new market. With our experience designing for Passive House standards on the Northland Newton Development project and others, we've seen which design approaches contribute to passive house building success.

Northland Newton Development
Newton, MA

First, a quick explanation of passive house.

Developed in Europe, passive house is a rigorous approach to design and construction that focuses on five major aspects of operational building energy use.

1. SUPER INSULATED ENVELOPES
2. AIRTIGHT CONSTRUCTION
3. HIGH-PERFORMANCE GLAZING/WINDOWS
4. THERMAL-BRIDGE FREE DETAILING
5. HEAT RECOVERY VENTILATION

DID YOU KNOW?

We use passive house lowercase for a general approach to design, and Passive House uppercase to denote standards or certification.

Simply put, a passive house approach creates a hyper-efficient building, allowing designers to use smaller, more efficient heating and cooling systems to keep occupants comfortable. That's a win-win!

Here are eight strategies we find useful when designing passive house multi-family residential projects:

1. ORIENTATION MATTERS

In a passive house design approach, the building's relationship with the sun is key. Passive house strategies seek to minimize heat gain in summer and maximize it in winter. Thus, site selection, site orientation, climate zone, and building orientation are key considerations on passive house projects. We can iterate massing options early in design and evaluate each for solar gain potential.

BC Housing King Edward Modular Affordable Housing
Vancouver, BC
Joint Venture: Stantec/Bird Construction and Stack Modular

LEARN MORE

2. LOOK FOR ENERGY—EVERYWHERE.

The passive house designer's goal is to use as little energy as possible. It's not only about the air conditioning, it's also the lights, appliances, hot water, windows, balcony doors, and anything else that uses energy or affects heating and cooling demands. In a multi-family building, items like a refrigerator or the amount of hot water piping servicing the bathroom add up quickly.

For example, ten feet of hot water piping per unit in a 500-units building results in 5000 feet of hot water piping in the building. In passive house design, we calculate the piping distance and volume from the hot water source to the end use fixture when we're accounting for the building's energy needs. If we shorten the distance the hot running water takes in a building unit, we can see substantial energy savings at the building scale. On the Northland Newton Development, we found that if we cluster bathrooms closer to the mechanical closet in the building units, we shorten the pipe servicing them and save energy at the building scale.

3. RUN MODELS OFTEN.

Designing for passive house standards requires the team to utilize energy modeling regularly. Our team runs models like THERM which calculate the two-dimensional heat-transfer effects in building components such as windows, walls, foundations, roofs, and doors. By building this modeling time into the early design process, we maximize its impact. The knowledge these models provide is critical on reducing energy use and thermal bridges.

4. DIG INTO THE DETAILS.

The smallest details can be extremely important to energy efficiency. With the Northland Newton Development, for example, we supported the brick cladding off steel relieving angles, a common practice. The conventional way to connect these steel relieving angles to the building's super structure creates a "thermal bridge"—that is a conductor between the building and the environment which would radiate cold from the outside to the inside in winter. Passive house seeks to eliminate thermal bridges, so we had to innovate. In response, we employed a strategy that connects the angles with a layer of non-conductive rubber to eliminate the thermal bridge.

5. COLLABORATION IS KEY.

Collaboration is foundational to our integrated design practice. To deliver a building at the elevated standards of Passive House certification, we must engage in deep cross-team collaboration.

For the Northland Newton Development project, we had to test that critical details like the thermally-broken relieving angle mentioned above (not yet common practice in construction in our region) would be effective. So, we collaborated early on with our structural engineer, sustainability consultants, and our contractor to confirm the detail would satisfy the structural requirements and be constructable in the field. With input from the mason, we devised a bolted version of the detail to allow adjustability in the field. This resulted in a relieving angle that our team is comfortable can be executed in construction while maintaining the thermal break.

Getting these details right is essential because the Passive House certification process means a Passive House verifier will inspect and confirm the construction in the field meets the requirements of the standard.

Inspiring action toward *sustainable* living

FortWhyte Alive Buffalo Crossing
Winnipeg, MB

We designed FortWhyte Alive's Buffalo Crossing visitor centre to Passive House standards. Buffalo Crossing shows that a low carbon approach is possible in Manitoba's challenging climate conditions. Buffalo Crossing, shortlisted for this year's World Architecture Festival, will be Manitoba's first commercial building to achieve Passive House certification.

60 kWh/m^2
ENERGY USE INTENSITY

0.7 $kgCO_2/m^2$
GREENHOUSE GAS INTENSITY

0.41 m^3
WATER USE INTENSITY

Northland Newton Development
Newton, MA

6. SAY YES TO WINDOWS *(AND SAVE ENERGY ELSEWHERE).*

Reducing window sizes is one route designers take to attaining passive house's extremely efficient building envelope standard. But for many potential multi-family clients, this approach does not meet market expectations for access to natural light. Understanding this, we had to find a way to achieve attractive window-to-wall ratios while maintaining a highly efficient envelope.

Passive house dwellings can be elegant and welcome natural light.

We looked to window manufacturers in the U.S. and Europe to see who could push efficiency higher. On this project, rather than import from Europe, we discovered highly efficient windows made in Kansas met our needs. These triple-glazed windows cost more, but they allow us to meet passive house standards, provide increased thermal comfort, have better acoustic properties to decrease outside noise, and they have the potential to pay for themselves over time in energy savings.

We also looked for energy efficiency trade-offs. If you want larger windows in a passive house building, you need to find ways to be more aggressive on energy savings. We looked at increasing efficiency in the building's light and power density, appliances, hot water heaters, and air handling and heating and cooling.
We found by spending some additional time fine-tuning the mechanical system with our engineers and consultants we were able to increase the efficiency of the building's mechanical systems. This additional effort helped offset the impact of the additional glazing.

To sum it up, passive house dwellings need not be solid and closed-off, they can be elegant and welcome natural light.
One of the advantages of passive house is that it's not prescriptive, so it gives us room to innovate or find efficiencies to meet its goals.

7. INSULATION MATTERS.

A well-insulated building is a basic requirement in a passive house approach. But as we have learned, it's not as clear cut as just adding more insulation to the walls and roof. Every aspect of insulation matters. For the envelope to be truly effective, the design must wrap the entire building and maintain insulation at the critical junctures between floor and wall and at unique intersections at balconies, canopies, and overhangs. The details matter. Passive House compliance simply pushes us to pay extra attention to these details. For our designs to be certified we must be able to demonstrate that the thermal and air barriers are maintained at all locations. At Northland Newton Development we found we did not have to increase the insulation values in our walls and roofs significantly, but we needed to be more intentional about maintaining our thermal envelope at every detail.

We prefer to use mineral wool as insulation whenever we can because it is a resilient and environmentally friendly material. On Northland Newton Development, we were able to minimize use of spray foam and use a combination of mineral wool and fiberglass batt on most of the envelope.

SEE "LIVING IN A MATERIAL WORLD" FOR MORE THOUGHTS ON INSULATION.

Northland Newton Development
Newton, MA

Northland Newton Development
Newton, MA

8. GET EXCITED, MAINTAIN HEIGHTENED AWARENESS.

On Northland Newton Development, we went on a journey with an engaged and ambitious client. We rallied our team and our consultants and construction team around the cause. We came out the other side of the passive house process stronger and wiser from the experience. Everyone involved was transformed into believers in passive house as a great way to design buildings.

This passive house experience heightened our awareness of the elements, details, and approaches that make an extremely efficient building work at the multi-family residential scale. We are taking this deepened experience forward and applying it wherever we can.

By 2024, Passive House will be the only path available for designing multi-family projects in many communities in Massachusetts, and we expect this trend to join others and expand across the industry.

Now is the time to embrace it.

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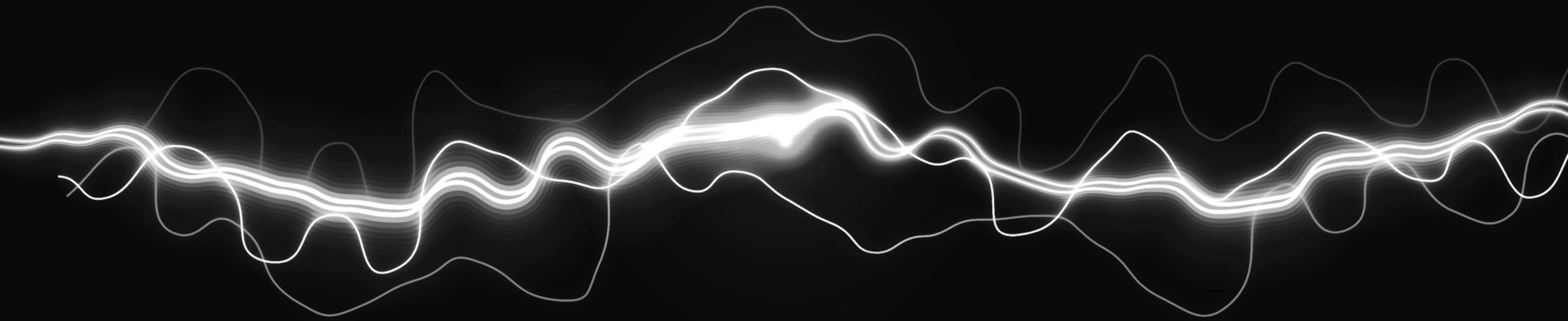
MORE MULTI-FAMILY RESIDENTIAL

Architect **Brett Lambert**, based in our Boston studio, is a Phius Certified Consultant (CPHC).



A NEW SPARK

Building a better electric vehicle battery factory

BY SERGIO SÁDABA

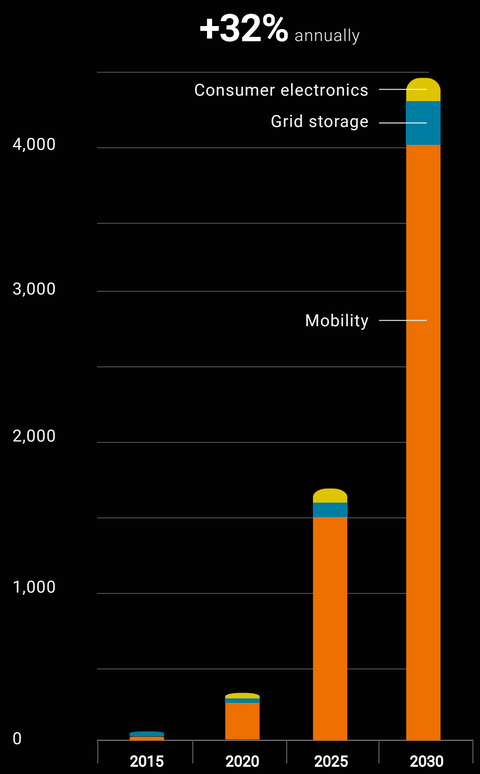
ELECTRIC VEHICLE SALES ARE SURGING

In 2022, the North American and European market for electric vehicles grew significantly. Nearly 300,000 new full battery electric vehicles (EVs) were sold in the U.S. in second quarter of 2023. In Canada, 9% of new vehicles registered in 2022 were ZEVs (zero emissions vehicles) which include battery electric cars and plug-in hybrids. Global sales of light EVs topped 10 million in 2022.

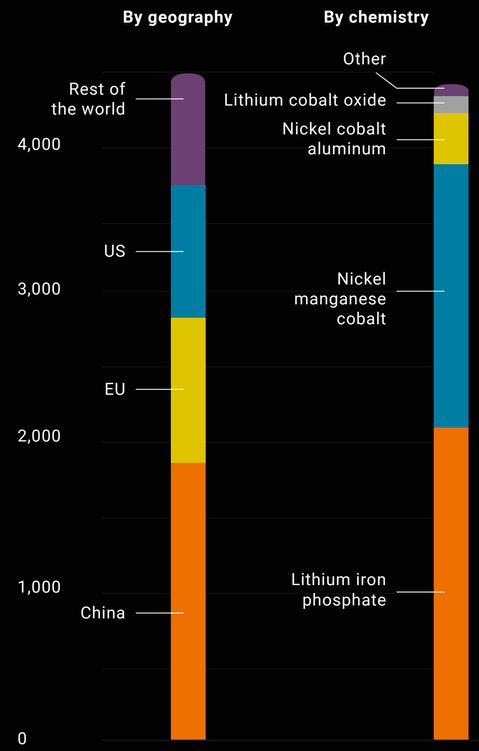
To power those EVs, we're going to need a lot more electrical vehicle battery factories. The headlines in North America today are talking about new advanced manufacturing facilities breaking ground to make solar panels, microchips, and batteries for electric vehicles. While the first two have much in common (silicon), the third factory type has its own set of challenges.

Companies planning to build large-scale electric vehicle battery (EVB) factories in North America need to be aware of the issues and challenges that we've seen in the first generation EVB factories. These challenges range from serious roadblocks that could affect production timelines to opportunities to find efficiencies to save money in the long run. Let's look at a few.

Demand for lithium-ion batteries 2015–30, gigawatt-hours (GWh)



Breakdown of demand, 2030, GWh



SOURCE:
McKinsey Battery Insights Demand Model

CLICK TO READ

ONE

TWO

THREE

FOUR

FIVE

LONG LEAD TIME FOR SPECIALIZED EQUIPMENT

Manufacturing EV batteries requires specialized equipment. For example, these factories need a super dry environment, requiring specialized dehumidifiers. With EV production ramping up on several continents, demand for this type of specialized equipment has exploded. While the supply chain issues we saw during the pandemic are fading, it's still very hard to procure the chillers, fans, electrical gears, substations, and variable frequency drives these factories need. It can take a year or longer to take delivery of this equipment. It's important to assess equipment needs and order early to meet project milestones and open on schedule.

Form Factory 1 Iron-Air Battery Production Facility
Weirton, West Virginia

LEARN MORE

Read in Adobe Acrobat or a web browser for the full experience.

With these five challenges in mind, we can suggest some best practices for EV battery factory design.

Early coordination of process and factory engineering experts will pay dividends.
Fast equipment selection and procurement will help meet opening and production deadlines.

Manufacturing processes evolve and adjust as new technologies emerge, so factory design needs to be as flexible and adaptable as the processes. **Decouple factory base building design from manufacturing to allow for this flexibility.**

Take advantage of hidden synergies between the manufacturing processes and factory design.
That can mean finding efficiency in energy flows, air systems, or water cycles. Advanced manufacturing facilities are complex and include a variety of processes, technology, and equipment. This presents hidden opportunities for our integrated design team to apply its ingenuity. Ideally, we'll save our manufacturing clients energy, expense, and time. We can make their critical buildings more resilient.

"IF WORLDWIDE EV DEMAND GROWS AS PROJECTED, THE INDUSTRY WILL NEED 200 NEW GIGAFACTORIES—IN ADDITION TO THE 130 GIGAFACTORIES THAT ALREADY EXIST, REPRESENTING **MORE THAN $400 BILLION IN DEPLOYED CAPITAL—BY 2030.** BUT COMPLICATIONS DURING THE DESIGN AND CONSTRUCTION PHASES CAN DELAY PRODUCTION START BY 12 MONTHS OR MORE."

SOURCE: EV BATTERY SHORTAGE: THE MARKET GETS HOTTER | MCKINSEY

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MORE MANUFACTURING

From our Seattle, WA studio, Sergio Sádaba leads the high-performance engineering team for our Buildings practice.

Carbon emissions, concrete, and steel

Reducing emissions associated with new buildings starts with structural engineers.

BY ROBBY VOGEL

As a subscriber to the ***Structural Engineers 2050 Commitment Program (SE2050)***, Stantec is committed to reducing embodied carbon in our project work, using fewer and/or less impactful structural materials.

WHY ARE WE TALKING ABOUT STRUCTURAL ENGINEERING AND CARBON?

For years, structural engineering wasn't at the forefront of the sustainability conversation. But sustainable buildings have grown up since low-VOC paint and bike racks helped earn LEED credits. Today, we can design and build high performance buildings that are operationally efficient. These new buildings use less energy for heating and cooling, trending toward net zero in some cases.

University of British Columbia (UBC) Brock Commons Tallwood House
Vancouver, BC
Stantec: Sustainability and building performance, and mechanical and electrical engineering services

Architect:
Acton Ostry Architects

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Meanwhile, demand is increasing for the design of healthier spaces—in terms of air, light, and non-toxic materials. Millennials (representing close to 80 million people in the U.S. alone) are driving not only the environmental, social, and governance (ESG) investing strategies, but also contributing to the major headcount in today's workforce. With the alignment of Millennials' personal values, including a "greener" planet Earth, to their company's office culture, many are choosing to work for and in more sustainable company cultures and WELL-certified buildings.

Today, when we look at the emissions metrics from high performance buildings, operational carbon is rapidly declining, leaving us with the unmovable stats for embodied carbon. The emissions required to build the building—its materials, their manufacture, and the construction methods—constitute a building's embodied carbon. Viewed through this lens, buildings still account for significant emissions. Structural engineers are increasingly center stage when it comes to embodied carbon reduction. This is a sea change for many structural engineers.

Embodied carbon is a one-shot deal.

Once the building has been designed and constructed, the embodied carbon is invested. In contrast we can improve operational carbon incrementally. The structural engineer can make a significant impact on embodied carbon.

When we're talking about embodied carbon in conventional building structures, we're referring to concrete, masonry, and steel. So, what really are the tools and approaches structural engineers can take to reducing embodied carbon, and what's standing in their way?

FLY ASH AS SUPPLEMENTARY CEMENTITIOUS MATERIAL (SCM)

Supplementary cementing materials amplify concrete's strength and durability. One way we can reduce embodied carbon is by using fly ash as an SCM in an alternative to sack Portland cement. Fly ash is a byproduct of coal burning currently used as an SCM. The problem? As we shutter coal plants, the fly ash supply is diminishing—not to mention that it's also in demand for roadway construction.

Without fly ash, we may be stuck using straight sack cement, which has a higher embodied carbon. So, we need to be on the lookout for alternatives, for example, concretes that sequester carbon.

303 Battery
Seattle, WA
Stantec: MEP design, energy modeling and life cycle assessment services
Architect: CollinsWoerman

LEARN MORE

CONCRETE WITH CALCINED CLAY LIMESTONE CEMENTS (LC3)

When burned at a high temperature, naturally occurring clay takes on properties that make it a great SCM. This innovative material has been used in buildings across Europe for years, but it hasn't been widely adopted across North America. It's promising as a replacement for the limestone used in cement. Manufacturers say metakaolin or calcine clay (CC) and LC³ (cement that blends limestone and calcined clay) can reduce 30-40% of CO_2 emissions compared to ordinary Portland cement (OPC) and perform just as well. The challenge for those wishing to specify CC or LC³ in concrete is that they are not yet widely used. It will take some early adopters to demonstrate the viability of these materials in the marketplace.

STEEL

The good news when it comes to steel in North America is that we're already recycling it at a high rate. With industrial electric arc furnaces, U.S. and Canadian plants manufacture steel that is roughly 93% recycled in content. The bad news is that the supply of recyclable steel is dwindling. Cars, previously a reliable source of steel, are made of less and less steel and it is not cost effective to recycle much of the steel out of raised buildings. So, we're facing a future where we will need to mine and manufacture more native material to meet the steel demand.

FOR MORE ON MASS TIMBER AND OTHER ALTERNATIVE MATERIALS.

Idaho Central Credit Union Arena
Moscow, ID
Stantec: Acoustics and vibration control
Architect: Opsis Architecture; Sports Architect: Hastings+Chivetta.

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MASS TIMBER, GLULAM, CROSS-LAMINATED TIMBER (CLT)

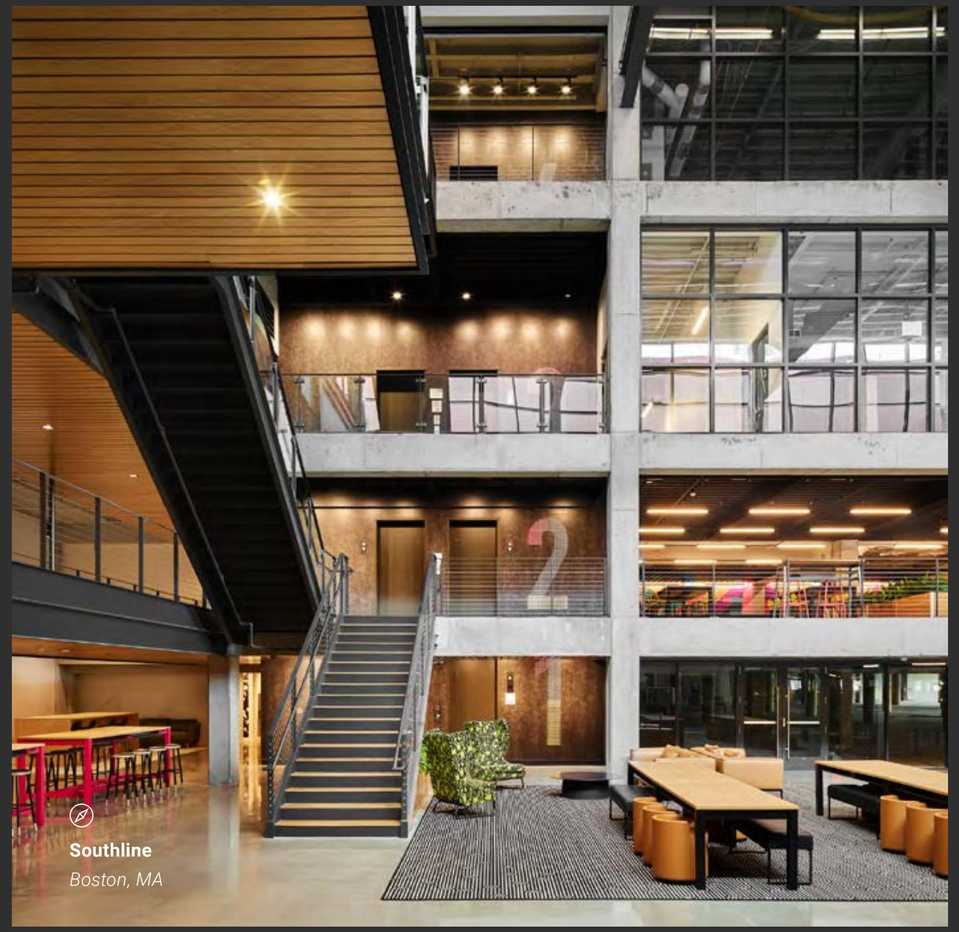
Wood feels good, it looks good—it has biophilic properties. With mass timber and CLT, we can build using a sustainable, renewable, carbon-sequestering resource. Mass timber buildings are lighter, requiring less concrete (and associated emissions) in their foundations. We're seeing take-up for mass timber in regions where the product is readily available, the Pacific Northwest and British Columbia, for instance. To be truly sustainable, mass timber must be harvested from well-managed forests. Codes that limit the height of mass timber buildings, the question of fire ratings, its relative expense, and lack of experience in certain regions are limiting its acceptance for now. But all of this is changing.

EMBODIED CARBON MODELING

One sure way to reduce embodied carbon today is for our teams to design buildings that simply use less concrete and steel to meet their programmatic goals. We have the ability to rapidly generate multiple conceptual designs and then model their embodied carbon based on the building material required. In this way, we can see in real time which possibilities have a smaller embodied carbon bill. The more we can incorporate embodied carbon in our modeling in the early design stages, the better decisions we make on use of low carbon alternatives. We are working to make embodied carbon analysis an automated part of our design workflow.

BUILDING REUSE

As the saying goes, “they don’t build them like they used to.” As structural engineers, we have an essential role in identifying existing buildings with good bones that can be reused to support our current programming needs and minimize our impact to landfills and harvesting virgin materials. The “greenest building” may have already been built.



Southline
Boston, MA

LEARN MORE

ROADBLOCKS

Availability, pricing, and lack of knowledge and experience are holding back uptake of materials that can reduce embodied carbon; even when a client is enthusiastic. Take a recent project for example. The client wanted to use carbon cure concrete—a product that has been injected with CO_2 to keep it out of the atmosphere—for the slab on a new facility. The supplier for the product, however, told us they didn't have a plant in the area—delivery would be prohibitively expensive.

We need more pioneers, more research, more successful case studies, and more leadership by example to tip the balance and increase availability and adoption. Someone must be first to specify a product in the local market. Why not us? Once it's been done, everything changes.

DRIVING EMBODIED CARBON DOWN

What will it take for clients to invest in building structures with lower embodied carbon? Laws, for one. Updating the codes to promote building design and health that are carbon friendly are underway in North America.

CORPORATE RESPONSIBILITY

Brand is another driver. The companies and organizations that walk the talk and design/build low carbon facilities have a positive story to tell. They can connect their values and practice with the clients, the staff, and the investors who take climate change and environmental mission seriously.

People will continue to have a need to occupy new and repurposed buildings through residential, commercial, or industrial uses. To bring down carbon emissions while meeting demand for the built environment, structural engineers will need to tackle embodied carbon on every project beginning now. Ⓓ

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MORE BUILDINGS ENGINEERING

Based in Stantec's Austin, TX studio, engineer **Robby Vogel** leads Stantec's Texas structural team.

Microsoft Building 83
Redmond, WA
Stantec: Acoustical, lighting, and mechanical design services
Architect: BORA Interiors, ZGF Shell

five questions

to answer before you write a decarbonization RFP

Clients who do their homework have a better shot at building an energy transition plan that meets their goals.

BY TANYA DORAN

Decarbonization is suddenly in the air. Corporations, organizations, and municipalities are now charged with formulating a decarbonization strategy if they haven't already. At some point on their sustainability journey, these organizations inevitably issue a request for proposals for a decarbonization project. But what they get back might not be what they really need. What could be an opportunity to revolutionize their operations for a long-term low or zero carbon future could end up missing the goal. Here are the questions we suggest clients ask before writing that request for proposals.

ONE

How do you define decarbonization?

Decarbonization RFPs can wildly vary due to the variables related to defining decarbonization. It's a huge issue. Ask three people and you may get three very different definitions of the term. Some are calling decarbonization the equivalent to electrification. But decarbonization isn't, in all cases, purely electrification. It depends on grid intensities, differences between those grids, grid reliability, and ultimately the power source.

We might make decisions differently in terms of decarbonization in a clean grid province or a clean grid market than we would in a more carbon intensive grid. Have you purchased renewable energy certificates to offset?

This can influence your decarbonization strategy. How we define decarbonization has a lot to do with our view of energy transition itself. The crux of it is we are roughly 26 years away from 2050 and our global carbon neutral goals. Equipment lifespan is approximately 25 years, meaning decisions made today will impact zero carbon goals for 2050. So, we're locking in carbon with decisions we make today. Does that mean that we automatically select an electrified solution, with the presumption that all electricity will be clean by that point? No.

Defining decarbonization is the first step in understanding your needs.

The Green at West Village at UC Davis
Davis, CA

LEARN MORE

TWO

What are you looking for in terms of decarbonization?

We talk to many clients looking for a road map to decarbonization. One type of client is really asking for an energy audit—they want to know the baseline and the proposed energy conservation measures to decarbonize their portfolio of buildings. They don't know where they are right now. They don't understand their energy usage. They don't know their natural gas consumption. They're looking for either a building-by-building or a whole portfolio energy audit to help them set baselines and understand their starting point.

Another type of client already has a full baseline and knows exactly where their energy usage lies. These organizations are prepared for an energy transition and the development of a plan to reach decarbonization goals. They've set clear goals for 2040 or 2050 and want to align their budget cycles with that decarbonization effort.

Then there's a type of client in the middle. For example, a client asked us to build a road map based on the energy strategies we identified in an audit of the first 50 buildings in its 250-building portfolio. This client wants help with a policy to guide that transition.

Each client starts at a different place on the road to a low carbon future. We can help organizations set and achieve goals at the right pace.

Lakehouse
Denver, CO

Owners of small buildings may prefer prescriptive energy upgrade requirements that don't require audits. Owners of larger building tend to prefer performance-based requirements.

SMALL BUILDINGS

95%
of total buildings

50%
of total emissions

VS

BIG BUILDINGS

5%
of total buildings

50%
of total emissions

SOURCE: ARCHITECTURE 2030

THREE

Do you have mandates or procedures that align with your policies and goals?

It's one thing to set a goal, it's another thing to have a policy or a mandate within your organization or municipality that drives your project.

Lessen the gray area. Even clients who have set clear goals for decarbonization are sometimes frozen and inactive. They might have public goals and clearly mandated documents that outline their targets and process. However, when it gets down to the individual building-by-building implementation level, they get caught in a discussion around whether those policies apply to that project. Organizations often need advisors who can guide them internally regarding their policies and get them on the right side of that guiding document. Policy guidance can save money.

On a recent project, we were at 66% design submission when the project went on hold for more than six months. The client revisited their guiding documents to see if indeed they needed to apply those carbon neutral goals to this project. Turns out they did.

This process, or lack thereof, feeds the myth that decarbonization or high performing buildings are more expensive. They are certainly more expensive when we need to redo design studies and investigate and incorporate potential renewable energy options on site late in the design stage. But it doesn't have to be that way.

FOUR

Are you asking the right questions in your RFP and interview?

The better educated you are during the selection process, the better chance you'll have to succeed in your decarbonization efforts. Once you've clarified your decarbonization goals and the implications of your policies, you should familiarize yourself with the wide range of design and engineering solutions available. With a sense of the scope and complexity of your project and possible solutions, you should be better equipped to compare holistic solutions to minimal or piecemeal efforts—getting you the level of services required, with an aligned budget, to meet your goals.

FIVE

Are you considering changing codes and regulations?

Codes are for laggards not leaders; however, it takes years for projects to go from vision to design to occupancy. Are you anticipating the changes in code and regulations that are coming to your market? Beyond the code iterations, what technology and to what kind of standards are you designing? Look at adoption, application, and strategies in advanced markets and work with someone who can bring those groundbreaking approaches to your project so you don't fall behind the curve. Potentially, innovative strategies can reduce first costs, lessen operational costs, and help future-proof projects by minimizing carbon lock in.

DECARBONIZATION BY THE NUMBERS

The building sector is responsible for

36% of the world's final energy consumption

and 37% of global energy-related carbon dioxide emissions.

$97 billion

in U.S. Department of Energy funding from the Infrastructure Law and the Inflation Reduction Act focuses on creating new pathways for federal investments in research and development, demonstration, and deployment programs to help to achieve carbon-free electricity in the U.S. by 2035 and a net-zero economy by 2050.

In 2022,

high fuel prices accounted for 90%

of the rise in the average costs of electricity generation worldwide, natural gas alone for more than 50%.

SOURCES: IAEA.ORG, BP Statistical Review of World Energy (2022), sciencebasedtargets.or, ABC NEWS

Decarbonization RFP

✓ TO DO LIST

Here's a quick to do list for clients who are formulating an RFP for decarbonization.

Click each box to explore more.

SET GOALS AND INTENTIONS AND MAKE SURE THAT YOUR RFP MATCHES *THOSE*. →

UPDATE YOUR STANDARDS AND TERMINOLOGY. →

UNDERSTAND THE METHODOLOGY AND EXPERTISE REQUIRED TO ATTAIN THOSE GOALS. →

CONSIDER WHAT YOU'RE PAYING FOR, AND WHAT YOU NEED. →

DREAM BIG AND COLLABORATE DURING THE RFP WRITING PROCESS. →

MORE ON SUSTAINABILITY & BUILDING PERFORMANCE:

Based in Edmonton, AB, Tanya Doran is Stantec's Western Canada Carbon Lead

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Set your goals and understand the meaning of the terms you use and ensure they reflect your intentions. If you want a project to be net zero carbon or net zero energy, know that those terms can mean different things in different areas.

Do you have a sustainability strategy or a green building policy or guiding document that sets out those goals? In the absence of having criteria outlined at every individual RFP phase, setting guiding parameters will be critical to your project success.

Living in a material world

It’s time to take a serious look at alternative building materials to lower embodied carbon in buildings.

Atlassian Headquarters
Sydney NSW, Australia
Stantec: Mechanical, electrical, hydraulic, security, acoustic engineering, fire services, lighting design, ICT/AV design, vertical transport design, BIM, and ESD

Joint Venture: LCI Consultants.

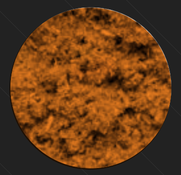
Architect of Record: Shop Architects and BVN Architects

LEARN MORE

If the building industry, and society in general, is going to take on climate change in a real way we need to talk about materials. The embodied carbon—the greenhouse gas emissions—required to make our built environment is largely associated with concrete, steel, and other carbon-intensive building materials. What are the alternatives? We asked our designers and engineers what they are excited about.

Jim Bereton

Principal Energy Innovator, Sustainability, in **Calgary, Alberta**



CELLULOSE FIBER INSULATION

STRUCTURAL HEMP

Jim Bereton is excited about hemp insulation.

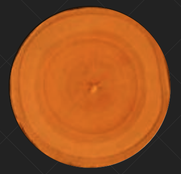
STATUS: **AVAILABLE NOW**

Sheep's wool, a natural low carbon insulating material, is particularly good at addressing moisture. It can get wet and then dry out and it doesn't settle or lose its shape over time. However, there are other lower carbon content options. Cellulose fiber insulation comes from wood waste or paper waste, so in theory it has a largest negative carbon footprint. It is also the cheapest and most easily blown in; but it does settle if not installed to the correct density. Hemp insulation is another negative carbon material. You can get it in it all kinds of different insulating and structural forms.

Structural hemp also has great promise. You grow the hemp, harvest the material, then compress it. They use mushroom glue to put the hemp pieces together. It only takes eight months instead of 25 years to grow the same amount of structural material as a well-managed Forest Stewardship Council (FSC) forest and the hemp sequesters many times more carbon. Structural material, board materials, insulating batt material, and insulating loose fill materials–you can get all of these from hemp. There are factories for hemp insulation in Quebec, Alberta, and the U.S. as well.

Brett Lambert

Architect in **Boston, MA**



MASS TIMBER

Brett Lambert loves mass timber.

STATUS: **AVAILABLE NOW**

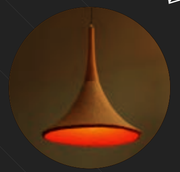
Most large buildings being designed and built today use concrete or a composite steel and concrete as their structure. Concrete and steel are the materials of choice and have been for decades. They are major contributors to embodied carbon in a building. The volume of these carbon-intensive structural components makes up a large part of the overall building. So, it makes sense to look at alternatives with lower carbon intensity such as mass timber, CLT (cross-laminated timber), glulam, and engineered wood products.

Building codes have evolved and we can now use mass timber to build taller than we were previously allowed by code. The key to mass timber is to harvest it sustainably so we must look for a company that is managing their forests appropriately and not clear cutting.

The benefit is that when you're using wood, it has actually already pulled carbon out of the environment. It's therefore possible for us to target carbon neutral or even carbon negative on the structure if done right. Mass timber also has the benefit of a lighter structure. This means you're able to reduce foundations, which can help decrease the amount of concrete and steel contained in the foundation and potentially reduce excavation extents.

Mass timber has many benefits even outside of embodied carbon. It can be exposed and celebrated in the design of the building and get the benefits of biophilic design. People have a natural connection to wood.

Right now, we are sourcing the mass timber and CLT for the projects we've designed in the Boston area from the West Coast, primarily from British Columbia, Canada. But there's talk of converting mills in the northeast to produce mass timber in order to meet the increasing demand locally.

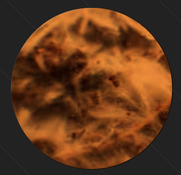


Jill Dexter

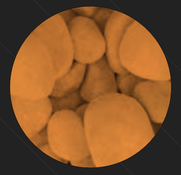
Interior Designer in **Chicago, IL**

Jill Dexter is enthusiastic about lighting grown from mushroom roots and biobased cement alternatives.

STATUS: **AVAILABLE NOW**



MYCELIUM FIBER



NATURAL AGGREGATE

BIOLOGICALLY GROWN LIMESTONE

MushLume lighting is made from mycelium fiber that's combined with sustainably sourced hemp. The mycelium grows quickly in various forms to create different shapes of the light fixture housing. Rather than using a plastic or resin for the housing they're using a plant-based material and it becomes durable enough that it will withstand being painted to achieve some fun colors. It also has a unique celestial look.

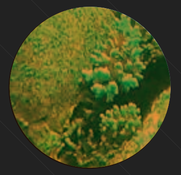
I can see these fixtures being used in hotels, restaurants, bars, and even common areas in multi-family residential spaces, or the workplace. Maybe you'd want to include a fixture or two in a new yoga studio or another place intended to be a little bit more serene.

Biolith tiles, by Biomason, are made using technology that harnesses power found in nature in which the manufacturer combines carbon and calcium to produce a final material made by microorganisms. The tiles are composed of 85% natural aggregate and 15% biologically grown limestone. The manufacturer says that for each 1 KG of Biomason Biocement that is used in lieu of Portland cement, 1 KG of CO_2 is saved from the environment. Right now, they're only available as pre-cast panels, but perhaps they will be available in a pourable solution one day so that we can really start to think about an alternative to our current concrete construction materials.

Hotel Zachary *Chicago, IL*

Marelle Davey

Sustainability Consultant,
Carbon Impact Team
in **Denver, CO**



LAB-GROWN
LIMESTONE

Marelle Davey is curious about limestone alternatives in concrete.

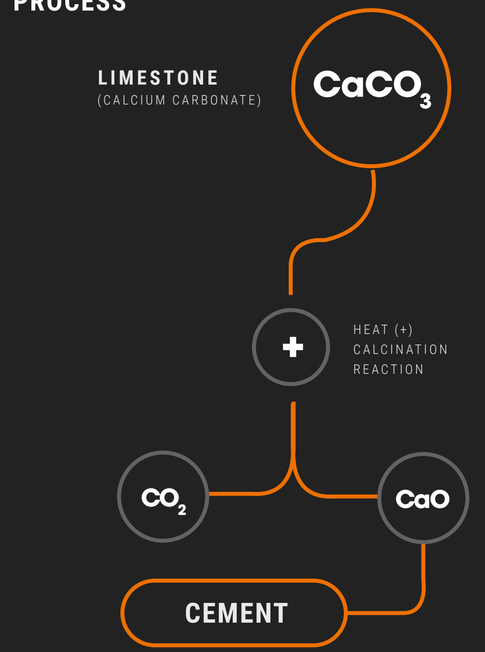
STATUS: **COMING SOON**

Concrete is the elephant in the room when it comes to embodied carbon in the building industry, which is why I'm passionate about innovative and creative low-carbon concrete technologies. I was particularly excited when I came across innovative solutions being hatched in my home state of Colorado.

One idea, developed by researchers at the University of Colorado, is to grow limestone in a lab via a carbon-sequestering process using algae. Once the limestone is grown, it still must be heated to manufacture cement. But the carbon sequestered by the algae in the limestone-growing process offsets the emissions from its manufacture, resulting in net carbon neutral or even carbon negative cement.

Another fascinating solution is to replace the limestone altogether with a substance that does not emit as much carbon when being transformed into cement. Several startups (like Terra CO2 in Colorado) are proposing limestone alternatives such as calcium-silicate that changes the chemical equation for cement production and delivers the same quality material while greatly reducing the embodied carbon.

Embodied emissions IN CONCRETE



Humans consume more concrete than anything else, except for water. And it significantly contributes to climate change.

Concrete (and cement) production accounts for 7-8% of greenhouse gas emissions globally. Cement is 12% of the volume of concrete but accounts for 95% of its carbon.

Each tonne of Portland cement produced releases roughly one tonne of CO_2 into the atmosphere. The cement industry is massive and growing.

Concrete is made up of three components: cement, water, and aggregate. Cement typically accounts for the largest portion of emissions—both direct and indirect. Cement is a product of heating up limestone at really high temperatures. Under the heat, the limestone undergoes a chemical reaction and produces cement, and CO_2. That's the direct emissions. The indirect emissions come from mining operations to extract the limestone and the fossil fuels burned to create the heat.

Then we have the aggregate.

Typically gravel or crushed rock from quarries, aggregate can carry its own embodied carbon due to the emissions associated with extraction, transportation, and processing.

Even the water used in concrete production is typically heated, and the heating process uses energy that comes with more emissions.

As architects and engineers, we're not the only ones with embodied carbon on our minds. With the passing of the Inflation Reduction Act, the United States Government has now allocated over $5 billion of funding for low carbon procurement targeting environmental product declarations, labeling construction materials, and use of low carbon materials. The White House also announced "Buy Clean" recommendations intended to advance low-carbon material procurement for federal building and transportation projects.

We have a few options when it comes to reducing emissions from cement itself.

1. **Reduce usage.** Design, model, and build with less concrete. Stantec is developing applications which can calculate the embodied carbon of a structure in the conceptual design phase, assisting us in evaluating and modeling design options. We can further reduce concrete use by choosing alternative materials like mass timber, or gravel paving for surfaces.

2. **Pursue alternative materials with lower emissions** like silicate or algae substitutes for limestone.

3. **Inject CO_2 in concrete itself.** CarbonCure's solution injects captured CO_2 into fresh concrete where it is mineralized.

4. **Use alternative aggregates:** Carbon-storing, recycled, synthetic, or plant-based.

5. **Use less water** and heat it to lower temperatures.

Barriers to innovation:
SPECS

Prescriptive specifications hold back innovation in low-carbon concrete.

For decades the AEC industry has relied on prescriptive specifications to ensure quality control on concrete mixes. These specs tend to limit the amount of SCM and prescribe a minimum amount of cement, for example. They limit the source and composition of materials but do not ensure performance.

Many materials experts say performance specifications make more sense today. Performance specs look at indicators for strength, permeability, shrinkage, sulfate resistance, and more measured by standard test methods. They allow for innovation, lower carbon approaches and even stronger concrete.

To increase uptake of lower carbon alternatives to concrete, we need to move from prescriptive to performance specifications which allow for a wider range of approaches to concrete. Ⓓ

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MORE SUSTAINABILITY

Jim Bererton offers an engineering perspective on renewable energy from Stantec's Kelowna, BC studio. Based in Denver, CO, **Marelle Davey** is a sustainability consultant. **Jill Dexter** is an interior designer based in Stantec's Chicago office on Michigan Avenue. Architect **Brett Lambert** is based in our Boston studio.

THIS IS YOUR BUILDING'S LIFE

What are life cycle assessments and who needs them?

BY AADITYA PATEL

evolv1
Waterloo, ON

Life cycle assessments (LCAs) aren't new, but these services are gaining industry momentum with an increased focus on decarbonization holistically.

Generally speaking, a life cycle assessment defines and reports on environmental impacts that stem from products and process in a building or infrastructure project. These environmental impacts include global warming, eutrophication, adverse effects on humans, and more. The LCA is a process that looks at carbon and various impact categories. When a client asks for a life cycle assessment, they might not even understand the full magnitude of what they're asking for or what they need. So, what's driving the new interest in LCAs?

303 Battery
Seattle, WA
Stantec: Mechanical engineering, plumbing, and energy modeling services
Architect: CollinsWoerman

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Refocusing on embodied carbon

The built environment represents close to 40% of global energy-related carbon emissions. It's critical that we tackle this sector if we are to reach the climate mitigation targets set out in the Paris Agreement.

Over the past decade, the industry focus has been on reducing the operational carbon emissions associated with buildings. We conduct energy modeling to understand building operations, then we implement energy efficiency strategies to reduce operational emissions. The building design industry has made great strides in energy efficiency and reducing operational carbon.

As a result of this success however, embodied carbon of new buildings has emerged as a greater contributor to total emissions, often as much as 50%. Now, as we drive toward decarbonization, the industry is refocusing on reducing embodied carbon, the emissions associated with the building materials themselves.

Most embodied carbon emissions occur before the building is operational. Operational carbon emissions on the other hand occur year on year. We can implement energy efficiency measures over the building life cycle to reduce these emissions. But with embodied carbon, once the design decisions are made and the materials are procured, the embodied carbon emissions are essentially locked in or sunk.

There is no going back.

Taking buildings on a journey towards net zero carbon requires a sequential approach to ensure that critical decisions are made at the appropriate point in the design process.

Understanding embodied carbon is essential to see the total carbon impact of the building over its entire lifespan. Embodied carbon emissions need to be a real focus for the buildings industry right now. The global construction industry will double in size over the next 40 years. If we're not focused on embodied carbon, we won't hit targets in the Paris Agreement.

The LCA is a step in the right direction.

LCAs come in a variety of forms.

For clients who want to understand the carbon impact from materials used on the project, the LCA needs to be done early in the project. To get the full value from an LCA and implement design strategies related to life cycle, it should be integrated whole-building design through the planning, pre-design, design, construction, and occupancy phases.

We recently did an LCA for a buildings project where our client was submitting for USGBC LEED. So, while the project was already largely designed and our LCA was coming late in the game, the LCA was useful for their future use. We did a proposed versus a baseline design, looking at what's there, how they designed their building versus some of the strategies that could have been implemented.

On a recent infrastructure project, we were asked to conduct an embodied carbon LCA, targeting a certification. We coordinated with the design team from early on in the design and continually updated the embodied carbon results based on design changes. We provided guidance to the design team on the carbon hotpots in the project so they could explore alternate solutions.

In this example, we identified concrete as a carbon hot spot. In both in-situ and precast form it was dominating the project's life cycle embodied carbon emissions. We first looked at optimizing design to use less concrete and then specified lower carbon concrete mixes by coordinating with the local suppliers. Overall, the project incorporated strategies such as re-use of existing site elements, alternative design approach requiring less materials, alternative transportation mode, specifying lower embodied carbon materials, and designing for extended service life. Employing those strategies, we managed to significantly reduce embodied carbon by 54%.

University of British Columbia
Brock Commons Tallwood House
Vancouver, BC
Stantec: MEP, sustainability and building performance services
Architect: Acton Ostrey Architects

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Who needs an LCA?

The trend is toward governments and cities looking at life cycles of city-owned or federally-owned buildings. Governments have large portfolios of buildings spread over the country and they want to know their carbon impact. They can lead the way. From that point it will flow down to big players and developers. Any entity with a large portfolio of buildings should be studying this so they can understand their historic impact in terms of embodied carbon and move forward.

Yes, we need an LCA.

When a client requests an LCA, our first step is to understand the need and the focus area for the evaluation. Some certifications (i.e. LEED) clearly define a focus on six different impact categories. For others, the core focus might be on carbon footprint. A client might request an LCA for LEED, which is a clear process, or they might request something very broad.

But when a client approaches us about an LCA, they may want to understand emissions from the transportation angle or specific to products they're purchasing. Depending on their focus, they may not be interested in other life cycle stages.

Whole Life Carbon Accounting

If you sum operational and embodied carbon, you get whole life carbon. As the name suggests whole life carbon accounting focuses on life cycle carbon emissions. This accounts for the embodied carbon (we use LCA to estimate/understand this aspect) and operational carbon (typically we employ energy modeling/utility analysis to estimate/understand this aspect). In whole life carbon accounting, we seek the adoption of some form of recognized and standardized methodology to establish consistent benchmarks and targets.

Requests for whole life cycle accounting are coming in from a broader sector of economy including buildings, infrastructure, water, mining and power.

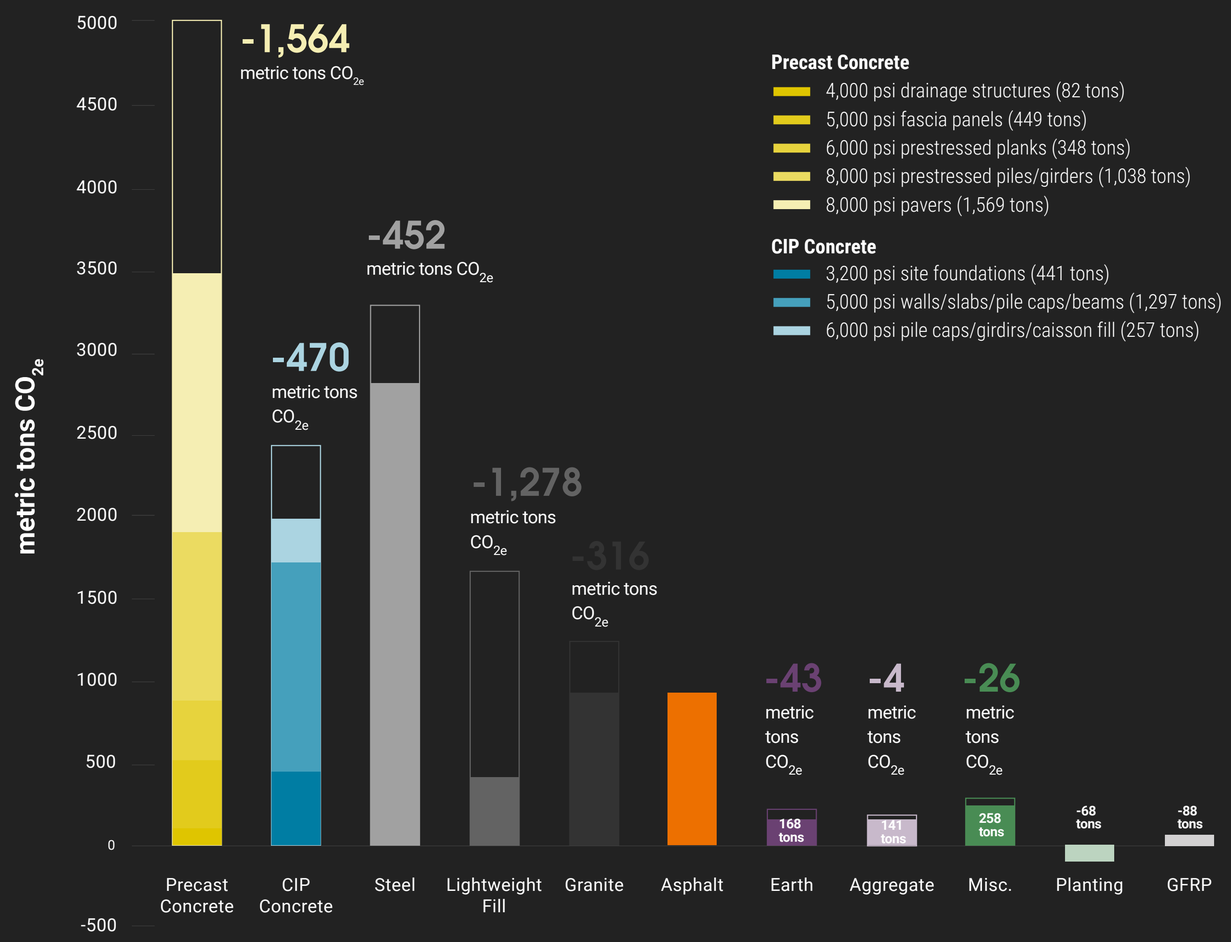
Certification: The client needs an LCA to attain a certification such as LEED or Envision.

Local regulations: The city, state, or province requires an LCA apart from the energy modelling requirements for new developments.

Internal mandates: The client's own ESG goals or a federal mandate require an LCA.

Life cycle analysis

For this resilience project, we compared the lifecycle carbon for the baseline project design against a proposed design to show where significant reductions were possible.



Stages of the life cycle

To understand carbon over the life of a building, a life cycle assessment looks at several different stages: the product stage, transportation, the use phase, and the end-of-life phase. It is important to understand the client's focus and how they're using the life cycle assessment. What are they trying to understand in terms of emissions?

For transportation, we ask what sort of material is moving. What are the distances and intensities for different transportation modes involved? Are there any alternative transportation modes available? We account for the emissions specific to transportation.

In the product stage we look at material sourcing and extraction and manufacture. An LCA could be focused on that piece of the puzzle.

LCA and steel

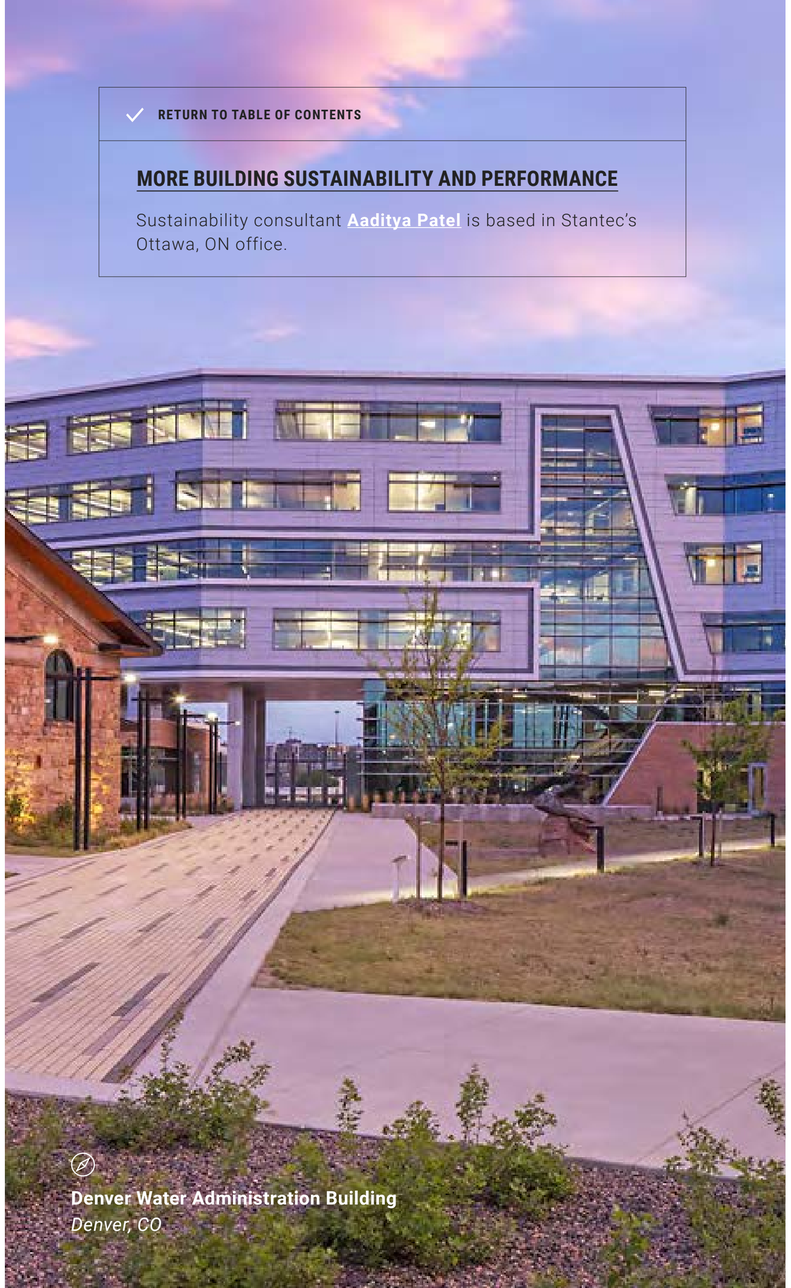
Concrete and steel typically dominate the embodied carbon picture of a building or an infrastructure project. Most of the steel produced in North America with electric arc furnaces uses high levels of recycled material and can be potentially powered by renewable energy sources.

Many global steel and concrete producers now have their own decarbonization targets. They have started looking at manufacturing their products using clean energy sources where it is feasible. This is leading to products having significantly lower product stage emissions. Hence, how materials/ products are manufactured needs to be understood as it can have a big impact.

Hot spots and replacement cycles

Insulation and glazing can also be embodied carbon hot spots. That depends on how long they last and how frequently they are expected to be replaced over the building's service life.

You can leverage life cycle assessments to focus on materials life cycles as well. Some interior materials like carpets, flooring, or countertops might not have a big impact when looked at initially. These interior elements might require several higher replacement cycles which can contribute to a significant portion of embodied carbon over a 60+ year time horizon.



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MORE BUILDING SUSTAINABILITY AND PERFORMANCE

Sustainability consultant **Aaditya Patel** is based in Stantec's Ottawa, ON office.

Denver Water Administration Building
Denver, CO

Most LCAs, however, exclude MEP equipment from their calculations primarily due to lack of availability of product specific environmental product declarations (EPDs) that help us identify their environmental impacts. As the industry is evolving, this is expected to change and soon MEP equipment would need to be an integral part of the LCA process. A building's concrete structure might last for 60 years but systems such as boilers and chillers have shorter service life and need replacement every 15-25 years. Three replacement cycles over a 60-year period could potentially form a carbon hot spot for the project.

Performing life cycle assessments to holistically understand the carbon footprint is a step in the right direction on the road to decarbonization.

Likewise, understanding the whole life carbon emissions of buildings is a key step for the industry towards creating meaningful reductions and credible pathways towards net zero. The solutions to meeting our climate change targets must be scalable, achievable, verifiable, and approached from a whole life cycle perspective.

Decarbonizing design

a conversation

We asked two experts what's happening in building decarbonization.

BY BETH TOMLINSON + ANTONINO LAGANA | INTERVIEW BY JOHN DUGAN

There’s a lot of talk today about the importance of electrifying buildings. If we’re trying to get to net zero and decarbonization, is that the right way to talk about this?

BETH TOMLINSON: When we talk about the first step toward decarbonization many people jump to electrification because it appears an easy solution to meeting our greenhouse gas emission and climate mitigation goals.

It’s not the first step. The first step is energy efficiency, whether in high performance design or in deep retrofits of existing building stock. And when we talk about deep retrofits, I don’t mean the low hanging fruit, it's not lighting upgrades. It's diving into the design or retrofit of the building envelope and increasing its performance to avoid high-energy heating and cooling demands.

After we improve the building’s envelope, then we assess the energy needs of the MEP (mechanical, electrical, and plumbing) systems. Decarbonization doesn’t mandate electrification. The building industry is committed to eliminating greenhouse gas emissions and that goal requires creative and innovative-market solutions and policies. That’s the message we need to prioritize.

ANTONINO LAGANA: I agree. The first step is energy efficiency, or the deep energy retrofit. You want a building to use energy efficiently. That's the common denominator in all energy landscapes.

I've delivered large and small zero carbon buildings. And I've electrified as far as you can electrify, and I've peak shaved with carbon neutral alternative fuels and energy storage. In many places the electrical grid cannot provide enough power to completely electrify a building or a community currently. So, we need carbon neutral alternative fuels like renewable natural gas.

Let’s talk about peak shaving. There are two types of charges on your building’s electrical utility bill. There is a charge for the energy cents per kilowatt hours, and then there's also the billing demand. The billing demand takes your monthly peak demand and slaps you with a charge for that. You want to shave that peak.

You can prevent that peak by using thermal energy storage, which is what we're doing for the Place du Portage, a large Federal project in Quebec. Or we can use fuel like renewable natural gas as I’ve recommended for the garage at Place du Portage. We cannot electrify the heating in the garage because it requires too much power and it’s sporadic.

Can you tell us what zero carbon ready means?

AL: So, to make your building energy efficient, we called that zero carbon ready. Why?

We sometimes think zero carbon means enough solar panels or a wind turbine on a property to supply all the energy required. But wind and solar are too variable and take up space. Battery storage beyond 6 to 8 hours is often cost prohibitive, and they need maintenance.

The truth is that delivering zero carbon buildings at scale is feasible where the utility provides affordable clean energy. In Quebec, where I live, we have a 'best world scenario' with clean energy from the grid, cheap electricity from hydropower, and affordable, renewable natural gas. The renewable gas is coming from our brown bins, existing landfills, and farm waste. They're injecting that methane into the natural gas network. The province of Quebec has made great strides in electrification and renewable gas. So much is dependent on the grid, so we need to talk about zero carbon-ready buildings.

Parcours Gouin Net Zero Reception Pavillion
Montreal, Quebec
Stantec: Mechanical, electrical, structural, and civil engineering services
Architect: BBBL Architectes / Provencher Roy

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So much is dependent on the grid, so we need to talk about zero carbon-ready buildings.

We can turn existing buildings into zero carbon ready buildings, right? The scope of the energy retrofitting market is huge. What's the tipping point for greater take up in the market?

AL: Everyone's on board when there's return on investment. ROI unifies everybody. There's nothing wrong with doing a deep energy retrofit because it makes money sense through energy savings and through timely equipment renewal. The approach varies from one energy landscape to another, however. For example, where electricity is expensive, you can focus on reducing electricity consumption to get a quick payback period. Natural gas is more expensive in some areas. So, you would focus on natural gas, retrofits, and measures that reduce your natural gas consumption, such as heat pumps, become more feasible.

In retrofits, you analyze each area of energy consumption. You examine each energy end use and find ways to reduce it. Typically, energy services companies come into your building, and they look for ROI through energy savings and equipment renewal. But some clients like to go the traditional way, and pay for their energy upgrade themselves, because it's less expensive for them in the long run.

BT: Another set of drivers for energy efficiency or deep retrofits are corporate commitments and reporting. When large corporations make ESG (environmental, social and governance) commitments, a component of reporting on progress requires benchmarking their existing building stock and reporting on emission reduction progress. When stockholders pay attention, deep retrofits have additional return on investment, in terms of social license.

Return on investment is also impacted by carbon taxes. The client's payback on deep retrofits or a high-performance building design expands from energy cost and savings to also include greenhouse gas emissions and associated carbon taxes. The drivers for documenting and incentivizing deep retrofits are changing. Building owners can avoid that future carbon tax by investing in themselves today.

Yukon University Polaris Project *Whitehorse, YT*

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WHERE IS THE CONCEPT OF CARBON TAX TAKING OFF?

New York City's LL97 was one of the first emissions-based building performance standards. Then Vancouver, Boston, and Washington, D.C. joined with their emissions regulation. The list grows every month. When a municipality, state, or province demands that existing buildings perform and add emission regulations, there's greater incentive for owners to make deeper retrofits. With the emissions regulations, we see incentives for deeper retrofits around the building envelope or adding passive efficiency solutions.

"Can you elaborate on some of the other elements of deep energy retrofits? What's changing there?"

BT: With older buildings, easy retrofit solutions might have been LED lighting, roofing, insulation, or window replacements. Traditionally, it was difficult to justify a deep retrofit of, say, the structural elements to support rooftop photovoltaics or investment in exterior wall insulation. These more invasive changes require careful consideration and coordination. But once you make these hard investments, there are positive domino effects. For example, if you upgrade your wall insulation, you can downsize your boiler systems or your cooling systems. Project timing is critical to leveraging planned capital expenses, like large preventative maintenance projects or system replacements.

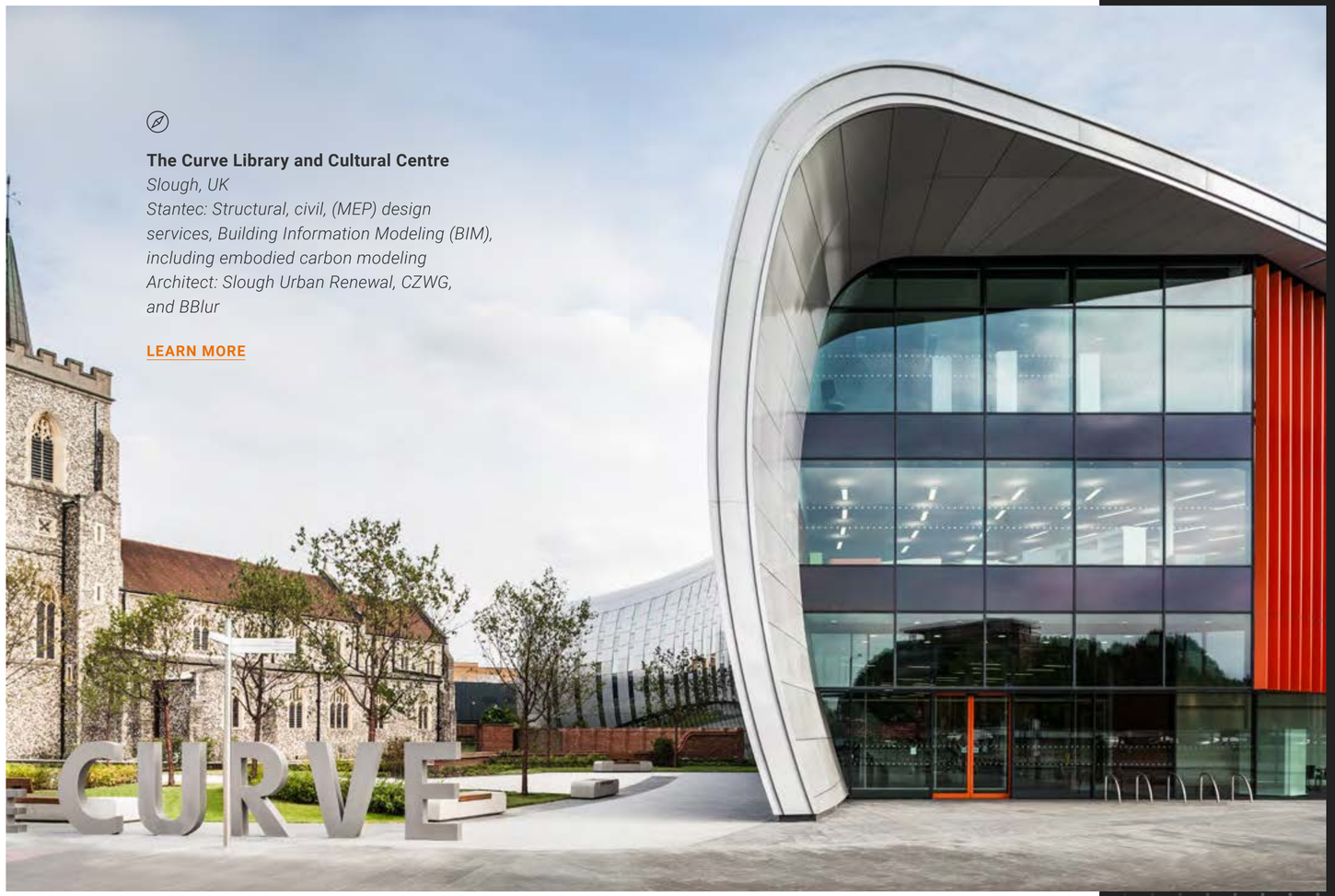
AL: Deep energy retrofits are the first step, the first brick in the wall. The U.S. needs to get its energy consumption down, and buildings use a lot of energy. But we also must convert our energy supply to clean energy. There's only so much clean energy right now. The U.S. won't be able to electrify transport and industry completely. It doesn't have the supply or the infrastructure. So, the U.S. needs to look at adding alternative fuels to its energy pie to reduce its emissions.

BT: In temperate areas, it's relatively easy to electrify. But in those areas with extreme heat and humidity or extreme cold, full electrification may outstrip current utility capacity. Additionally, we need to share that capacity with transportation's electrification evolution. We should think about reserving carbon intensive fuel for industries that desperately need it and use alternatives when we can. Whether that means using heat pumps for most of the year and only utilizing natural gas when urgently needed or using passive solar thermal to reduce natural gas demand, there are options.

These are the kinds of solutions we can offer and implement for our clients. We need to incentivize greenhouse gas emission reduction not only from the design standpoint, but to help the clients understand that these building performance standards are rapidly expanding across the United States and in Canada. Clients need to know that if they are implementing these solutions today, if they invest in a carbon neutral future through deep retrofits and energy transitions, they can avoid carbon tax expenses in the future.

Do we want to dip our toe into embodied carbon?

BT: We do. Much like the regulation of the energy consumed to operate a building and that energy's associated emissions, new regulations are beginning to take shape on embodied carbon, or the greenhouse gas emissions associated with the materials used in the whole life of a building. The State of California is implementing an embodied carbon requirement for new construction. That legislation should be in effect by 2025. As designers, we master plan projects for our clients and their campuses that look out to 75 years. So, clients need to prioritize adaptive reuse of existing buildings wherever possible.



The Curve Library and Cultural Centre
Slough, UK
Stantec: Structural, civil, (MEP) design services, Building Information Modeling (BIM), including embodied carbon modeling
Architect: Slough Urban Renewal, CZWG, and BBlur

LEARN MORE

What about building life? You're getting more from that investment in embodied carbon and money from the 50-year building than a 30-year building, right?

AL: At Place du Portage, the structure is already about 50 years old and we're conserving the structure so that we don't have to pour new concrete and needlessly add materials that have embodied carbon.

So for embodied carbon, the strategy is to retrofit the building and keep as much of the material, the concrete and the steel, as possible. We will redo the fenestration with a triple glazed curtain wall to make it efficient. The embodied carbon strategy is to conserve because that concrete could last a long, long time.

BT: Another significant driver of operational and embodied carbon emission regulations is the current development of a new building standard for whole life greenhouse gas emissions accounting. It will be a code enforceable standard for the building industry on emissions accounting. When it's adopted by jurisdictions, there will be a whole life cycle analysis for buildings so that we can compare proposed design performance of a building design or major remodel.

This will influence industry. Building developers often think in the short term. But stranded assets are risky if standards are adopted. When you start talking about climate adaptation, if you're not addressing risk upfront, then you may incur risk. There may be damage. You may need to demolish or repair or rebuild. That's also incurring embodied carbon for your portfolio.

As the industry codifies greenhouse gas emission accounting for buildings, we need to consider emissions of right-sized vs robust structural systems and risk of loss during climate extremes. Ideally, we create a holistic carbon-neutral design that balances emission reduction and tomorrow's risk.

Place du Portage, Phase 3
Gatineau, Quebec
Stantec: Mechanical, electrical, and structural engineering

Joint Venture: Stantec/BPA/ Provencher Roy/ Perkins&Will / Two Row Architects

BACK TO CARBON EMISSIONS, CONCRETE, AND STEEL

303 Battery Street
Seattle, WA
Stantec: Mechanical engineering, plumbing, and energy modeling services
Architect: CollinsWoerman

Are you hopeful about the opportunity to make a more sustainable built environment?

AL: In an ideal world, the utility provides clean, affordable energy and the building owner makes their building energy efficient. The U.S. needs to increase the supply of clean energy. The government could set up conditions so that it's favorable to utilities to provide clean energy. Then it's a matter of building owners doing their part to retrofit their buildings.

I think it's engineers like us who should be advising the government rather than just business leaders. We develop solutions every day and can say, 'Look! These are the most promising leads. This is how it can be done.'

BT: I'm incredibly hopeful. This is the most exciting time to be an engineer.

We're a part of the greatest transition in the building industry. Change is incentivized by governments and change is demanded from the social level, pushing corporations to do better. From corporations, building owners, and industry leaders in the insurance and financial sectors to local governments, utilities, and manufacturers: the transition is happening at all levels and it's very exciting.

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MORE SUSTAINABILITY AND BUILDING PERFORMANCE

Beth Tomlinson serves as Stantec's Carbon and Climate Discipline Leader for Buildings from our Minneapolis, MN studio. Based in Longueuil, QC, **Antonino Lagana** specializes in green buildings engineering.

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Executive Editors **Andrea Johnson** and **Summer Heck**
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Graphic Design **Miranda Esteve**