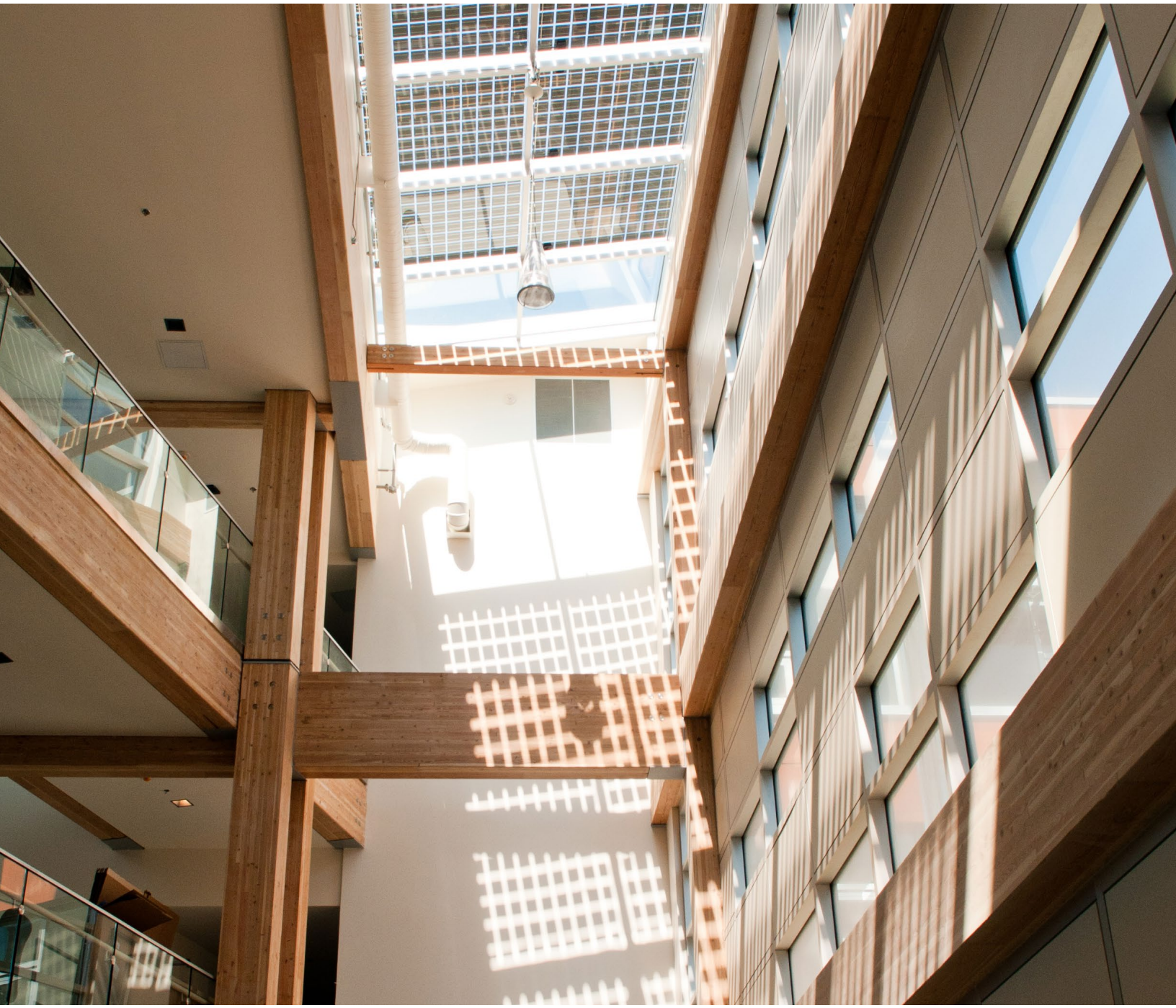
Advancing Embodied Carbon Knowledge and Policy in Municipalities

RESEARCH FINDINGS OF UBC SUSTAINABILITY SCHOLARS



THE UNIVERSITY OF BRITISH COLUMBIA
Sustainability Hub

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AUTHORSHIPS

This report was prepared by the University of British Columbia (UBC) Sustainability Hub as part of the Pathways to Net-Zero Embodied Carbon in Buildings project, which seeks to build local and regional collaborations and partnerships to identify immediate barriers and challenges to implementing embodied carbon policies and actions. The report describes the findings of five applied research projects conducted by UBC graduate students through the UBC Sustainability Scholars Program, each focusing on advancing embodied carbon knowledge and policy development in municipalities.

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The cover photo of the building's solar panels casting a shadow down the three stories of the UBC CIRS atrium lobby is courtesy of Martin Dee / UBC Brand & Marketing.

UBC Sustainability Scholars Projects:

1. Research to develop a contractor toolkit to reduce embodied carbon in new home construction
   Prepared by David Owolabi (Doctor of Philosophy in Forestry), supervised by John Ogbeba, Community Energy Specialist, City of Kamloops.
   Link to full report: https://sustain.ubc.ca/about/resources/research-develop-contractor-toolkit-reduce-embodied-carbon-new-home-construction
2. Guide to Reducing Embodied Carbon Emissions in Municipal Procurement
   Prepared by Christine Lee (Master of Arts in English Language and Literatures), supervised by Alex Leffelaar, Low Carbon Building Specialist, City of Nelson.
   Link to full report: https://sustain.ubc.ca/about/resources/guide-reducing-embodied-carbon-emissions-municipal-procurement
3. Research to update the demolition bylaw for the City of Richmond
   Prepared by Yumna Jilani (Master of Public Policy and Global Affairs), supervised by Marcos Alejandro Badra, Circular Economy Program Manager, City of Richmond.
   Link to full report: https://sustain.ubc.ca/about/resources/research-identify-opportunities-update-demolition-bylaw-city-richmond

4. Policy Options to Reduce Embodied Carbon in New Multi-Unit Residential Buildings
   Prepared by Simarjeet Nagpal (Master of Community and Regional Planning), supervised by Chris Moore, Senior Energy Specialist, City of Victoria.
   Link to full report: https://sustain.ubc.ca/about/resources/policy-options-reduce-embodied-carbon-new-multi-unit-residential-buildings

5. Research to inform embodied carbon requirements in the District of Squamish's Community Climate Action Plan
   Prepared by Juan Luis Rivera Espinosa (Master of Advanced Studies in Architecture), supervised by Ian Picketts, Manager of Sustainability and Climate Change, District of Squamish.
   Link to full report: https://sustain.ubc.ca/about/resources/research-inform-embodied-carbon-requirements-district-squamishs-community-climate

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To support the mandate of Canada's Net-Zero Advisory Body related to research, this project was undertaken with the financial support of the Government of Canada. Funding was provided through the Environmental Damages Funds' Climate Action and Awareness Fund, administered by Environment and Climate Change Canada.

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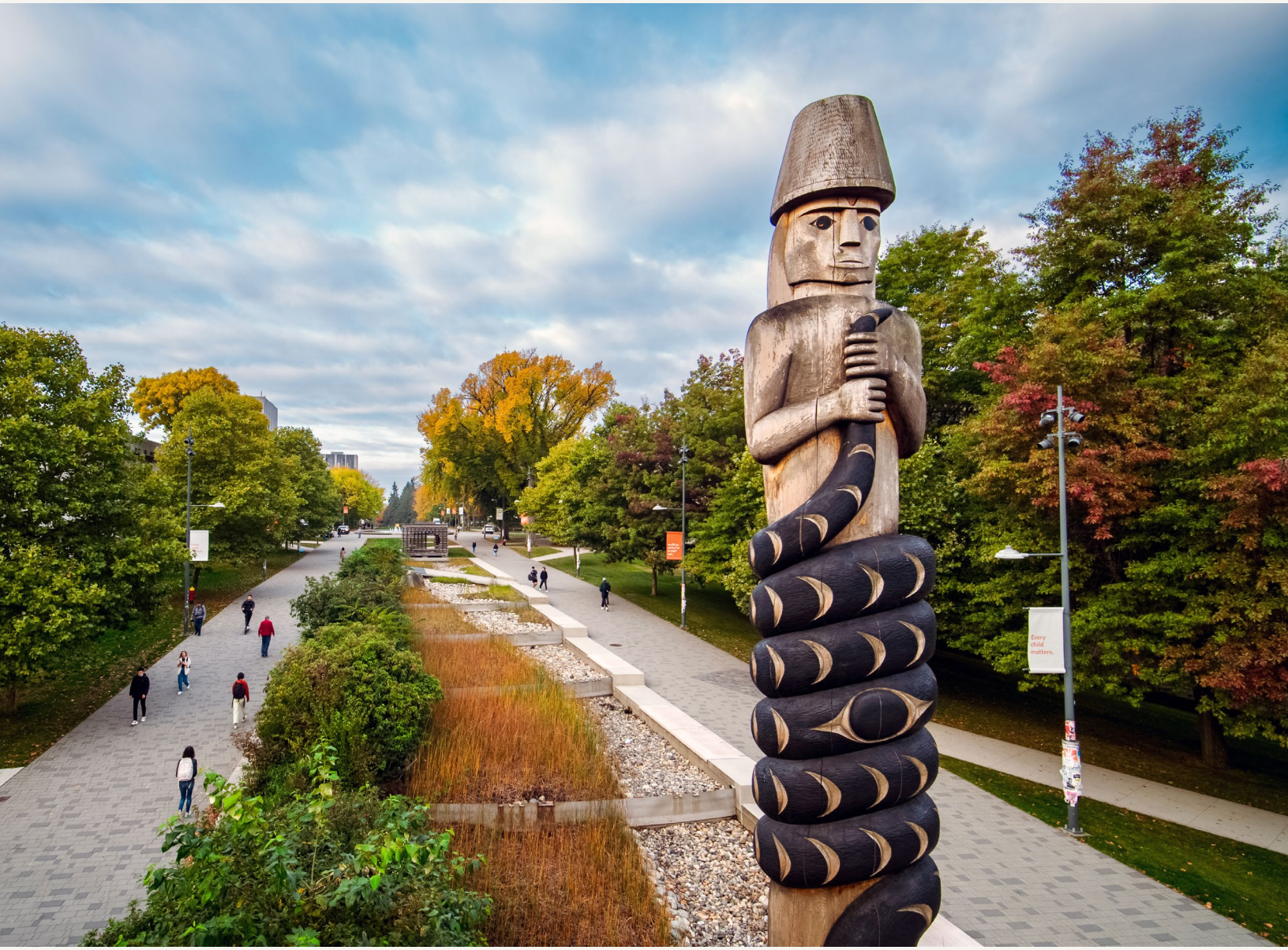
DISCLAIMER

Opinions, recommendations, and any errors in this report are those of the authors and do not necessarily reflect the views of municipal staff or the University of British Columbia.

LAND ACKNOWLEDGEMENT

The Sustainability Hub office is located at the UBC Point Grey campus, situated on the traditional, ancestral, and unceded territory of the xʷməθkʷəy̓əm (Musqueam). As part of the larger UBC community, we are guests and settlers on the traditional, ancestral, and unceded territories of the xʷməθkʷəy̓əm (Musqueam), Sḵwx̱wú7mesh (Squamish), Sel̓íl̓witulh (TsleilWaututh), and Syilx (Okanagan) Nations.

In our pursuit of sustainability, climate action and climate justice, we understand that protecting human rights is indelibly woven into environmental protection and sustainability.



ATTRIBUTION GUIDELINE

When referencing this report, please use the following citation:

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Please ensure to list "UBC Sustainability Hub" as the primary contributor.

EXECUTIVE SUMMARY

The Pathways to Net-Zero Embodied Carbon in Buildings project is a two-year initiative led by the Sustainability Hub at the University of British Columbia (UBC), with the goal of addressing barriers to reducing embodied carbon emissions from buildings. Embodied carbon, which includes the greenhouse gas (GHG) emissions produced during material extraction, transportation, construction, and disposal, represents a growing share of emissions in the building sector. The project focuses on developing local and regional partnerships to create actionable solutions that align with Canada's commitment to achieving net-zero carbon emissions by 2050.

To support the mandate of Canada's Net-Zero Advisory Body related to research, this project was undertaken with the financial support of the Government of Canada. Funding was provided through the Environmental Damages Funds' Climate Action and Awareness Fund, administered by Environment and Climate Change Canada.

The Pathways team collaborated with the UBC Sustainability Scholars program on five research projects. The UBC Sustainability Scholars Program is an innovative paid internship program that matches UBC graduate students with on- and off-campus sustainability partners to work on applied research projects that support the advancement of sustainability and climate action.

Between May 1 and August 31, 2024, five UBC graduate students participating in the Sustainability Scholars Program undertook research projects for the City of Richmond, City of Kamloops, District of Squamish, City of Victoria, and City of Nelson. Each project was tailored to address specific gaps in embodied carbon policy and implementation relevant to each municipality's unique context.

- City of Kamloops: With limited regulatory authority compared to larger cities, the project explored practical ways to reduce embodied carbon in new single-family home construction in the City of Kamloops. The research culminated in the development of a contractor toolkit, offering strategies such as using low-carbon materials and optimizing building design to reduce carbon impacts.
- City of Nelson: With a focus on reducing embodied carbon emissions through procurement processes at the City of Nelson, the research resulted in a comprehensive procurement guide that provides municipal staff with strategies to prioritize sustainable purchasing decisions, including using low-carbon concrete and promoting material reuse.
- City of Richmond: Already a leader in waste diversion through its demolition bylaw, the City of Richmond sought to expand its policies to address embodied carbon in the construction industry. The research focused on updating existing demolition bylaws to further reduce embodied carbon emissions by promoting material reuse and reducing landfill waste.
- City of Victoria: As part of its broader GHG reduction targets the City of Victoria seeks to reduce embodied carbon in multi-unit residential buildings (MURBs). The research identified key opportunities, such as implementing embodied carbon reporting requirements, revising off-street parking policies to minimize concrete use, and incentivizing the use of low-carbon building materials like wood.
- District of Squamish: The District of Squamish is in the process of updating its Community Climate Action Plan, with an emphasis on integrating embodied carbon considerations. The research recommended strategies to incorporate Scope 3 emissions, which are generated along the supply chain, and proposed adopting a circular economy approach to track material flows and reduce consumption-based emissions.

RESEARCH FINDINGS OF UBC SUSTAINABILITY SCHOLARS

EXECUTIVE SUMMARY

The research that the Sustainability Scholars completed benefitted the participating municipalities in three key ways. Firstly, it addresses knowledge gaps regarding design strategies associated with lower embodied carbon emissions and the availability of low-carbon materials. Secondly, the projects provide critical research and guides to help municipalities build their capacity for developing and implementing embodied carbon emissions policies. Thirdly, it informed upcoming policy changes at several municipalities in regard to their climate plans and demolition bylaws.

All of the projects proposed several approaches for municipalities to include in their future policy decisions. Developing better benchmarking methods can assist policymakers in collecting sufficient data to inform future policy. Further use of financial incentives can reduce industry costs and encourage compliance with embodied carbon emissions reduction policies. Several projects offered resources that municipalities can draw from to increase the use of low carbon materials. The research proposed innovative ways to increase the effectiveness of circular economy practices, including increasing minimum recycling requirements and promoting home relocation. Various types of programs and workshops can greatly mitigate the low awareness of embodied carbon emissions and associated challenges. The projects advocated for phased approaches of all of the different recommendations to avoid straining developers. Additionally, the projects encouraged an increase in collaborative efforts to create educational materials, policy language, workshop series, and feedback sessions.

The outcomes of Sustainability Scholars' research was presented to the Embodied Emissions Peer Network (EEPN) in December 2024, and it will be presented to officials in various levels of government in 2025. Insights from all Pathways project workshops and pilots, along with other municipal-focused engagements will be synthesized into policy, strategy, and resource recommendations for reducing embodied carbon emissions in buildings in 2025. These recommendations will be shared with local, provincial, and national governments to support policy changes, education and training, tools and resources, and governance structures that advance Canada's 2030 and 2050 carbon emissions reduction targets.

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GLOSSARY OF TERMS

Circular Economy: A system where materials are used instead of becoming waste, and nature is restored and protected by design. In this system, products, components and materials are maintained at their highest utility and kept in circulation through processes such as maintenance, reuse, refurbishment, recycling, and composting. (Geisendorf & Pietrulla, 2017) (Also referred to as Circularity.)

Consumption-Based Emissions Inventory (CBEI): An estimate of total Greenhouse gas emissions associated throughout the life cycle of products and services—covering production, transportation, use, and disposal— within a specific timeframe (Urban Sustainability Directors Network, 2024).

Community Charter: A legislative framework that gives municipalities and local governments the power to enforce bylaws, manage public assets, and plan for community development (Government of British Colombia, 2003).

Embodied Carbon Emissions: Total emissions linked to manufacturing of building materials and products, as well as construction, maintenance, and demolition of a built asset across a part or all stages of its life cycle (Azari & Badri, 2021).

Environmental Product Declarations (EPD): Third-party-verified documents report the environmental impacts of a product. They often represent impacts associated with raw materials extraction, product manufacturing, and transportation and distribution (NRC, 2022).

High Impact Procurement Opportunity (HIPO): A procurement process that is prioritized for sustainable purchases of goods and services or individual projects (City of Winnipeg, 2022).

Leadership in Energy and Environmental Design (LEED): The most globally recognized green building rating system, developed by the nonprofit U.S. Green Building Council (USGBC). To achieve different levels of LEED certification, a project collects points across various categories including location and transportation, sustainable site development, water conservation, energy efficiency, materials, indoor air quality (Canada Green Building Council, 2024).

Life Cycle Assessment (LCA): A systematic set of procedures for compiling and examining the inputs and outputs of materials and energy and the associated environmental impacts directly attributable to a product system throughout its life cycle (National Research Council Canada, 2022).

Operational Carbon: Emissions associated with energy used to operate buildings.

Scope 3 Emissions: Emissions resulting from activities pertaining to assets not owned or controlled by the reporting organization, but that the organization indirectly affects in its value chain (U.S. Environmental Protection, 2023)

Whole Building Life Cycle Assessment (WBLCA): Life Cycle Assessment applied to a whole building or part of a building (National Research Council Canada, 2022).

ABBREVIATIONS

CCAP | Climate Change Action Plan

CRD | Construction, Renovation, and Demolition

ECCC | Environment and Climate Change Canada

EPD | Environmental Product Declaration

GHG | Greenhouse Gas

LCA | Life Cycle Assessment

LCHP | Low Carbon Homes Pilot

LEED | Leadership in Energy and Environmental Design

MURB | Multi-unit Residential Buildings

NRC | National Research Council Canada

OCP | Official Community Plan

SCMs | Supplementary Cementitious Materials

WBLCA | Whole Building Life Cycle Assessment

ZCSC | Zero Carbon Step Code

After the transportation and oil and gas sectors, buildings rank as the third largest contributor to Canada's total greenhouse gas (GHG) emissions, accounting for 12% of all emissions (Environment and Climate Change Canada, 2022). However, this total only encompasses operational emissions and is expected to rise to 18% if embodied carbon emissions are included (Net Zero Advisory Body, 2023).

Embodied carbon emissions refer to the GHG emissions produced from energy used for raw material extraction, manufacturing, transportation, installation, maintenance, and disposal of buildings and their materials (Azari & Badri 2021). A majority of buildings' embodied carbon emissions are generated during the production of their materials and components, including raw material extraction and transportation throughout their supply chain, and construction process. Unlike operational carbon emissions, which can be reduced through post-construction efficiency updates, opportunities to reduce embodied carbon emissions are limited once the building is constructed.

Until recently, most building policies and standards have focused on reducing operational emissions. However, as buildings become more energy-efficient, embodied carbon emissions associated with the manufacture and use of materials are becoming a more significant proportion of total building-related emissions. In Canada, embodied carbon emissions could represent over 90% of a new building's total emissions by 2050 (CAGBC, 2021). As such, immediate action is required to understand and reduce embodied carbon emissions to avoid undermining GHG emissions reductions from energy efficiency.

Unlike a number of European countries, Canada lacks national-level regulations and standards to assess carbon emissions of buildings and construction products. Recent federal initiatives, such as Platform to Decarbonize the Construction Sector at Scale and Greening Government Strategy, aim to fill this gap by integrating low-carbon requirements into building codes and mandating life cycle carbon accounting. Despite these initiatives, local municipal governments remain at the forefront of embodied carbon emission reduction efforts, developing policies that address regional variations in building types and construction practices. However, these local policies often face challenges in new policy development and implementation due to limited resources, technical expertise, guidance, and coordination from higher levels of government.

With additional support, municipalities can enact new policies and contribute to creating a robust policy ecosystem at national and local levels that accelerate the reduction of embodied carbon emissions across Canada.

PATHWAYS TO NET-ZERO EMBODIED CARBON IN BUILDINGS

The "Pathways to Net-zero Embodied Carbon in Buildings" is a two-year project led by the Sustainability Hub at the University of British Columbia (UBC) to address challenges and pilot innovative solutions to reducing embodied carbon emissions from buildings. Fostering local and regional collaborations and partnerships, the project aims first to identify immediate barriers and challenges to implementing embodied carbon policies and actions. Following this, the project will help develop action items, such as policy changes, educational training, tools, and resources to contribute to Canada's 2030 and 2050 carbon emissions targets.

Four key objectives of the Pathways project and their corresponding activities have been outlined as follows:

- Identify barriers and challenges to the implementation of local and regional policies and regulations to reduce embodied carbon emissions from building materials.
- Identify and develop potential solutions to urgent challenges through collaborative and applied research projects, building on the collective expertise and experience of government, Industry, and academia.
- Create pathways or models to pilot and test proof-of-concept policy solutions and analyze their effectiveness, as well as related benefits, constraints, and trade-offs.
- Create educational and skills development materials and activities around policies and regulatory barriers and solutions, to increase capacity and inform and motivate change in government and Industry.

To achieve the key objectives, the project also conducted a series of strategic Challenge-to-Solutions workshops, with regional experts and policymakers in the Fall of 2023 and focused on the identification of key challenges and solutions for implementing embodied carbon into building policy (Challenge-to-Solution Workshop, 2024). An important outcome from the initial workshops was the recognition that successfully developing and implementing embodied carbon emissions reduction policy is critical at the municipal level, because there has been very limited leadership in policy development from higher levels of government.

The Pathways team presented these outcomes in December 2023 to the Embodied Emissions Peer Network (EEPN). This network is co-led by the Community Energy Association and Carbon Leadership Forum British Columbia (CLF BC), a program of the Zero Emissions Innovation Centre (ZEIC). The EEPN it is the only dedicated network in Canada focused on supporting local governments in their embodied emissions planning. This engagement, along with insights from the Sustainability Scholars Program, allowed the Pathways team to secure five BC municipalities to hire UBC graduate students to integrate embodied carbon considerations into municipal policies and codes.

SUSTAINABILITY SCHOLARS PROGRAM: EMBODIED CARBON PROJECTS

The Sustainability Scholars Program is a unique paid internship program managed by the UBC Sustainability Hub that connects UBC graduate students with local governments and organisations across the region to work on applied research projects. The program offers students the chance to gain practical experience while addressing real-world sustainability challenges and provide valuable insights, research, and innovative solutions that can be implemented to drive sustainability across the region.

The embodied carbon cohort of the Sustainability Scholars was designed to assist the research being done in the Pathways project to address knowledge gaps and advance regional policies. These Scholars' projects were specifically designed by the municipal partners and the Sustainability Scholars Program Manager to develop tools and provide strategic recommendations for each municipality. The participating local governments were: the City of Richmond, the District of Squamish, the City of Kamloops, the City of Nelson, and the City of Victoria.

The City of Richmond prioritized improving its demolition waste management and circular economy practices, focusing on material reuse and recycling as a way to lower embodied carbon emissions. The District of Squamish focused on integrating embodied carbon emissions reduction considerations into its Community Climate Action Plan, ensuring that Scope 3 emissions from materials were addressed within existing policies. The City of Kamloops, recognizing the role of small-scale construction, aimed to create a toolkit for contractors to guide low-carbon residential building practices. The City of Nelson concentrated on embedding low-carbon procurement practices into its operations, with a focus on municipal purchases and construction projects. The City of Victoria tackled the challenge of carbon-intensive parking structures, exploring how policy adjustments could minimize concrete use in multi-unit residential buildings.

After these research projects were completed, the Pathways project team undertook a detailed review of the reports to synthesize the findings and draw insights. This process involved analyzing the common themes, challenges, and approaches taken by each city. While all the municipalities were taking a different approach to reducing embodied carbon emissions, the review highlighted shared issues such as data gaps in embodied carbon emissions tracking and the need for robust reporting frameworks. It also brought to light how distinct approaches are tailored to local contexts, such as the City of Richmond's circular economy focus, the City of Victoria's innovative parking policy adjustments, and the City of Nelson's procurement-driven strategies. This synthesis not only provided a deeper understanding of how different cities are addressing embodied carbon emissions reductions, it also offered valuable lessons and best practices that could be shared to foster collaborative solutions across the region.

BACKGROUND

The Scholars' projects embarked on unique yet complementary pathways aimed at advancing embodied carbon emissions reduction policies and practices within their local built environments. Each project was tailored to address specific gaps or challenges relevant to the local context. By developing targeted tools, policy recommendations, and strategic plans, these projects contribute to the broader objective of reducing embodied carbon emissions from buildings in the region.

- City of Kamloops: The City of Kamloops explored workable embodied carbon emissions reduction strategies for new home construction without using the Community Charter powers through the Scholar project, aimed at being included in a contractor toolkit.
- City of Nelson: The City of Nelson aimed to find out the best approaches to integrate embodied carbon emissions reduction considerations into their procurement policy and processes through the Scholar project
- City of Richmond: The City of Richmond implemented a strong by-law for reducing and diverting waste from landfills in single-family residence demolitions. In the Scholar project, city staff worked to update the demolition bylaw with a focus on reducing embodied carbon emissions from the all-other construction industry.
- District of Squamish: The district was updating their Climate Change Action Plan (CCAP) in 2024 with an emphasis on expanding the focus to Scope 3 emissions. In the Scholar project, District of Squamish investigated approaches to integrate embodied carbon emissions reduction considerations into this new update.
- City of Victoria: The City of Victoria explored best practices to incorporate embodied carbon emissions reduction into Victoria's development plans, particularly for MURBs.

CITY OF KAMLOOPS: CONTRACTOR TOOLKIT FOR NEW HOMES

The City of Kamloops is committed to reducing community emissions by 80% by 2050, as per its Community Climate Action Plan (CCAP), adopted in June 2021. One of key strategic focus areas is reducing emissions from buildings and construction materials at the local scale. In alignment with this commitment, the City of Kamloops is developing guidelines for local building industry stakeholders on opportunities for reducing embodied carbon emissions (ECE) in the construction of single-family residential homes.

Working under the general guidance of City of Kamloops staff, David Owolabi, a PhD candidate in the Faculty of Forestry at UBC, conducted research and produced a report called "Research to Develop a Contractor Toolkit to Reduce Embodied Carbon in New Home Construction." The purpose of the project was to create a toolkit for contractors that outlined opportunities to reduce embodied carbon emissions in construction projects. A rich resource, the toolkit includes strategies, such as incentives, practices, policies and programs for optimizing building design and size and selecting and sourcing materials, as well as other resources and information relevant to the construction of single-family homes in the City of Kamloops.

Research Approach

Based on a literature and case study review of cities of similar size to the City of Kamloops and who lack the authority to set building code requirements the research gathered recommendations for reducing embodied carbon emissions. Surveys and interviews were conducted with subject experts in new construction to assess their expertise, experience with, and understanding of embodied carbon emissions concepts and reduction strategies. The surveys and interviews also collected opinions on emissions reduction practices and policies, and recommendations for integrating embodied carbon emissions considerations into housing projects in the City of Kamloops.

Results

The surveys and interviews showed that respondents had slightly above-average knowledge of embodied carbon emissions. While 75% were aware of embodied carbon impacts, only 67% were familiar with Environmental Product Declarations (EPDs) for materials or considered them in project decisions. Furthermore, just over half knew how to perform a Life Cycle Assessment (LCA). However, 75% expressed interest in training in the field.

The results show there's curiosity and willingness to shift to low embodied carbon materials for insulation, cladding, and interior surfaces, although there remains a strong preference for carbon-intensive cement. This preference may be due to challenges (such as strength gain and concrete finishing) with supplementary cementitious materials in the City of Kamloops' dry climate.

Of the emissions reduction practices, the most accepted were delivering materials in bulk to construction sites and using modular building units. Conversely, the most challenging practices were concrete-free slabs on grade and salvaged materials.

Regarding policies, the most popular included a phased approach to introducing embodied carbon emissions reduction strategies, voluntary reporting through a sustainability checklist, embedding reduction targets into the British Columbia Energy Step Code, and providing permit fee rebates for meeting reduction targets. In contrast, the least favored policies were waste management plan requirements as part of building permit applications, EPD requirements for specified building equipment and materials, and restrictions on the disposal of organic materials.

The research proposes several key recommendations for reducing embodied carbon emissions in new home construction in the City of Kamloops:

- Material suppliers and building professionals can compare EPDs from different manufacturers and choose more low-carbon materials.
- Designers need to integrate building designs with the local landscape, rather than forcing designs onto it. This approach could help reduce concrete use and carbon emissions during construction.
- Builders can make more efficient use of concrete, potentially reducing the overall carbon impact by maximizing the benefits of its structural properties, such as by incorporating radiant heating and cooling systems.
- Outreach and awareness campaigns must be organized to address industry and consumer concerns about increased housing costs due to embodied carbon emissions practices and policies.
- The City should work with its partners to provide education and training for building professionals on embodied carbon.
- The City should consider adopting a phased approach to implementing an embodied carbon policy, starting by increasing education and awareness, then providing incentives for voluntary compliance, and finally through regulation.

CITY OF NELSON: PROCUREMENT GUIDE

The City of Nelson has been leading low carbon building research and initiatives targeting embodied carbon reductions through the Low Carbon Homes Pilot (LCHP) since 2021. One of the programs projects this year was to develop a Toolkit to support other local governments to take leadership through the integration of sustainability and embodied carbon consideration into their procurement policy and practices.

To support this project, Christine Lee, a UBC master student in English Language and Literature, lead a Scholar project titled "Guide to Reducing Embodied Carbon Emissions in Municipal Procurement". This project lays out guidance and resources for municipalities and public sector organizations to support the reduction of embodied carbon emissions in capital-building projects through procurement decisions.

Research Methodology

The guide, for reducing embodied carbon emissions was based on a review of existing procurement policies and legal frameworks at the City of Nelson. Which was in turn complemented by an in-depth analysis of sustainable procurement policies and examples at 24 Canadian jurisdictions to identify best practices and opportunities for improvement. Interviews with sustainable procurement experts provided insight into their experiences, challenges, and strategies for integrating sustainability into procurement processes. Additional research explored various sustainable procurement resources, including purchasing groups, educational tools, consultants, and newsletters, to inform the final recommendations.

The result of this research is a comprehensive guide for City staff that offers a flexible range of sustainable procurement options for each phase of the process. This flexibility enables staff to adopt and implement strategies tailored to their specific needs and priorities, supporting the City of Nelson's long-term sustainability and embodied carbon emissions reduction goals.

Results

The guide is structured into three sections: Getting Started, the Procurement Process, and Procurement Policy. In the Getting Started section, City of Nelson staff have two initial options to consider:

Option 1 involves adopting a long-term, phased strategy for sustainable procurement, which should be approved by the City Council. This strategy would outline the City of Nelson's vision for a Sustainable Procurement program, including a chosen model like the Circular Economy or the four Pillars of Sustainable Procurement (i.e., environmental, social, Indigenous, and ethical pillars according to Canadian Collaboration for Sustainable Procurement), and may involve creating a dedicated staff position.

Option 2 focuses on identifying High Impact Procurement Opportunities (HIPO) and prioritizing education and outreach to raise awareness among staff and vendors about sustainable procurement. HIPOs, as the name implies, are high-impact, high-risk, or strategically important procurement areas, such as construction projects.

The Procurement Process section provides recommendations for each phase of procurement: pre-purchase, purchase, and post-purchase.

For the pre-purchase phase, checklists are offered to prompt considerations for sustainable purchasing, focusing on reducing new purchases and materials while maximizing product use, lifespan, and recycled content. For example, checklists include questions like, "Are the materials recycled, biodegradable, or renewable, including packaging?" Additionally, the guide suggests incorporating sustainable purchasing considerations into the City of Nelson's Purchase Order request form.

In the purchase phase, the guide suggests that the City of Nelson request information about vendors' sustainability practices and policies by including a sustainability questionnaire in their Request for Proposal (RFP) and assigning a point value to this criterion. This approach encourages vendors to integrate sustainability into their practices and helps the City make more informed procurement decisions. Examples of criteria for construction projects might include the use of low-carbon concrete mixes, obtaining Leadership in Energy and Environmental Design (LEED) certification, providing EPDs for materials, and performing whole-building life cycle assessments (WBLCA).

In the post-purchase phase, the guide emphasizes ensuring that sustainability-related contract requirements are adhered to throughout the duration of the contract. This includes monitoring and reporting obligations. Examples of contract clauses for construction projects might involve requiring data collection on material quantities and concrete supply, mandating reuse or recycling instead of demolition, and requiring regular reporting or disclosure of the operational carbon footprint.

The last section of the guide, the Procurement Policy section, outlines what constitutes a sustainable procurement policy and how it can be applied by municipalities. For example, a sustainable procurement policy must extend beyond just considering the lowest upfront costs and incorporate sustainability impacts to determine the "best value" for purchases. It sets procedures or criteria for City staff to include sustainability considerations in procurement decisions. Examples from other municipalities include the City of Richmond, which emphasizes best value with circular economy outcomes; and the District of Squamish, which addresses embodied carbon and evaluates best value based on social, environmental, and financial costs over the product lifecycle.

For the City of Nelson, the guide recommends updating its procurement policy to integrate new definitions of "best value" that include sustainability impacts and to align sustainable procurement strategies and the city goals. The City of Nelson can also consider including specific measures for embodied carbon emissions reductions in its procurement policy, ensuring it aligns with sustainable procurement strategies and supports the carbon reduction goals in the City of Nelson's Community Climate Plan.

CITY OF RICHMOND: ADVANCING CIRCULARITY

The City of Richmond has been a leader in the British Columbia by implementing a strong demolition by-law for reducing and diverting waste from landfill in single-family residence demolitions. By prioritizing material reuse, the City of Richmond has met its downstream embodied carbon emissions reduction targets; and now it is expanding this policy to the broader built environment in City of Richmond. Building on this success, the City of Richmond is now expanding its policy framework to address the broader built environment.

In partnership with the Pathways project, the City of Richmond piloted the research project, "Research to Update the Demolition Bylaw for the City of Richmond", by Yumna Jilani, a UBC Master student in Public Policy and Global Affairs program. The purpose of this project is to inform an updated demolition bylaw with a particular emphasis on reducing embodied carbon emissions within the construction industry.

The City of Richmond has focused on updating its Demolition Waste and Recyclable Materials Bylaw No. 9516 to advance its sustainability goals. This update involves strengthening recycling requirements, encouraging deconstruction practices, and promoting circular economy principles. The City of Richmond's approach involves collaborating with stakeholders from the construction industry, local experts, and municipal staff to identify best practices that can be implemented to enhance Circularity in building projects. The City of Richmond aims to shift from a traditional "take-make-waste" model to a more sustainable approach where materials are reused, recycled, or repurposed, thereby reducing the demand for virgin resources and minimizing embodied carbon emissions.

Research Methodology

The research supporting these efforts involved a comprehensive jurisdictional scan to evaluate existing policies from other municipalities in British Columbia and across Canada. The study included semi-structured interviews with municipal staff and industry experts to assess current practices and gather insights on potential improvements. A thorough literature review was also conducted to identify best practices in embodied carbon emissions reduction, focusing on the most effective policies and strategies that could be applied in City of Richmond's context.

Results

The study revealed several key areas where City of Richmond could strengthen its embodied carbon reduction efforts, particularly through enhanced Construction, Renovation, and Demolition (CRD) waste management. One of the primary recommendations is to increase recycling targets to 100% for clean wood and 85% for other materials, ensuring a higher diversion of waste from landfills. Additionally, expanding the scope of the bylaw to include multi-family dwellings, as well as industrial, commercial, and institutional (ICI) buildings, would significantly broaden the impact of the policy. The research also emphasized the importance of promoting deconstruction over traditional demolition, which can help salvage valuable materials and reduce waste.

Another major finding was the need for the establishment of local reuse hubs, where reclaimed materials can be stored and accessed by builders, contractors, and the public. These hubs would make it easier to incorporate reused materials into new projects, promoting circularity, and reducing the need for new materials. The study also highlighted the importance of education and training programs for professionals in the construction industry, helping them understand deconstruction techniques, embodied carbon emissions reduction strategies, and the benefits of circular economy practices. Furthermore, the use of technology to improve data collection and tracking of material use and waste management was identified as a critical component in optimizing the City of Richmond's waste reduction strategies.

Based on the findings of this research, the following recommendations were proposed:

- City of Richmond should set higher recycling requirements, aiming for 100% recycling of clean wood and 85% recycling of all other CRD materials.
- The bylaw should cover a broader range of building types, including multi-family residential, industrial, commercial, and institutional buildings, to capture more opportunities for waste diversion.
- The City of Richmond should encourage deconstruction practices over traditional demolition, as deconstruction allows for the recovery and reuse of building materials, reducing waste sent to landfills.
- The City of Richmond should develop local reuse hubs that make salvaged materials more accessible to builders and contractors, promoting the use of recycled materials in new construction projects.
- Offering education and training programs for construction industry professionals will help increase awareness and implementation of embodied carbon reduction practices, such as deconstruction and material reuse.
- Implementing better data collection tools and tracking systems will help the city monitor and optimize material use and waste management, ensuring that circularity goals are being met.

CITY OF VICTORIA: POLICY OPTIONS FOR NEW MURBS

The City of Victoria is responding to the climate crisis by taking action to reduce greenhouse gas emissions and is committed to cutting its GHG emissions by 80% compared to 2007 levels and shifting to 100% renewable energy by 2050. In line with this commitment, the City of Victoria wishes to minimize the climate impact of growing as a City and seeks to better understand current policies and programs that can reduce life cycle carbon emissions from the new construction of multi-unit residential buildings (MURBs).

To support this goal, City of Victoria staff designed and supervised the Scholar project "Policy Options to Reduce Embodied Carbon in New Multi-Unit Residential Buildings" by Simarjeet Nagpal, UBC Master Student in the School of Community and Regional Planning. The research aimed to identify key opportunities for municipal governments to reduce embodied carbon emissions in new multi-unit residential buildings and to assess how these strategies could be adapted to the municipal context of the City of Victoria.

Research Methodology

The research for this project involved a comprehensive review of existing policies and best practices from other jurisdictions across North America. The research included consultations with experts to gather insights into the financial, technological, and regulatory factors influencing embodied carbon emissions. The team conducted a detailed policy scan, identifying strategies that could be adapted to the City of Victoria's context, such as prioritizing carbon-efficient building typologies, incentivizing low-carbon construction practices, and promoting material reuse and waste diversion.

Results

The analysis of best practices across North America revealed that embodied carbon emissions estimates can and should begin at the concept design phase, because carbon reduction opportunities will decrease and potentially get more expensive as the project progresses. The research also identified an opportunity for the City to reassess current land zoning practices to integrate geotechnical, environmental, and climate considerations. The study, furthermore, looked into ways for the municipality to encourage designing new buildings for easy deconstruction and expand its waste diversion requirements based on the examples of other cities.

An overview of many waste management bylaws in cities that have established waste diversion thresholds provide a useful reference for the City to draw on when conceptualizing circular economy practices. The study also highlighted policies targeting the use of concrete, which have established thresholds for the disclosure requirements of projects. The City was also encouraged to explore possible updates for zoning requirements that necessitate below-ground parking and waive general parking minimum requirements to reduce the quantity of concrete required in new developments.

Six noteworthy policy considerations and recommendations resulted from the research.

1. Adopt embodied carbon reporting requirements for new developments, using development permits and building permits to collect the data. This data will, in turn, inform future policy development and encourage reduced embodied carbon emissions in new projects.

2. Adapt off-street parking policies to reduce concrete use. Reducing number of parking spaces requirements, particularly for underground parking, which uses a lot of carbon-intensive concrete.

3. Prioritize carbon-efficient built typologies in the Official Community Plan (OCP) update. In updating the Official Community Plan, the City of Victoria can consider prioritizing carbon-efficient building types, like wood-frame mid-rise buildings. The City of Victoria can also update design guidelines based on embodied carbon impacts and consider geotechnical factors in zoning to avoiding large developments on unstable soils and optimizing choices to reduce structural material use and carbon emissions.

4. Implement a corporate low-carbon purchasing policy that prioritizes low-carbon materials. The policy can include emission intensity limits for high-carbon materials (like concrete), and require recycled content to boost demand for materials such as salvaged timber. The City can consider applying artificial discount rates and shadow pricing to factor carbon emissions into bid evaluations alongside cost and schedule.

5. Increase construction waste diversion and material reuse by setting higher waste diversion thresholds (50%-75%), implementing bylaw s that make home relocation more attractive than demolition, advocating for provincial standards on reclaimed wood quality, and recommending adjustments to CRD landfill tipping fees to incentivize recycling over landfilling.

DISTRICT OF SQUAMISH: UPDATING THE COMMUNITY ACTION PLAN

Community Climate Action Plan (CCAP) to guide efforts toward a 45% emissions reduction by 2030 and achieving net carbon neutrality by 2050. The plan consists of 122 actions organized into six Big Moves focused on waste, transportation, buildings, and organizational readiness. The CCAP is being updated in 2024 to include targets, actions, and impactful measures for reducing carbon emissions within the community. It also focuses on expanding Scope 3 emissions—embodied emissions not directly produced within the District of Squamish, but generated along the supply chain of goods and services.

To support this, Juan Luis Rivera Espinosa, a UBC graduate student in the Master of Advanced Studies in Architecture program, worked with staff at the District of Squamish on the project: "Research to Inform Embodied Carbon Requirements in the District of Squamish's Community Climate Action Plan." This project aimed to investigate the best approaches to integrate the reduction of embodied carbon emissions considerations into the next iteration of the District of Squamish's CCAP.

Research Methodology

The current 2020 CCAP and other internal documents were reviewed to identify opportunities for incorporating Scope 3 emissions into the plan's existing structure. A selection of 18 climate plans was also examined to identify effective examples of plan organization, communication, actions, quantification, and measures of success.

Results

Initially, the District of Squamish considered developing an estimated Consumption-Based Emissions Inventory (CBEI) specific to the area. However, after reviewing the 2020 CCAP, the research suggested that developing a CBEI might not be the best approach due to its cost, complexity, and high margin of error. Instead, the District could use existing estimates from the Community Energy Association and Metro Vancouver. The research recommends that the District of Squamish develop alternative KPIs specific to each proposed Scope 3 strategy in the new CCAP. This approach will provide more accurate metrics regardless of whether a CBEI is conducted.

Following a jurisdictional review and analysis of 18 climate action plans, the research recommended integrating Scope 3 emissions actions into the District's existing Big Moves 1, 4, 5, and 6, rather than adding a new Big Move to the plan. Among the many recommended actions "Big Move 1: Close the loop on waste" focuses on advancing a circular economy by addressing a key driver of consumption-based emissions—the flow of materials, goods, and services. The District is well-positioned to adopt this approach by leveraging its Circular Economy Roadmap and implementation plan. Therefore, instead of conducting a CBEI, the research suggests developing a Circularity Index. This index would help the District understand regional flows of materials, goods, and services, and track progress toward circularity, while ultimately reducing consumption-based emissions. The built environment (Big Moves 4 and 5) was also a major area of focus, and a key proposed action was offering a density bonus to developments that can illustrate meaningful reductions in embodied carbon.

In addition to the proposed actions, the research outlines three guiding principles to enhance the 2024 CCAP update:

- Avoid pigeon-holing embodied carbon. Embodied carbon should not be limited to specific sectors like the built environment or waste. Instead, it should be recognized as an interconnected issue that affects all sectors and be integrated across all aspects of the CCAP.
- Employ systems-thinking. Addressing Scope 3 emissions requires a shift from a sector-based perspective to a systems-based perspective that considers the emissions from the flow of goods, services, waste, and energy into and out of the District's boundaries.
- Invest in capacity building and education, including broad-based training efforts, especially for marginalized and underserved groups, to accelerate policy implementation and ensure an equitable transition to net-zero emissions.

IMPACT OF THE PROJECTS

The Sustainability Scholars and their municipal partners designed the projects in a way that would provide long-lasting benefits for the municipalities and the region as a whole. The projects provided a wide range of considerations for different audiences, which can help increase awareness of embodied carbon emissions reductions. Since the topic is niche to many policymakers and industry professionals, the contributions of the projects will provide a valuable contribution for future research and policy development.

Scholars' research with the municipalities uncovered and addressed several knowledge gaps. The level of literacy regarding embodied carbon emissions reductions in design among local construction professionals was surveyed and measured. This can help inform municipalities on how to further educate the industry to provide feedback on new regulations. The project for the City of Nelson specifically developed a guide for contractors and policymakers alike to support sustainable procurement of construction materials. This resource can be used by many regions to help design policies and support the low-carbon supply chain.

Insights from the projects can help municipalities build capacity to address embodied carbon emissions reductions. The Sustainability Scholars were able to conduct critical research and produce high quality results in a short period of time that might have been difficult for municipal staff to do on their own, due to financial barriers and lack of time. The City of Kamloops now has a roadmap for engaging the construction industry in reducing embodied carbon emissions. The City of Victoria has a foundation for future embodied carbon emissions tracking and benchmarking in its development process. Moreover, the contractor toolkits, procurement guides, and policy recommendations provide information that will be of use currently and in the future.

The Scholars' projects will be used by the city partners to inform upcoming policy changes that include embodied carbon as a priority for future building processes. Several guiding principles for policy language came from the District of Squamish's project. Other municipalities can rely on such a framework to begin the process of considering embodied carbon emissions reductions in their policies. The City of Richmond's project included a jurisdictional scan assessing policies regarding circular economy practices was given to the City of Richmond, aiming to support the latest update to the municipality's demolition bylaw. As the City of Richmond is a key leader for deconstruction policy, the project can have a wide impact across the region.

The Scholars' research identified a number of common approaches to advancing regional work on embodied carbon emissions reductions that staff and policymakers can apply in their work. In general, they fall into two larger categories: context- or locale-specific approaches that can be actioned most effectively at a municipal level; and, approaches best leveraged through collaboration and partnerships.

MUNICIPAL APPROACHES

Develop Better Benchmarking Methods and Data Collection

Currently most municipalities do not collect information related to building materials or their emissions. One strategy to systematically gather building materials emissions data could be to require the submission of a materials and emissions checklist along with the building permit application. The checklists could ask about sourcing, manufacturing, packaging, operations, repair, and disposal of the construction materials. They could also include applicable information about the use of reclaimed or recycled materials, if the municipality is developing or implementing circular economy initiatives. Municipalities can aggregate data from these checklists to help policymakers determine life-cycle assessment benchmark targets and approaches to lower embodied carbon emissions.

Many of the projects assessed benchmarking tools for embodied carbon emissions and methods to collect data within municipalities. A survey of tradespeople in the City of Kamloops indicated a clear preference for voluntary sustainability checklists. The project for the City of Richmond reported a lack of adequate technology to effectively track and organize embodied carbon emissions data within the municipality. Developing a unique consumption-based emissions inventory was found by the research for the District of Squamish to be impractical due to financial constraints. Instead, the report suggested considering what the City of Montreal's Climate Plan 2020-2030 had done in its evolving circularity index, which helps policymakers decide the degree of implementation of circular economy practices.

Provide Financial Incentives to Encourage Best Practices

Offering rebates on permit fees for projects with locally sourced, reused, and other low-carbon materials can nudge developers to consider such options to lower their budgets. This could help suppliers of low-carbon materials to increase production and grow the low-carbon material supply chain in BC. Rebates could additionally be offered to developers who retrofit existing buildings. Making the retrofitting process easier and more affordable could prevent a huge amount of demolition waste, especially in cities where it is currently more financially viable to demolish rather than rebuild buildings.

The report for the City of Victoria demonstrated some cost savings in using low-carbon purchasing, specifically that using wood frames offered over 15% in savings in construction costs compared to concrete structures. Research included a jurisdictional scan of cities with incentives for better design, and it highlighted the State of Oregon's Sustainable Buildings for All (SB4A) Incentive Framework as a model for the City to consider. This policy has a system of financial incentives based on the LCA certification level of the project application submitted. The research for the City of Richmond urged staff to learn from the City of Squamish's policy to require permit holders to pay a refundable Demolition Diversion Fee. When developers demolish a structure, they are given a portion of their fee back depending on how much divertible material they were able to salvage. If implemented in the City of Richmond, this could further encourage demolition companies to adjust their process to include deconstruction services. The project for the City of Kamloops similarly identified that permit fee rebates were a popular idea among surveyed contractors, who had already admitted to limited use of low carbon materials in their projects.

Increase the Use of Low Carbon Materials

Several projects suggested that cities use local supplier's Environmental Product Declarations (EPDs) and the City of Nelson's Material Carbon Emissions Guide to provide developers with more information to make their material choices. Pre-purchasing guidelines are effective to minimize new material use, extend product life span, and leverage LCAs and EPDs to ensure accurate carbon accounting. Such resources could be used to develop and implement mandatory low-carbon purchasing policies. These policies can include requirements for recycled content and shadow pricing for carbon emissions to ensure they are considered alongside cost, schedule, and other existing criteria.

Surveys of contractors in the City of Kamloops revealed that few use low-carbon materials, partly because the construction industry is slow to adopt changes and partly because of the limited availability of such materials in Kamloops. Contractors voiced concerns specifically around using concrete-free slabs in structural work, due to the challenges presented by dry climate and its effect on concrete strength. The report for the City of Victoria encouraged staff to focus on increasing the usage of specific low-carbon materials. It cited the City of Langford's Low Carbon Policy, which requires reporting and reductions specifically for the use of concrete, as an example of the path the City of Victoria could take. Research for the City of Nelson suggested including sustainability criteria in the pre-purchase, purchase, and post-purchase phases of the City's procurement process. The report drew upon the procurement policy of the City of Squamish, which considers the social, environmental, and financial costs in material selections.

Advance Circular Economy Practices

Several projects recommended increasing municipalities' minimum recycling requirements to reduce landfill waste, with a specific emphasis on reusing clean wood. Increasing reuse requirements could encourage innovative solutions to disassemble and reuse materials, store materials for reuse, construct houses to be deconstructed, and relocate houses when possible. Home relocation is a novel strategy that homeowners are largely unaware of, and this can be further encouraged with bylaws to make it more straightforward and affordable. A municipality can track circular economy practices according to its own criteria using a public benchmarking interface that uses graphics to demonstrate progress in various categories. A circular economy asset map can highlight tools and resources for the region by organizing them by theme in a graphic. Such measures can help the industry and public take advantage of material rescue opportunities.

A jurisdictional scan for the City of Squamish found that, across the board, embodied carbon reduction policies were often "pigeonholed" and not integrated with circular economy policies. Research for the City of Richmond showed that their current bylaws are in line with broader regional efforts, with a focus on reusing materials such as concrete, asphalt, and clean wood. In contrast, the City of Victoria, the City of North Vancouver, and the City of Vancouver have prioritized the salvage of old-growth lumber, and this is a missed opportunity for the City of Richmond. The project for the City of Victoria identified that contractors across the region lacked trust in reclaimed wood, in part because there was a lack of quality assurance. Oregon State Building Code and State of Washington's International Building Code's Used Solid-Sawn Lumber Section were cited as examples for BC to follow, as it has been overcoming this issue by establishing a standard grade for the quality of reclaimed wood.

Refine Public Engagement Strategies

Workshops and other educational series can be put on by municipalities to educate the public and building industry officials on embodied carbon emission reduction strategies in order to build overall awareness and encourage public participation. The sessions can cover a variety of topics, such as low carbon material availability and local vendors, construction methods to reduce embodied carbon emissions, and energy efficient retrofitting. This can be supplemented by low carbon material trade shows, question and answers sessions, and consumer reuse challenges. Public engagement events are useful for community members and industry officials to meet each other and develop connections. This can help low carbon vendors to attract more business, homeowners to understand their options for deconstruction, contractors to design with less embodied carbon emissions, and municipal staff to finetune policies according to the concerns of the community.

Lack of awareness of embodied carbon emissions in the industry presents substantial challenges. Research for the City of Kamloops found that low literacy on embodied carbon emissions and its reduction strategies within the construction sector hinders effective policy implementation. Gaps in public awareness about embodied carbon were also identified in the City of Nelson, the City of Victoria, and the City of Richmond. This slows the adoption of sustainable practices and limits broader community engagement in carbon reduction efforts. The City of Richmond was found to be effective in its creation of educational materials for the community and its collaborative efforts with deconstruction companies and other municipalities. Research on best practices for the District of Squamish found the Smart Climate City Strategy Vienna in the City of Vienna, Austria to be successful for encouraging public participation. Its digital public participation channels with accessible, user-friendly design enables all social groups to be able to provide input.

Embed Embodied Carbon Reduction into Existing Policies

There are questions around the extent of a municipality's regulatory authority regarding embodied carbon emissions of buildings, which causes municipal staff to hesitate to create legislation on the subject. Some cities have already folded embodied carbon emissions considerations into existing bylaws, and this has been shown to be effective. A phased approach to all of the aforementioned recommendations is best to provide time to educate the public and to avoid straining developers.

Surveys of contractors in the City of Kamloops found that they favour a phased approach to embodied carbon emissions reduction strategies. The City of Richmond has integrated embodied carbon emissions reduction practices within its demolition bylaw updates for residential buildings. The project for the City of Richmond noted that this causes inconsistencies among different development types which will continue until commercial and multifamily units are gradually included.

COLLABORATIVE APPROACHES

Many of the aforementioned strategies to reduce embodied carbon emissions for buildings require collaboration with various stakeholders. This section has been developed as an outcome of the Sustainability Scholars projects and the previous workshops conducted under the Pathways project.

Creating Educational and Feedback Sessions

A lack of industry and public understanding around measuring and reducing embodied carbon emission from buildings was a common theme across all of the Scholar's projects, echoing feedback from Pathways' project workshops. Municipalities are uniquely positioned to create educational and policy feedback sessions tailored to the needs and opportunities within their communities. For example, workshops to explain the overall concepts of embodied carbon emissions can assist a broader public awareness campaign, technical design workshops could allow design and construction professionals learn about available tools and their applications, and workshops on sustainable purchasing for the industry's vendor community can increase the specification and procurement of low-carbon materials in local projects.

The City of Kamloops has begun offering community workshops on salvaging materials. The City of Richmond offers regular public feedback sessions which have allowed the municipality to pass cutting-edge deconstruction legislation. Inspired by the City of Richmond, the Scholar for the City of Victoria recommended creating more public engagement strategies to inform the public on the practicality of house relocation, as an alternative to demolition. Such efforts can be developed by several municipalities together to help build long-term engagement and support across the region.

Coordinating Policy Language and Educational Resources

A lack of consistent or overall embodied carbon emission regulation for BC was also a common issue across the Scholars' projects. Previous Pathways' project workshops have flagged the importance of provincial or federal legislation, or building codes updates in helping both industry and local authorities plan and transition to a low-carbon construction economy. Without legislation from other levels of government, more strategic bylaw alignment across the region could assist in the consistent implementation of embodied carbon reduction efforts. This is already happening to some degree. For example, the City of Richmond has collaborated with the City of Victoria and the City of Vancouver to inform the development of its new demolition bylaw. Additionally, smaller cities like the City of Nelson, the City of Castlegar, the District of Squamish, and the City of Kamloops have common challenges in jurisdictional authority and staff capacity. These municipalities could work more closely with each other on policy development as well as educational materials, sharing resources to reduce the workloads and consolidate efforts.

Similarly, establishing shared opportunities and platforms for municipalities to exchange information, challenges, solutions and lessons learned could facilitate this type of collaboration. Contractor toolkits developed by the City of Kamloops and the procurement guides created by the City of Nelson, for example, could serve as useful templates for other cities in BC. The projects for the City of Nelson and the City of Kamloops recommended the cities also reference low-carbon sourcing guides made by Canadian universities and NGOs. Academic institutions and NGOs can do more to assist in the development of such resources, and facilitate knowledge exchange and discussions among municipalities, as well as with provincial and federal government agencies .

NEXT STEPS

The UBC Sustainability Scholars embodied carbon cohort of projects, supported by the Pathways project, played a critical role in advancing embodied carbon knowledge and policy within the municipalities of Richmond, Kamloops, Squamish, Victoria, and Nelson. Each city's project was designed by the city partners to address specific gaps, whether it was the City of Richmond's focus on updating demolition bylaws to reduce embodied carbon emissions, the City of Kamloops' development of a contractor toolkit, or the City of Victoria's innovative approach to integrating embodied carbon emissions considerations into parking and building typologies. These Scholars' projects not only resulted in practical tools but also provided strategic recommendations for future municipal policies aimed at reducing the carbon footprint of buildings. In addition, these projects highlight the importance of collaboration between municipalities, industry stakeholders, and academic institutions in achieving ambitious climate goals.

Municipalities, policymakers, and industry professionals can adopt the recommendations from these projects to move forward with their own approaches to embodied carbon emission reductions. Cities can begin by integrating embodied carbon emissions reporting requirements, promoting low-carbon building materials, and aligning local policies with provincial and national climate goals. Collaboration across sectors and between cities in sharing best practices, data, and resources will help drive forward the implementation of embodied carbon reduction strategies. Steps such as offering incentives for low-carbon construction and developing educational campaigns, can help municipalities build capacity and raise awareness on the importance of reducing embodied carbon.

As the next step for the Pathways project team, the outcomes of Sustainability Scholars' research will be presented to the Embodied Emissions Peer Network and to officials in various levels of government. Insights from all Pathways project workshops and pilots, along with other municipal-focused engagements will be synthesized into policy, strategy, and resource recommendations for reducing embodied carbon emissions in buildings. These recommendations will be shared with local, provincial, and national governments to support policy changes, education and training, tools and resources, and governance structures that advance Canada's 2030 and 2050 carbon emissions reduction targets.

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