Burying Carbon in Buildings

Low-Carbon Concrete Procurement Guide

CAGBC
Canada Green Building Council
Conseil du Bâtiment Durable du Canada

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About the Canada Green Building Council
The Canada Green Building Council (cagbc.org) makes sustainability a competitive advantage. As Canada's leading authority on green building, CAGBC accelerates efficient, low-carbon buildings with the solutions the sector needs to protect assets and deliver value – through our trusted certifications, data-driven insights, government advocacy efforts, and professional skill development.

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About Pratus Group (in partnership with Quasar Consulting Group)
Pratus Group (pratusgroup.com), in partnership with Quasar Consulting Group, is a full-service mechanical, electrical, ICAT, sustainability, energy modelling, and commissioning consulting firm with multiple offices across Canada. Together, Pratus Group and Quasar provide expertise in the design, development, and operation of low-carbon, sustainable buildings and infrastructure.

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Introduction

Project Background

Meeting Canada's climate targets will require rapid, large-scale emissions reductions across the built environment – not only from building operations, but increasingly from the materials used to construct our homes and infrastructure. The industrial manufacturing of materials used in building and infrastructure construction is a significant contributor to carbon emissions. Decarbonizing these heavy industries will have an impact on reaching Canada's climate targets – but doing so will require unique strategies.

Concrete and cement sit at the centre of this challenge. They are foundational to nearly every building and infrastructure project in Canada, and their emissions profile makes them a priority for industrial decarbonization.

Cement accounts for seven percent of global CO_2 emissions each year, while Canadian cement emissions represent about 1.4 percent of total annual emissions as of 2020. Decarbonizing concrete and cement materials is a shared challenge and will require new methods to make and use these materials along with new approaches to building and infrastructure design and construction.

At the same time, demand for concrete will remain strong. More than 14 million tonnes of cement and 60 million tonnes of concrete are produced in Canada each year. From 14 grey cement plants and more than 1,100 concrete manufacturing plants, Canada's cement and concrete industry contributes more than $5 billion directly to the economy, accounting for more than two percent of total Canadian manufacturing Gross Domestic Product (GDP).

Concrete will continue to underpin community growth and nation-building projects - from housing and energy infrastructure to ports and airports, highways and transportation corridors, dams, and bridges.

This near-term demand creates an opportunity. Public sector policies, green building certifications, and private sector commitments are increasingly driving demand for lower-carbon materials, including concrete. Yet, market uptake remains uneven. Pathways to meaningful emissions reductions are not always clear to project teams, owners, and procurement professionals. Investment in carbon capture and utilization technologies for cementitious building materials (CCU-CBM) offers a promising avenue to reduce carbon while maintaining the performance, durability, and scalability that the built environment requires.

Canada has been an early pioneer in the development of low-carbon technologies for cement and concrete production including CCU-CBM. Unlocking the full potential of these technologies requires clear guidance on how they can contribute to emissions reductions at the building and portfolio level, and how they can be integrated into existing procurement and certification frameworks.

Recognizing this opportunity, the Canada Green Building Council (CAGBC) initiated the Burying Carbon in Buildings project to develop, test, and outline recommendations for quantifying and maximizing potential emissions reductions from CCU-CBM technologies. Delivered through nine-stages between the years 2022 and 2026, the project focused on quantifying emissions reductions, understanding market implications, and translating technical innovation into practical action.

The *Burying Carbon in Buildings* project consisted of a nine-stage process delivered between the years 2022 and 2026. This report fulfills the last stage of the project scope and provides guidance on the procurement of lower-carbon concrete overall, and concrete made with CCU-CBM technologies specifically.

Establishment of an Expert Advisory 1	**Publication of the Market Primer** 4	**Development of a Framework for Use / Application of CCU-CBM** 7
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University of Toronto Research   CAGBC Publications

Figure 1: Project phases in the CAGBC Burying Carbon in Buildings Project

Cement and Concrete Fundamentals

This report is not intended to provide a comprehensive understanding of cement and concrete materials. For cement and concrete fundamentals, see the previously published *Market Primer: Carbon Capture and Utilization in Cementitious Building Materials.*

Further information is available in this companion document, including information on:

- How cement and concrete materials are manufactured.
- Embodied carbon and environmental impacts of cementitious materials.
- Decarbonization strategies for cementitious materials.
- Status of deployment of these strategies in Canada.
- Viewpoints of relevant stakeholders on barriers and opportunities to low-carbon concrete.

Fundamental concepts of cementitious materials and concrete products are summarized on the following pages.

Additional information is available through other technical reports prepared by industry associations, consultants, government agencies, and non-profits, including:

- Cement Association of Canada: Concrete Zero
- Concrete Ontario: A Guideline for Specifying Low Carbon Ready Mixed Concrete in Ontario
- Lower Carbon Concrete Task Force: Lower Carbon Concrete Guide
- National Research Council Canada: Low-Carbon Concrete Materials: Current and Emerging Technologies
- Pembina Institute: Building One Canadian Economy
- ZGF, Fast+Epp, EllisDon, & Lafarge: Concrete: A Pragmatic Approach to Lowering Embodied Carbon

Concrete and Embodied Carbon

Embodied carbon is the total greenhouse gas (GHG) emissions associated with a material, product, or building, excluding emissions from energy used in operations. Building materials generate environmental impacts throughout their life cycle, including during their production, transportation, manufacturing, installation, maintenance, and disposal at end of life.

Concrete consists of a mixture of cement, sand, gravel, water, air, and minor quantities of other additives. For concrete materials, almost 90 percent of embodied carbon emissions arise from the manufacturing of cement. The calcination reaction used to create clinker used in Portland cement is fuel-intensive (which generates emissions from fossil fuel combustion), and the calcination reaction itself directly results in the release of CO_2 into the atmosphere.

Variations in the specific proportions of the materials used in the concrete mix results in a wide range of products that have different strengths, durability, and other properties. This variation also leads to differences in the emissions intensity of the resulting product.

Concrete that uses higher proportions or total quantities of cement will generally have higher emissions intensities, while concrete mixes that make use of cement alternatives or which require lower strengths will generally have lower emissions intensities.

It is important to note, however, that performance requirements for durability, service life, and structural efficiency are factors that significantly influence whole-life carbon performance of concrete. In some exposure conditions, higher-performance concrete may reduce life cycle emissions by extending service life and minimizing maintenance requirements.

Methods for Quantifying Embodied Carbon

Embodied carbon emissions are quantified using a technical methodology called life cycle assessment (LCA). This methodology assesses the environmental impacts produced at each stage of the material life cycle, including upstream and downstream processes associated with each stage. Impacts are then summed for all components and reported using consistent metrics.

When applied to specific building products or materials, the environmental impact of a given product or material can be reported using a tool known as an Environmental Product Declaration, or EPD. In addition to carbon emissions, other environmental impacts are often also reported, such as ozone depletion or acidification potential. Whole-building LCAs can also be completed that quantify the embodied carbon of a whole building utilizing the information from the individual EPDs for constituent materials and the quantity or volume of materials used in the construction of the subject building.

Industry benchmarks and average values for the carbon intensity of different concrete mixes are already available across Canada. The carbon intensity of a given mix can be compared against these industry baselines to estimate the emissions reduction potential in comparison to a standard mix.

Strategies for Reducing the Embodied Carbon of Concrete

USING ENABLING PROCUREMENT STRATEGIES

Concrete products can be specified either prescriptively or based on desired performance. Prescriptive specification approaches define exact requirements for concrete mix proportions and material quantities, preventing innovation. Prescriptive specifications leave little room for miscommunication but requires specifiers to have accurate understanding of available materials, expected outcomes, and current best practices. Performance-based specifications enable flexibility for concrete suppliers to optimize their mixes to meet measurable criteria but requires careful attention and collaboration so that all partners can understand the intent and requirements for the project. Performance-based specifications are foundational to achieving lower-carbon concrete outcomes.

SWITCHING TO LOWER CARBON FUELS

Cement kilns require high consistent temperatures of approximately 1,450° Celsius. Fossil fuels such as coal have traditionally been used to achieve these high temperatures. The use of alternative fuel sources that have a lower carbon impact reduces the emissions generated by the manufacturing process through reduced emissions from fuel combustion. Possible alternative lower-carbon fuel sources include municipal, commercial, and pre-consumer or non-hazardous industrial wastes, agricultural wastes, construction and demolition, and/or non-recyclable plastics. Alternative fuels can contain biogenic materials. The combustion of these materials in cement kilns can be lower-impact than traditional incineration, waste-to-energy, or landfill disposal methods. Other energy sources to power cement kilns are being researched and explored, including hydrogen energy sources and electrification.

CLINKER REPLACEMENT AND MIX OPTIMIZATION

As approximately 90 percent of the embodied carbon of concrete products arises from the production of Portland cement used to make concrete products, reducing clinker content through the use of supplementary cementitious materials (SCMs), Portland limestone cement (PLC), or through optimized mix designs can achieve embodied carbon emissions reductions between 10 - 40 percent. Actual reductions achieved are influenced by the availability of these materials and desired performance requirements for the concrete. Optimizing concrete mix designs to reduce the total quantity of cement used or replacing some quantity of the cement with alternative binder materials are commonly deployed strategies, though alternative materials are not always regionally available and may affect project costs. In addition, supplies of commonly used alternatives to Portland cement such as fly ash or ground granulated blast-furnace slag are expected to decline as these alternative binder materials are byproducts of other heavy industries (e.g., coal-fired power generation) that are transitioning to lower-carbon approaches. New SCMs are emerging to replace these traditional alternative binders.

NATURAL CARBONATION

Concrete products can absorb CO_2 through a process referred to natural carbonation. This absorption of CO_2 can occur during the service life of the concrete, and/or at end of life. The rate and extent of CO_2 uptake vary depending on the environmental conditions, the original concrete mix design, and the constituent materials used to make the concrete. The European Cement Association has reported that the equivalent of up to 23 percent of the total emissions generated from the calcination emissions from clinker production may ultimately be sequestered in concrete products. Research recently conducted by the University of Toronto reports that the carbon uptake of concrete across 12 Canadian locations was measured at less than 10 percent.

CONSTRUCTION EFFICIENCIES

Reducing waste or making changes to construction schedules can reduce the cost of concrete materials for construction projects while also reducing carbon emissions. Ready mix concrete is one of the only construction materials that is manufactured for or at the job site. Making changes to its curing times can impact the quantity of cement required. By waiting longer before putting concrete structures into service, less cement can be used, resulting in lower emissions. However, this can impact project schedules and costs. Effective quality control and ongoing monitoring of concrete curing can reduce waste. Precast concrete products that are assembled on-site can similarly reduce the volume of waste concrete materials.

CARBON CAPTURE AND UTILIZATION

Direct capture of process emissions at the cement kiln can reduce total carbon emissions impact by 95 percent or more. CO_2 can be captured from the kiln through a variety of methods, including chemical or physical solvents, membranes, or solid materials that react with CO_2 to extract it from the flue gas stream. Captured carbon can then either be stored in a secure storage location or used in the production of other valuable materials such as synthetic fuels, plastics, or concrete to prevent its release into the atmosphere. CCU-CBM technologies are those that capture CO_2 from point sources within the cement and concrete value chain, or that provide a means for CO_2 to be used in the manufacturing process. CCU-CBM innovators have used CO_2 within concrete production in multiple ways. CO_2 has been used to produce aggregate materials, directly injected during the mixing of fresh concrete, and has been used to create alternative cementitious materials from waste products. Additional information on these approaches is provided in the Market Primer, and in other resources prepared as a part of this project.

Benefits of Lower-Carbon Concrete

Low-carbon concrete refers to concrete produced with a lower carbon footprint than traditional mix designs using baseline technology, while still meeting all relevant performance requirements. Beyond carbon benefits, low-carbon concrete offers additional advantages.

Concrete Jobs are Local Jobs

The cement and concrete industry directly employ 29,000 Canadians, accounting for two percent of all manufacturing jobs in Canada. Of these jobs, 90 percent are full-time, with hourly wages that exceed the national industry average by 30 percent. In addition to this direct employment, the concrete and cement supply chains support an estimated 34,000 indirect jobs. Almost all jobs in this industry are localized in the communities where cement and concrete are produced, as the properties of these materials incentivize local consumption. While significant quantities of cement and supplementary cementitious materials are imported and exported, transportation costs limit import or export of finished concrete products.

Ready-mix concrete must be used within a limited radius as curing and hardening can occur within 90 minutes. Precast and prestressed concrete materials can be shipped across longer distances, but logistics costs may favour local suppliers. Due to these factors, concrete plants are typically located in communities of all sizes across Canada to supply local job sites.

Concrete Performance

While there is a relationship between cement content and the strength of concrete materials, the addition of more cement to a concrete mix does not necessarily achieve higher strength. It does, however, directly lead to higher emissions intensity of concrete materials.

Lower-carbon approaches to manufacturing concrete can offer performance benefits in addition to emissions reduction. SCMs such as steel slag can improve concrete's durability, reduce permeability, and add colouring effects to concrete that otherwise would incur additional cost. CCU-CBM technologies can act like accelerating admixtures and may enable faster concrete curing and support reductions in the total quantity of cement required to meet desired performance.

These benefits mean that there are often compelling reasons to specify lower-carbon concrete mixes for projects whether emissions reduction is an explicit goal.

Innovation to Control Costs

Continued innovation to improve manufacturing and material efficiencies can also offer cost benefits, both to the cement and concrete industry and to end users. Some of the ways that low-carbon concrete mixes can contribute to cost efficiencies include:

- SCMs may have lower per unit costs than Portland cement.
- Technologies that reduce concrete curing times can accelerate production and construction schedules, saving on labour costs.
- More durable and resilient concrete products have longer lifespans and will not require replacement as frequently.
- If broadly deployed, CCU-CBM technologies that enable beneficial reuse of industrial waste products or recycled concrete aggregates may reduce the cost of waste disposal and pressure for pits and quarries to supply raw materials.

Growing domestic markets for low-carbon concrete coupled with stable and predictable demand for innovation will bring down deployment costs and help Canadian cement and concrete manufacturers expand production while reducing the environmental impact of this key material.

What We Learned

Purpose of this Report

The purpose of this document is to support project owners and the design, construction, and development industry in strengthening their capacity to specify, procure, and use low-carbon concrete materials. It includes specific guidance for procuring materials made with CCU-CBM technologies recognizing that these technologies are inherently tied to the same foundational strategies used to deliver low-carbon concrete more broadly.

This report provides clear and actionable guidance for stakeholders seeking to reduce the carbon impact of their projects through the use of lower-carbon concrete in general, and the application of CCU-CBM technologies in particular the guidance is designed to be accessible to all professionals either directly or indirectly involved concrete specification procurement, and use, supporting the informed decision-making.

This report explains how the specification and procurement of concrete materials creates a shared opportunity to build market demand for lower-carbon materials, empowers designers to make informed choices, and can ultimately drive down the carbon impact of building and infrastructure construction.

Recognizing that readers of this report will have varying levels of experience with the procurement and use of concrete materials, this report is structured to:

- Communicate fundamental concepts influencing the carbon intensity of cementitious materials.
- Clarify the roles and capacities of project partners involved in the design and construction process to influence the selection and use of cementitious materials.
- Support informed and effective collaboration between project partners across the cement and concrete value chain.
- Outline guidance that can be implemented on projects to achieve low-carbon concrete.

It should be noted that while the principles reflected in this report are generally consistent with international best practices, the guidance presented here is specific to Canadian practitioners operating within the Canadian market. Additionally, while this guide is focused on embodied carbon reduction within concrete, it is just one element low-carbon design and construction. Reducing the carbon impact of concrete is significant, but more will be needed to achieve full-scale decarbonization.

Consultation with Interested Parties

Where concrete has been identified as the most appropriate material choice, the specification and procurement process represents the greatest opportunity to improve efficiency and reduce emissions. For this reason, understanding real-world challenges and opportunities in low-carbon concrete procurement and specification was a central focus of this project. Consultation with thought leaders helped identify existing market needs, as well as opportunities and barriers to low-carbon concrete materials procurement and specification.

Interviews were held in late 2025 with Canadian leaders possessing advanced expertise in low-carbon concrete materials specification. Consultation was conducted through the form of structured interviews by a facilitator using a standardized questionnaire.

A list of all individuals that were interviewed is shown in **Appendix A.**

Key Themes from Interviews

DIRECT EXPERIENCE WITH CCU-CBM TECHNOLOGIES REMAINS LIMITED

Canadian professionals in the architecture, engineering, and contracting industries reported that they had limited to no experience with CCU-CBM technologies. With limited familiarity, commonly cited concerns with these technologies included the potential for cost premiums, potential impacts to the project schedule, concerns about the environmental benefits of CO_2 used by the technologies, and concerns about the longevity of captured or stored carbon in concrete materials.

Specifiers noted that few concrete suppliers currently use CCU-CBM technologies in Canada, and that availability is limited to specific jurisdictions. Specifiers reported that there is strong interest in learning more about CCU-CBM technologies and all interviewees were supportive of using concrete made with these technologies, provided they had access to sufficient information and data.

Technology providers similarly cited the limited availability of CCU-CBM technologies in the Canadian market and noted that lack of awareness and demand from specifiers has made it challenging for them to promote the use of their technologies with domestic cement and concrete manufacturers.

Several interviewees stated that they expected future iterations of the Canadian National Building Code would include embodied carbon guidance and requirements, and that this would likely contribute to greater interest and deployment of all approaches to reducing the embodied carbon of concrete, including CCU-CBM technologies.

LOW AWARENESS OF ENABLING LOW-CARBON SPECIFICATION STRATEGIES

Prescriptive approaches to specifying concrete were reported as very common and the norm in most regions of Canada, particularly for public sector-led projects. This practice limits the ability of concrete producers to make changes to concrete mix designs, preventing them from proposing alternate approaches. Performance-based specifications were universally cited as a minimum requirement to achieving lower-carbon concrete mixes and enabling the use of CCU-CBM technologies.

Environmental Product Declarations (EPDs) are a common tool broadly understood by Canadian design professionals, but the availability of these resources is unevenly distributed across Canada. EPDs for cement are available for all Canadian regions, as are industry average EPDs for concrete mixes. However, EPDs for individual concrete plants / mixes are more limited, and the knowledge of how to use these tools is currently highly concentrated in Canada's largest cities. This is a reflection of municipal green standards that are in force in cities such as Toronto and Vancouver. Absolute targets for emissions intensity of materials in municipal green standards were reported as a significant motivator for engineers and contractors to review and revise their existing concrete specification language.

What We Learned

Purpose of this Report

Consultation with Interested Parties

Key Themes from Interviews

Summary

BROADER BENEFITS CRITICAL TO THE VALUE PROPOSITION OF LOW-CARBON MATERIALS

The topic of embodied carbon in concrete was cited by interviewees as an excellent opportunity to tie sustainable design directly to economic value, on the basis that lower-carbon approaches may be less expensive due to reductions in total material or the replacement of cement with lower-cost alternatives.

CCU-CBM innovators reported that successful projects they had supplied to date in Canada were often driven by co-benefits from their technologies. Emissions reduction is the central value proposition, but other attributes that affected concrete performance, such as appearance, cost, or other factors were drivers of decision-making. Technologies that can offer benefits beyond emissions reduction were reported more likely to be adopted and to commercially scale.

DESIRE FOR CLEAR AND SPECIFIC PROCUREMENT GUIDANCE

Design and construction professionals routinely face challenges working with clients, colleagues, or project partners that rely on outdated specification language that does not reflect current industry realities. In many cases, these specifications do not align with current standards or market practices, and some interviewees reported encountering requirements for concrete products no longer available in the local market. A commonly cited reason for the prevalence of outdated specifications is the ease and efficiency of reusing legacy language without conducting a critical review.

Guidance for procurement of concrete was also described as complex, and stakeholders noted that in some instances provincial and federal standards and approaches do not match. It was also noted that some classes of CCU-CBM technologies may require specific language to be successfully incorporated into specifications

NEED FOR A CENTRALIZED RESOURCE

Interviewees universally felt that there was no ‘one size that fits all’ approach to the specification of low-carbon concrete materials, and that additional education resources are needed for Canadian professionals. It was reported that outside of major urban centres there is less awareness of – and experience with – specifying these materials, partially resulting from differences in availability of technologies and materials. This is due to differences in availability of technologies and materials.

While a broad range of reference documents were identified by interviewees, it was noted that existing documents that address low-carbon concrete are very technical and potentially inaccessible to professionals new to specifying low-carbon concrete mixes. It was recommended that a centralized repository of guidance be developed that summarizes and references these existing technical resources.

Summary

Insights from the interviews directly informed the development of this low-carbon concrete procurement and specification guidance. In response to the needs of stakeholders across the Canadian design and construction community, the resulting resource focuses on practical, implementable recommendations grounded in established low-carbon procurement principles. This guidance reflects current and emerging best practices in the Canadian market and is intended to support meaningful, verifiable reductions in embodied carbon of concrete products used in construction.

To address the gaps that were identified by the stakeholders interviewed, the guidance included in the *Roles in Specifying Concrete Materials* and *Low-Carbon Concrete Procurement Guide* sections of this report was structured to provide the following:

- Information on the roles and responsibilities of different professionals in the specification and procurement of concrete materials.
- Overall recommendations for professionals responsible for specifying and procuring concrete materials to reduce the embodied carbon of these materials.
- Recommendations for embodied carbon reduction strategies that reflect different levels of knowledge and experience so that guidance is accessible to all readers.
- Specific considerations for the specification of concrete made using CCU-CBM technologies.

Roles in Specifying Concrete Materials

Specification and procurement of concrete materials involve multiple stakeholders across the supply chain. Key stakeholders in a traditional procurement approach include:

ROLE	RESPONSIBILITY
Owner	Establishes goals for the project and outlines expectations for design and construction partners to achieve.
Architect	Determines building form and function to meet owner objectives. Establishes aesthetic and functional requirements for concrete. Specifies architectural concrete and non-structural elements such as concrete masonry units.
Sustainability Consultant	May support the project owner or architect to conduct life-cycle assessment of project materials and align with regulatory and third-party certification requirements. Also known as a whole-building LCA practitioner.
Structural Engineer	Specifies expected quantities and concrete performance requirements for each project element. Reviews and approves mix designs from the concrete producer.
General Contractor	Oversees construction operations and schedule, procures specialized contractors, and procures materials.
Concrete Contractor	Provides input on fresh properties and early-age requirements, identifies potential conflicts in specifications, and manages placement of concrete.
Concrete Producer	Designs, produces, and delivers concrete mixes to meet specified requirements.

Figure 2: Stakeholders involved in the concrete materials supply chain

Concrete specifications define detailed requirements for expected performance, including fresh and hardened concrete properties. Project objectives established by the owner and architect should be reflected in the specification language. Specifications are developed by qualified engineers during the design phase of a project and may be modified or updated by the concrete contractor at or before the start of active construction.

Concrete producers may have access to a range of technologies and constituent materials, enabling them to provide concrete mixes that can meet performance criteria while having lower costs and/or environmental impacts. If part of the project team, sustainability consultants typically lead analyses of embodied carbon and facilitate integration of requirements from municipal standards or third-party green building certification frameworks.

> The specification of concrete is therefore a shared responsibility. Frequent, effective communication and coordination between all project partners is critical to achieving lower-carbon concrete.

Specification Development Throughout the Design & Construction Process

The specification of concrete materials is a collaborative and iterative process. Effective communication and teamwork between supply chain partners are critical to delivering a successful project and achieving lower-carbon design.

Opportunities for promoting lower-carbon concrete materials through specification development and the procurement process are summarized in this section.

Further detail on the phases of project design and construction is provided in **Figure 3.**

Owner | Architect | Sustainability Consultant | Structural Engineer | General Contractor | Concrete Contractor | Concrete Producer

PROJECT DEFINITION	CONCEPTUAL DESIGN	ENGINEERING DESIGN	PRE-CONSTRUCTION COORDINATION	MIX DESIGN DEVELOPMENT & SUBMITTALS	CONSTRUCTION & PLACEMENT
Project goals and objectives are identified	Initial concepts for building form and structural systems are explored	Concrete performance requirements are established and documented in specifications	Outreach and engagement with prospective concrete suppliers is conducted	Concrete suppliers propose mix designs based on the specifications for review and discussion	Concrete is delivered to the job site or poured on-site, per the specification requirements

Figure 3: Concrete specification and procurement actions during project planning, design, and construction

Project Definition

Phase Lead: Project Owner

- The project owner should identify any embodied carbon goals for the project based on corporate objectives and informed by expert advice.
- Implications for cost, schedule, and / or risk from requesting lower-carbon concrete options should be considered by the project owner during this phase.
- Any critical project elements that may limit the use of alternative concrete mix designs should be identified (e.g., architectural concrete, exposed finishes, critical structural elements, etc.).
- Project goals should be clearly communicated by the project owner to the project design partners (e.g., architect, structural engineer) through the Owner Project Requirements and the Basis of Design documents.
- Requirements for embodied carbon quantification / reporting and responsibilities for completing these analyses should be clearly identified within contractual agreements with the design partners.
- Any requests for evaluation and testing of specific novel concrete technologies / materials should be clearly identified to the project design partners.

Conceptual Design

Phase Lead: Architect
Supported by Structural Engineer

- Structural systems and building form are developed during this phase, providing the opportunity for adjustments in member size, span and systems to optimize material volume.
- Preliminary concrete quantities and element types are established and considerations for any potential reduction in required concrete volume can be made.
- Early durability and exposure classification are identified, and any “over-design” considerations should be addressed (e.g., the existence of exposure classification requirements in specifications when said exposure conditions are not present and/or are not codes and standard requirements).
- The required methodology and responsibility for quantifying embodied carbon should be established for the project, specifically outlining requirements for post-placement review of mix records, test results, and Environmental Product Declarations (EPDs) to verify that the low carbon specification was followed by the entire supply chain.
- Whole-building life cycle carbon analysis, or more limited analyses of concrete materials can first be completed during this phase and can be updated and refined at future phases as further information is available.

Engineering Design & Specification Development

Phase Lead: Structural Engineer
Supported by Architect

- Concrete performance requirements should be defined with the project owner's embodied carbon goals as a focal point. A specification can employ a whole-project and / or concrete-specific embodied carbon target structured to meet or exceed the project owner's goals.
- Critical elements that could limit the use of lower carbon concrete strategies should be identified and addressed (e.g., limiting or avoiding prescriptive specifications, addressing potential over-design, minimum water/cement ratios, etc.).
- Carbon reduction strategies should be introduced into design elements at this point and explicitly outlined in the specification language.

Pre-Bid / Pre-Construction Coordination

Phase Lead: Structural Engineer
Supported by General Contractor

- The structural engineer should conduct initial outreach discussions with local concrete contractors and suppliers to determine what options exist for concrete mix designs within the local market.
- Ongoing communication with suppliers can create opportunity to identify options for further embodied carbon reductions.
- If the project owner is supportive of exploring novel concrete technologies / materials, the structural engineer should engage with qualified local contractors to confirm the feasibility of the proposed concrete specifications.
- The level of information appropriate to share with the concrete contractor and/or concrete producer should be carefully considered to maintain competitive procurement practices.

Mix Design Development and Submittals

Phase Lead: Concrete Producer
Supported by Structural Engineer & General Contractor

- Expectations for concrete performance, including embodied carbon expectations, should be clearly communicated within
the specification to the concrete producer.
- The structural engineer should confirm acceptable methods for concrete producers to communicate the carbon intensity of proposed mix designs (e.g., EPDs, embodied carbon intensities, material quantities, etc.).
- The specification language should encourage or require concrete producers to provide one or two alternative concrete mixes that meet performance requirements but may require a change to the specifications or incur additional cost to achieve greater emissions reduction.
- The structural engineer and the concrete contractor should work alongside concrete producers to evaluate opportunities to trial and test novel low-carbon concrete innovations in the project.

Construction and Placement

Phase Lead: Concrete Contractor
Support by General Contractor

- The contractor should ensure proper work site time management and planning to avoid unnecessary concrete waste and rejected concrete deliveries.
- Later-age strength should be accepted by the contractor where it is expressly permitted in the specification.
- The contractor should work alongside concrete producers to learn about, and apply, any special requirements for concrete placement, curing and finishing concrete made with low carbon and / or CCU-CBM technologies.

Additional Considerations for Specifying CCU-CBM Technologies

Specifying concrete materials made using CCU-CBM technologies will likely require additional considerations to be successful. Canadian codes and standards are performance-based and generally do not reference specific technologies. As CCU-CBM technologies are new to the industry, existing codes and standards generally will not directly address their use. While codes and standards do not explicitly bar the use of CCU-CBM technologies, the absence of technical guidance creates real and perceived risk for specifiers. Over time, prescriptive guidance for emerging approaches is likely to be developed, but renewal cycles for codes and standards take place over several years.

Some concrete products made with CCU-CBM technologies that utilize CO_2 may be classed as a novel concrete. Novel concretes are those that contain constituent materials that do not conform to existing concrete standards. This may be because the existing standard predates the existence of the CCU-CBM technology itself, so the language does not reflect consideration of the approach. In other cases, the technology may only be available in a small number of markets, so specific guidance was not developed or included in universal codes or standards. For example, CO_2 mineralization in concrete is currently referenced in Annex S of the CSA A23.1 standard, but it is not referenced within the main body of the standard.

While the changes to concrete constituent materials created by CCU-CBM technologies may be novel, their impact on concrete performance may be well understood. Substantial data may be available on concrete poured using these technologies, and the mode of action may be fully understood. Concrete made with these technologies, however, typically requires additional testing or may require concrete suppliers to provide guarantees of performance.

Reliance on proprietary materials also has the potential to limit competitive procurement of concrete suppliers.

The geographic availability of CCU-CBM technologies currently varies across Canada. This reflects that many technology innovators are in early stages of commercialization. Some CCU-CBM technologies are widely available anywhere in Canada, while others have limited local availability based on existing manufacturing or customer locations. CCU-CBM technologies in early stages of development may not be able to deliver industrial scale projects, even in geographies where they are available. Technologies that have not yet achieved economies of scale may introduce additional costs to projects, and project owners may be required to accept higher costs to adopt these technologies.

Due to the limited geographic availability and production capacity of some CCU-CBM technologies, when specifying, it is preferable to state allowances or permissions for desired approaches and technologies rather than using language that strictly requires a specific material or technology over a broad geographic area (e.g., national or master specifications). A technology-agnostic approach that evaluates total concrete performance, including embodied carbon emissions, will likely find the most success. Taking this approach will reduce friction for project teams while remaining supportive of innovation and signaling market demand for lower-carbon concrete products.

Low-Carbon Concrete Procurement Guide

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Low-Carbon Concrete Procurement Guidance

How to Use this Guidance

Detailed procurement and specification guidance are summarized in this section and structured to provide actionable recommendations based on different levels of knowledge of, and experience with, low-carbon concrete materials.

Three levels of guidance have been defined in this Procurement Guide:

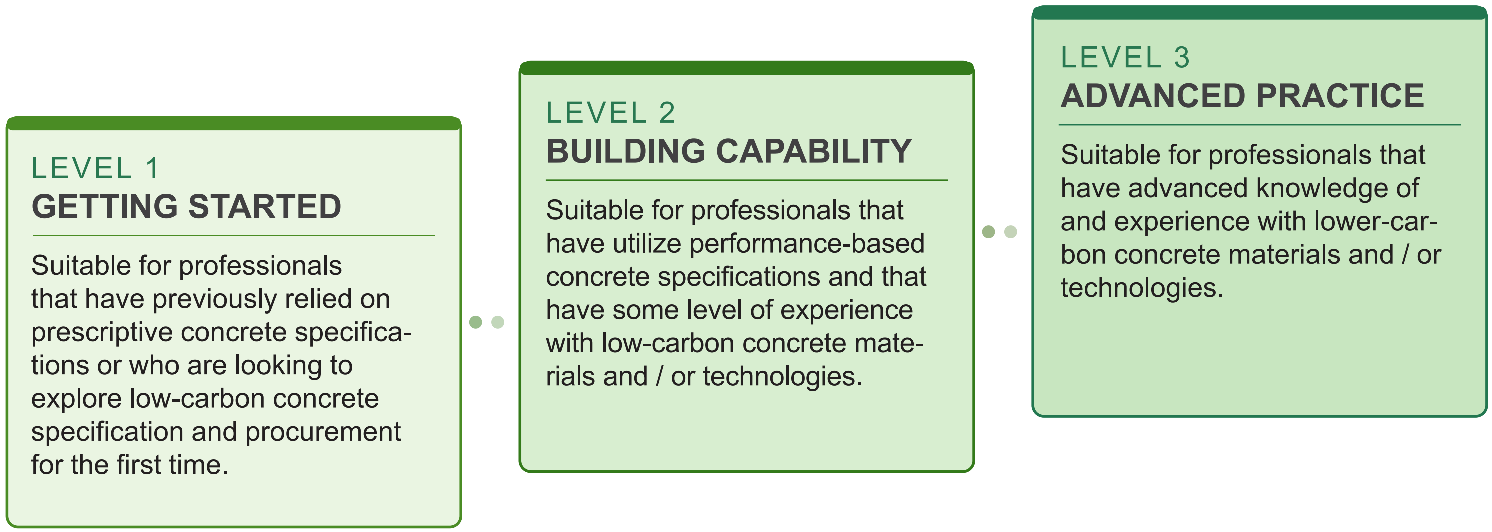

Figure 4: Levels of low-carbon concrete procurement guidance

For each level, multiple strategies are identified for consideration. Each strategy includes the following information:

- Context: Overall description of the intent of the strategy and the requirements to successfully implement the strategy.
- Responsibility: Identifies the project partner that is most likely to be responsible for leading the execution of the strategy.
- Phase: Defines when in the project timeline the strategy should be implemented. Note that some strategies may be revisited during additional phases of the project as more information becomes available.
- Relevant Resources: Reference resources that should be reviewed to obtain additional technical direction building on the information provided in the strategy.

The complete list of strategies is summarized in **Table 1.**

Table 1: Low-carbon concrete procurement strategies

Level 1 Strategies	Level 2 Strategies	Level 3 Strategies
Adopt Performance-Based Specifications	Request Environmental Product Declarations	Establish Embodied Carbon Reduction Goal for Concrete Materials
Understand Local Concrete Mixes	Conduct Whole-Building Life-Cycle Analysis & Establish Project Baseline	Explicitly Permit CCU-CBM Technologies
	Explore Design Optimizations	Verify Concrete Mixes and Volumes Supplied
	Explore Cement Reduction or Replacement Opportunities	

Limitations

All guidance provided within this report consists of a suite of best practices that can be implemented either in whole or in part. All guidance should be considered as optional and must be vetted by appropriate professionals in the context of an individual project.

Critically, guidance provided should complement, and not supersede, technical resources such as codes and standards or industry guides. References to relevant technical resources are included in each strategy, and readers are encouraged to consult these resources for additional direction on best practices for specifying and procuring concrete materials.

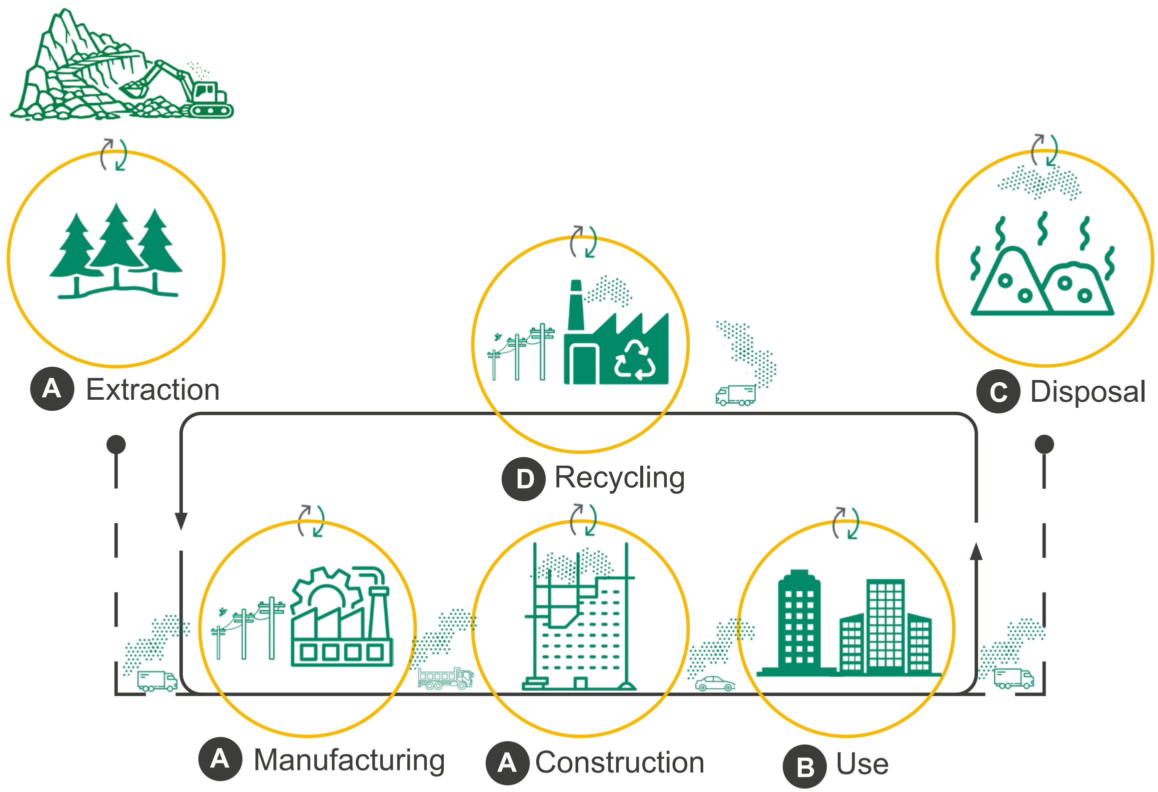

Figure 5: Life cycle stages typically considered in the quantification of embodied carbon emissions of cementitious materials

Low-Carbon Concrete Procurement Guidance

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Level 2 Guidance - Strategy 1

Level 2 Guidance - Strategy 2

Level 2 Guidance - Strategy 3

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Level 3 Guidance - Strategy 1

Level 3 Guidance - Strategy 2

Level 3 Guidance - Strategy 3

Level 1 Guidance

Strategy 1: Adopt Performance-Based Specification

In Canada, specifiers establish performance criteria for concrete materials that must be achieved by the concrete producer and the concrete contractor. This responsibility is outlined in the CSA A23.1 Concrete Materials and Methods of Concrete Construction national standard. CSA A23.1 requires that concrete be specified either completely by prescriptive or performance-based standards.

Prescriptive specification approaches imply that owners / specifiers take ownership and liability of the performance of the concrete that they have prescribed. A performance concrete specification defines the required outcome in mandatory language, with the processes, materials, or activities used by the contractors, manufacturers, and materials suppliers left to their own discretion. Adoption of performance-based specifications creates a permissive structure for the design and construction team to select the best available materials, technologies, and methods to achieve the defined project objectives.

Performance-based specifications are foundational to achieving low-carbon concrete outcomes. Adoption of this specification approach is an enabling strategy for all other strategies presented in this document.

The performance specification should outline the responsibilities of all parties in the contract language and define a system for all project partners to assess and maintain the quality of concrete materials. It should also establish requirements for:

- Concrete strength (e.g., compressive strength, flexural strength, etc.)
- Durability (e.g., freeze-thaw resistance, resistance to sulfates, etc.)
- Concrete curing and setting time
- Workability and placement
- Permeability and porosity

STRUCTURAL ENGINEER

Leads

Phases

Engineering Design & Specification Development

RELEVANT RESOURCES

- CODE-323-24: Low Carbon Concrete ↗
- Technical Bulletin 4: Alternate Methods for Specifying Concrete ↗
- A Guideline for Specifying Low Carbon Ready Mixed Concrete in Ontario ↗
- CSA A23.1:24 Concrete Materials and Methods of Concrete Construction ↗
- Guide to Improving Specifications for Ready Mixed Concrete ↗
- SE2050 Specification Guidance ↗

Level 1 Guidance

Strategy 2: Understand Local Concrete Mixes

Early engagement with concrete producers can assist project teams in understanding and evaluating all the options available for achieving lower-carbon concrete mixes. Exploring available options early in the design process creates the greatest window of opportunity to identify efficiencies and emissions reductions.

Suppliers can advise on what materials or technologies are available within the local market and what approaches are possible and realistic for achieving the project's embodied carbon goals. Producers may also have input to assist structural engineers with determining the optimal approach to the mix design, and maximum age at which design strengths could be attained at the job site. A recommended practice is to have producers identify two mix alternatives. One alternative should represent a more ambitious carbon reduction strategy, while the other alternative could represent an approach that achieves emissions reductions while balancing cost or other critical project factors such as impacts to the project schedule.

If novel concretes are available from local concrete providers, early engagement also provides an opportunity to explore questions or concerns. Additional testing requirements may be established between the structural engineer and the concrete producer to enable these requirements to be included in the specification before it is issued.

The level of engagement between concrete producers, contractors, structural engineers, and architects may depend in part on the project delivery structure. Design-build models offer the greatest opportunity for direct collaboration, while with more traditional models, engagement may be more limited and focused on available options within the local market. In either case, communicating carbon goals for the project early in the development process can build buy-in and support the ability of concrete suppliers to contribute to the project objectives.

Leads: STRUCTURAL ENGINEER, CONCRETE PRODUCER, GENERAL CONTRACTOR

Phases: Pre-Bid / Pre-Construction Coordination

RELEVANT RESOURCES

Guide to Improving Specifications for Ready Mixed Concrete ↗

Top 10 Ways to Reduce Concrete Carbon Footprint ↗

Level 2 Guidance

Strategy 1: Request Environmental Product Declarations

As stated in the whole-building life-cycle assessment (LCA) strategy, Environmental Product Declarations (EPDs) provide critical information on the estimated embodied carbon intensity of construction materials, along with other environmental impact criteria in a standardized format. This information can be used to complete the LCA to provide an understanding of the project's expected embodied carbon footprint. Within the EPD documentation, the carbon values are listed under the Global Warming Potential (GWP) metric and are expressed in units of carbon dioxide equivalents (CO_2e).

There are multiple types of EPDs that provide increasingly accurate and granular information. The specification language should request Third-party Verified Type III EPDs. For concrete materials, the hierarchy of EPDs is as follows (from most to least precise):

1. Batch-specific EPD
2. Plant or product-specific EPD
3. Industry average EPD for concrete mix classes

Figure 6: Parts of an EPD

Adapted from: Hines Embodied Carbon Reduction Guide

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Leads

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Mix Design Development & Submittals

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Level 3 Guidance - Strategy 3

Level 2 Guidance

Strategy 1: Request Environmental Product Declarations

The specification language should request (but not require) that all bidders provide batch or plant-specific EPDs if available. EPDs consider the expected impacts of the manufacturing process and constituent materials, so generating batch-specific EPDs is straightforward once the initial work to set up the EPD at the plant has been completed. The EPD should reflect the plant that will be used as the source supplying the project.

If plant or batch-specific EPDs are not available, the specifier should access industry average from relevant databases. The total quantity of cementitious materials used in the concrete mix can also be used as proxy for estimating the embodied carbon of concrete materials in the absence of an EPD, as this constituent typically accounts for 90 percent or more of total embodied carbon.

EPDs should be submitted by the concrete producer as part of its bid submission.

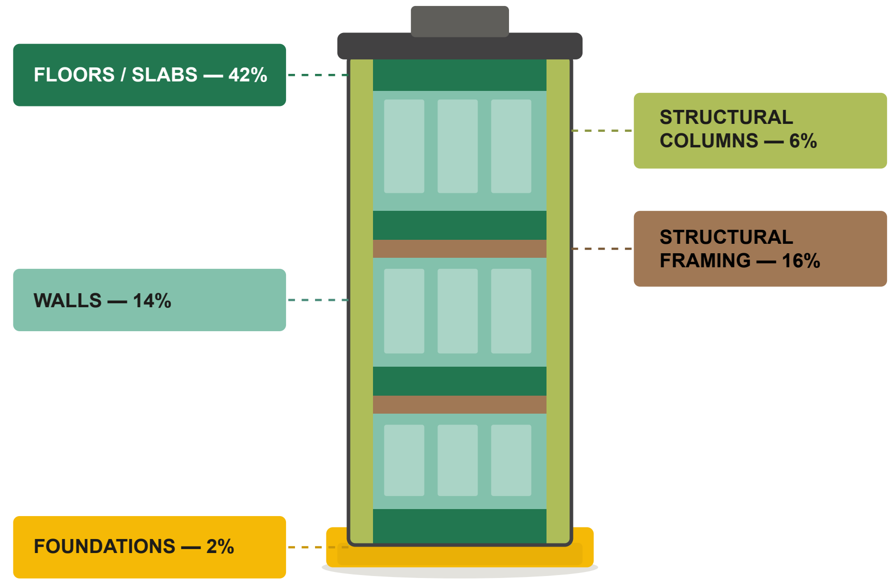

Figure 7: Average contribution of concrete building structural components to total embodied carbon

Adapted from Fang, Kenny, & Mueller (2025)

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Leads

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Mix Design Development & Submittals

RELEVANT RESOURCES

- Building Transparency: Draft Specification Modifications for Low Carbon Concrete ↗
- Building Transparency: The EC3 Tool ↗
- Canadian Concrete Masonry Producers Association: EPD ↗
- Canadian Precast/Prestressed Concrete Institute: EPDs ↗
- Carbon Leadership Forum:Model LCA Specification ↗
- CarbonStar Standard ↗
- Concrete Canada: Regional EPDs ↗
- Ready Mixed Concrete Association of Ontario: Best Practices Guidelines for Concrete Construction ↗
- Hines Embodied Carbon Reduction Guide ↗
- Fang, Kenny & Mueller (2025): Material Efficiency and Embodied Carbon in Structural Systems ↗

Level 2 Guidance

Strategy 2: Conduct Whole-Building Life-Cycle Analysis & Establish Project Baseline

Understanding the expected whole-building embodied carbon is critical as this information will inform the strategies chosen to address the embodied carbon intensity of concrete materials. Quantification of whole-building embodied carbon is achieved through completion of a Life-Cycle Assessment (LCA).

Completion of an LCA relies on two data inputs:

- Total material quantities for concrete mixes expected to be used on the project.
- Data for the carbon intensity of construction materials.

Carbon intensity values can be obtained through EPDs. Concrete suppliers and other material manufacturers may provide EPDs for their specific concrete mixes. In the absence of this information, industry average EPDs can be obtained from provincial concrete associations. These average values are less accurate but are suitable to use during early stages of design or if EPDs are not available from local concrete suppliers.

Concrete material quantities are typically estimated by the structural engineer, or potentially by the project architect, a quantity surveyor, or the whole-building LCA practitioner. Estimates are typically available during the Conceptual Design phase, and these values are updated and revised as the design evolves.

Conducting an LCA can similarly be completed at many points throughout design. Best practice is to complete the analysis early – during Conceptual Design once general structural and architectural details are confirmed. The LCA can then be updated as further information becomes available on material quantities and actual concrete mix designs.

The results of the LCA analyses provide the owner with a baseline estimate of the total carbon impact of the proposed project. It can be used to identify high priority materials / building elements that should be iterated upon to achieve embodied carbon emissions reduction. Several of the strategies presented within this report to reduce the embodied carbon of concrete are common recommendations from LCA analyses.

Leads

ARCHITECT ↔ SUSTAINABILITY CONSULTANT

Phases

Conceptual Design

RELEVANT RESOURCES

- Athena Impact Estimator for Buildings ↗
- Embodied Carbon: A Primer for Buildings in Canada ↗
- Zero Carbon Building Design Standard v3 ↗
- Material Baselines for North America ↗
- National Whole-Building Life Cycle Assessment Practitioner's Guide ↗
- National Guidelines for Whole-Building Life Cycle Assessment ↗
- Academy Online LCA Courses ↗
- Tally LCA Tutorial and Resources ↗
- Standard on Embodied Carbon in Construction ↗

Level 2 Guidance

Strategy 3: Explore Design Optimizations

The design of concrete structures significantly influences the volume of concrete required. More efficient structural systems can provide the desired form and function while requiring lower quantities of concrete.

Strategies to reduce the total concrete required for structures include:

- Obtaining detailed information on geotechnical conditions.
- Efficient layouts that avoid step-backs and minimize requirements for transfer slabs.
- Using regular, repeated floor plans and structural columns with equal spacing.
- Reducing total parking requirements and parkade sizes through use of Transportation Demand Management strategies.
- Identifying building components that can use lower compressive strength concrete or that do not require higher early strength gains.
- Minimizing Slab-on-Grade concrete.

The structural engineer should explore more detailed strategies in collaboration with the architect to create an efficient structural design that optimizes the total volume of concrete required to achieve the project goals.

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Level 3 Guidance - Strategy 1

Level 3 Guidance - Strategy 2

Level 3 Guidance - Strategy 3

Leads

STRUCTURAL ENGINEER

Phases

Conceptual Design

Engineering Design & Specification Development

RELEVANT RESOURCES

Structural Engineers Study Embodied Carbon of 600 Buildings ↗

Structural Engineering and Embodied Carbon ↗

Practice Advisory: Embodied Carbon Considerations for Structural Engineers ↗

The Structural Carbon Tool, Version 3 ↗

ECOM, Embodied Carbon Estimator ↗

Beacon Tool ↗

Level 2 Guidance

Strategy 4: Explore Cement Reduction or Replacement Opportunities

The most effective and immediate way to reduce embodied carbon in concrete is by reducing the total and proportionate quantities of Portland cement in the mix design. This can be achieved through a variety of strategies without sacrificing strength or performance.

These strategies include:

- Use of Portland Limestone Cement.
- Use of cement blends that contain SCMs such as fly ash, slag, silica fume, or other materials as a partial cement replacement.
- Use of cement blends that include low carbon cements (e.g., calcium silicate derived cements, decarbonized lime, reactive silica-based cements, etc.).
- Use of CCU-CBM technologies and subsequent mix design optimization.
- Use of chemical admixtures such as high or mid-range water reducing admixtures.
- Avoiding over-design of concrete mixes.
- Avoiding specifying or ordering more concrete than required to reduce wastage.
- Avoiding or reducing the need for high-early strength concrete mixes.
- Permitting longer concrete curing times for appropriate project elements.

It is possible to combine multiple strategies to achieve even greater emissions reductions. Mix designs should be discussed and confirmed between the structural engineer, the concrete contractor, and the concrete producer.

It is standard practice to require the concrete producer to provide mix design information as part of its bid submission. In addition to requiring the concrete producer to complete these standard bid forms for the specified concrete mixes for the project, the structural engineer should also request that the concrete producer submit an alternate bid form with their proposed low-carbon mixes. These mixes must continue to meet the performance requirements established by the structural engineer.

Low-Carbon Concrete Procurement Guidance

Leads

STRUCTURAL ENGINEER | CONCRETE PRODUCER | GENERAL CONTRACTOR

Phases

Engineering Design & Specification Development

Mix Design Development & Submittals

By taking this approach, the owner maintains the right to select lower-carbon alternatives, while the concrete producers maintain the ability to put forward its most competitive bids. This also provides the project team with the means to evaluate opportunities and constraints around lower-carbon concrete options that best meet the project schedule, budget, and objectives.

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RELEVANT RESOURCES

- American Concrete Institute: Cementitious Materials for Concrete ↗
- Concrete BC: Specifying Sustainable Concrete ↗
- Mineral Products Association: Specifying Sustainable Concrete: Supplementary Cementitious Materials ↗
- National Research Council Canada: Low-Carbon Concrete Materials: Current Emerging Technologies ↗
- Rocky Mountain Institute: Concrete Solutions Guide ↗
- Structural Engineers 2050: Specifying
- Sustainable Concrete: Using 56-Day Concrete Strengths ↗

Leads

STRUCTURAL ENGINEER | CONCRETE PRODUCER | GENERAL CONTRACTOR

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STRUCTURAL ENGINEER | SUSTAINABILITY CONSULTANT

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Conceptual Design

Level 3 Guidance

Strategy 1: Establish Embodied Carbon Reduction Goal for Concrete Materials

Establishing a whole-building goal for achieving embodied carbon emissions reductions may be driven by codes or regulations (e.g., municipal green standards), third-party certification frameworks (e.g., CAGBC Zero Carbon Building Design Standard, LEED, etc.), or as established by the project owner to meet its own objectives.

As concrete is typically one of the largest contributors to whole-building embodied carbon, it can be appropriate to establish a specific reduction goal for the concrete material category. To establish this target, the project team should:

1. Determine the number of concrete mix designs that are expected to be used and their relevant details (e.g., compressive strength, exposure class, cure time requirements, etc.).
2. Quantify the total volume of concrete expected to be required for the project (by concrete mix).
3. Identify the expected carbon intensity for each concrete mix design.

The industry regional value as reported by the Concrete Canada regional EPDs should be considered as the baseline value for each concrete mix. Note that the regional EPDs are expected to be routinely updated, so specifiers should always review the most recent versions of these documents.

The embodied carbon reduction target should be expressed in terms of percentage reduction against the regional EPD value. It is highly recommended that one overall reduction target be established, that is achieved through the combined contribution of each individual mix design.

This permits the contractor and concrete producer to customize mix designs based on the required performance requirements without compromising critical project requirements. In practice, it is easier for some concrete mixes to be modified than others, so providing an overall reduction target provides flexibility while achieving a meaningful reduction.

Establishing the embodied carbon reduction goal early in the project is recommended. Communicating the target early in the process will provide direction to the project team and provide the greatest opportunity for achieving reductions in the embodied carbon impact of the project.

The overall target should achieve a reduction in embodied carbon from concrete materials of at least 10 percent or greater against the regional baseline for the Product Stage (A1 – A3), but targets can be considerably higher. Targets should be aggressive but realistic. Reduction targets should reflect project type, structural requirements, exposure conditions, and local material availability. Refer to the *Treasury Board Secretariat Standard on Embodied Carbon in Construction* for further information on the approach taken by the federal government.

Level 3 Guidance

Strategy 1: Establish Embodied Carbon Reduction Goal for Concrete Materials

To calculate a whole-building embodied carbon budget for concrete, the following steps should be undertaken:

1. Obtain the full list of concrete mixes that are intended to be used for the project from the structural engineer or the contractor.
2. Obtain the estimated concrete quantities for each mix from the structural engineer or contractor during early design.
3. Request Environmental Product Declarations from the concrete supplier. If EPDs are not available, obtain industry average values from the relevant provincial industry association.
4. With this information, an estimated carbon budget for concrete can be established.

With this information, an estimated carbon budget for concrete can be established. An example is shown in **Table 2** below:

Table 2: Example carbon budget worksheet

Mix Name	Application Type	Project Installation Location	Mix Strength (MPA)	Total Material Quantity (m^3)	Baseline GWP per Unit ($kgCO_2e/m^3$)	Total GWP per Mix Design ($kgCO_2e$)
Mix 1	*Slab on Grade*	*Foundation*	*40 MPa*	*100*	*350*	*35,000*
Mix 2						
Mix 3, etc.						

As shown, the embodied carbon of each individual mix is quantified by multiplying the total material quantity by the emissions intensity per unit of the material. The sum of each mix represents the total carbon budget. Once the budget is established, the concrete supplier, the contractor, and the structural engineer can propose alternative mixes that would achieve reductions against the budget. By using the budgeting approach, experts can innovate for mixes where changes are achievable, while avoiding critical project elements where change could negatively impact performance, timelines, or incur cost.

Leads

STRUCTURAL ENGINEER

SUSTAINABILITY CONSULTANT

Phases

Conceptual Design

RELEVANT RESOURCES

Standard on Embodied Carbon in Construction ↗

Level 3 Guidance

Strategy 2: Explicitly Permit CCU-CBM Technologies

Specifiers can provide a clear market signal to the concrete industry by choosing to explicitly permit, even by name or technology type, CCU-CBM technologies in their concrete design specifications as part of their embodied carbon reduction strategy.

This strategy can be deployed in the following ways:

- **Permit Innovative Approaches:** Including a list of permitted CCU-CBM technologies in an embodied carbon reduction target section of the specification signals that concrete suppliers are encouraged to adopt and use these technologies. Directly listing technology types creates confidence that deployment of innovative approaches or investment or partnership with technology providers can provide benefit to concrete suppliers.
- **Alternative Mix Design Options:** If the specification lists permitted CCU-CBM technologies as described above, specifiers can also require submittals to include alternative pricing for any available CCU-CBM technologies available within a specified geographic radius of the project. This strategy encourages innovation while still maintaining the ability of the project owner to evaluate cost implications of CCU-CBM options. It also addresses the current geographic and production volume limitations with CCU-CBM technologies by enabling concrete suppliers to bring forward these options when they are available within the project's vicinity.
- **Demonstration Projects:** Owners can contribute to overall development and deployment of novel CCU-CBM technologies by permitting use in small, non-critical sections of concrete placed on the project. Some CCU-CBM technologies may be early in their development, and innovators may not be able to deliver an industrial-scale construction project. This approach can help CCU-CBM technology innovators gather valuable data and case studies. Real-world case studies are one of the most common requests of specifiers, so providing small-scale demonstration opportunities accelerates learning within the design and construction industry and can build market demand and acceptance of CCU-CBM technologies.

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Leads

PROJECT OWNER

STRUCTURAL ENGINEER

Phases

Mix Design Development & Submittals

Level 3 Guidance

Strategy 2: Explicitly Permit CCU-CBM Technologies

Using permissive language in your specifications sends a strong signal that the project owner is open to accommodating recommendations from the contractor and the concrete supplier. To explicitly signal that CCU-CBM technologies are welcomed, the following language could be adopted as part of Division 03 (Concrete):

- The use of CCU-CBM technologies may be approved at the sole discretion of the Engineer of Record.
- The use of CCU-CBM technologies is permitted (or preferred), where such technologies are available, provided that concrete performance criteria are met.
- Alternative processes for mixing of concrete, such as CCU-CBM technologies, are acceptable provided it is included in the laboratory trial batch and corresponding concrete mixture submittal, subject to the Engineer's approval.

Note that it is important to not restrict specification language to specific technologies or classes of technologies. As CCU-CBM technologies are not yet commonplace, an individual product or technology may not be available to the project or may only be available from one supplier. There is no concrete mix that is perfect for every application or geography. By keeping specification language open, experts on the project team can collaborate to select from the best options available while maintaining a competitive procurement environment.

RELEVANT RESOURCES

Low Carbon Concrete Key to Hyperscaler Campus ↗

Lower Carbon Concrete Guide: Lower Carbon Concrete Task Force ↗

Leads

PROJECT OWNER

STRUCTURAL ENGINEER

Phases

Mix Design Development & Submittals

Level 3 Guidance

Strategy 3: Verify Concrete Mixes and Volumes Supplied

It is common for concrete mixes to continue to be adjusted over the course of the delivery of a project to adapt to prevailing weather conditions. Cold temperatures may limit the feasibility of using some low-carbon concrete mixes that rely on supplementary cementitious materials for example. Shifting project timelines can also lead to choices that change strength requirements for mixes to ensure that key project milestones can continue to be met.

The estimated total quantity of concrete that will be used for the project established during design may also be inaccurate. Site conditions that differ from what was anticipated could lead to requirements for additional concrete. Errors in project sequencing or placement of concrete may lead to the removal of some material as waste. Substitutions may be made by the contractor based on product availability. Products may be delivered from different sources or plants than originally expected.

Taken together, these factors usually result in a material change in the total quantity of concrete supplied to the project, and potentially to the composition of mix designs that are used. To confirm that embodied carbon objectives have been met by the project, it is recommended that a post-construction estimation of embodied carbon be conducted.

This will provide an opportunity for all partners in the supply chain to evaluate the effectiveness of strategies deployed and communication and teamwork within the project team.

To verify the embodied carbon contribution of concrete to the total project, the following steps should be taken:

- Validate the total quantity of concrete by mix design delivered to the project site through analysis of waybills or other documentation.
- Confirm whether any concrete supplied to the project site was ultimately disposed of as waste material (separately reporting any waste concrete as a result of site demolition).
- Compare the mix designs and their EPD documentation (if available) for the concrete delivered to the project site against the mix designs proposed during design.
- Update the LCA to reflect the true values for total concrete supplied by mix design.
- Quantify the delta between the original estimate and the true value for the embodied carbon of concrete materials.

RELEVANT RESOURCES

Kammer et al.: Smart Sustainable Concrete Construction ↗

Leads: GENERAL CONTRACTOR ↔ SUSTAINABILITY CONSULTANT

Phases: Construction and Placement

APPENDIX A. ACKNOWLEDGMENTS

The following individuals were interviewed as part of the stakeholder consultation process for this project. Interviews were conducted in late 2025 with Canadian leaders possessing advanced expertise in low-carbon concrete materials specification.

Interested Parties Interviewed

Stephanie Voysey	Amrize
Caroline Butchart	ASPECT Structural Engineers
Yuri Mytko	CarbiCrete
Mike Carter-Conneen	CarbonCure Technologies
Rob Cooney	Cement Association of Canada
Sarah Petrevan	Cement Association of Canada
Jolene McLaughlin	EllisDon
Navisa Jain	EllisDon
Tom Place	Equilibrium Consulting Inc.
Jeremy Field	Introba
Lara Gumushdjian	Kirkor Architects
Jon Makar	National Research Council
Jessica MacInnis	Nova Scotia Department of Public Works
Steve Montgomery	PCL
Amy Brander	Perkins & Will
Iain MacFayden	RGS Consultants Ltd.
Adam Lubell	RJC Engineers
Daniel Snodgrass	RJC Engineers
Scott Cumming	WSP Canada

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