Mackenzie SE 2050 Embodied Carbon Action Plan

2025

1 Introduction

As members of the design profession, we have both the responsibility and the opportunity to reduce the built environment's impact on global carbon emissions.

Mackenzie's vision as a design firm is the unified pursuit of building equitable communities for generations to come. As part of this overarching mission, it is essential that we hold ourselves and our profession accountable in achieving climate goals.

In 2023, Mackenzie joined the Structural Engineering 2050 (SE 2050) Commitment as well as the American Institute of Architects 2030 Commitment (AIA 2030), formally committing to reduce operational and embodied carbon (EC) in our projects.

Jo Ann is a structural designer at Mackenzie with nine years of experience. She chairs the Sustainable Design Committee for the Structural Engineers Association (SEA) of Oregon and serves as a liason to the National Council of SEAs.

Jo Ann Offill
Embodied Carbon Champion

The **Embodied Carbon Champion**'s primary role will be educating staff on the importance of reducing embodied carbon and providing staff with the resources to meet our firm's goals.

She will stay informed on best practices in EC accounting and reporting, and track the development of EC policies in our region, keeping staff informed of policies that will affect our projects and educating staff on all compliance pathways.

Over the next year, she hopes to foster more cross-discipline collaboration and facilitate more discussions around embodied carbon in our projects.

(Education Elective 1 / 5)

Why 2050?

Scientists agree that by limiting the average global temperature to a threshold of 1.5° Celsius above preindustrial temperatures, we can significantly reduce the risk of serious and irreversible impacts due to climate change.

To stay below this threshold, scientists have recommended two goals:

- Cut emissions 45% by 2030 (from 2010 levels)
- Achieve net-zero emissions by 2050.

According to the UN, the Buildings and Construction sector accounted for more than 37% of worldwide energy and process related CO2 emissions in 2021*.

While many stakeholders have begun efforts to reach net-zero by 2050, recent reports suggest that we will surpass the 1.5°-threshold sooner than expected, illustrating an urgent need to reduce emissions quickly.

Why Embodied Carbon?

Embodied carbon is the measure of all emissions throughout a project's life-cycle. It includes everything from raw material extraction, manufacturing, transportation, construction and installation, as well as maintenance and disposal.

While operational carbon emissions are generated over the life-cycle of a building, the majority of embodied carbon emissions are generated up front before the building is in use. Because embodied carbon emissions are generated at the beginning of a building's life-cycle, there is great potential to cut emissions in the short term.

Our structural engineers are committed to understanding, reducing, and achieving net-zero embodied carbon in our projects by 2050.

*"CO2 emissions from buildings and construction hit new high, leaving sector off track to decarbonize by 2050", UN Environment Programme, press release, 11-9-22

1 Commitment

Continued

We support the vision that all structural engineers shall understand, reduce, and ultimately eliminate embodied carbon in their projects by 2050.

2 Education

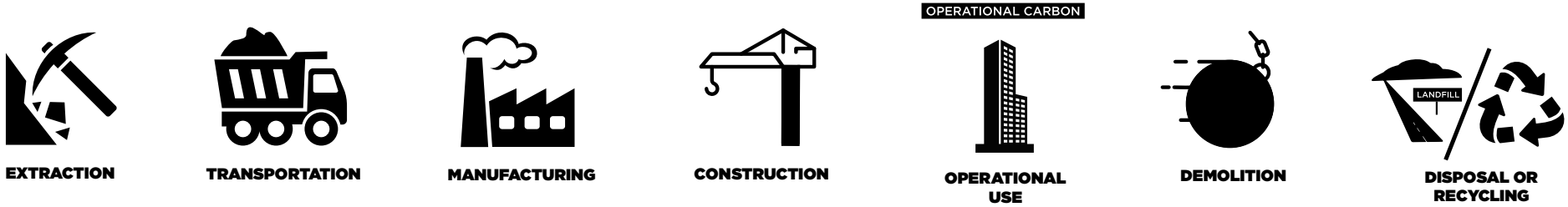
Mackenzie believes that educating employees on embodied carbon is a fundamental step towards achieving our ultimate goal of net-zero carbon by 2050. Our Education Plan outlines our strategy for engaging our engineers and empowering all staff to work towards the goals of the program.

Note From EC Champion

At this time, there are very few jurisdictions that mandate the reduction of embodied carbon emissions, instead focusing on operational carbon and energy efficiency standards governed by energy codes.

The industry has made great strides towards reducing operational carbon. In fact, recent studies have found that in many cases embodied carbon impacts will surpass total operational carbon impacts over a building's lifecycle as the grid decarbonizes. It is important that our engineers understand the significant impact that structural materials have on a building's total carbon footprint and the critical role that structural engineers will have in reaching carbon neutrality.

EMBODIED CARBON LIFE-CYCLE



The Plan

We commit to educating all staff, not just structural engineers, on embodied carbon, keeping staff informed of best practices and policy and/or code updates in our region. An internal working group led by the EC Champion was established in **year one** to work toward Program goals. The team prioritizes the development of EC educational resources and disseminating information to staff.

Annual Commitment

- ✓ Engineering staff commit to attend a minimum of one webinar, workshop, or presentation focused on embodied carbon annually. **(Education Elective 2/5)**
- ✓ A minimum of one presentation dedicated to SE 2050 efforts will be held annually. Staff will receive updates on data gathering efforts, progress towards SE 2050 goals, and future goals for carbon reduction.

2 Education

Continued

Ongoing Efforts

- ✓ A digital resource library available to all staff to create, share, and discuss embodied carbon educational resources. The SE 2050 team regularly updates the library to include new research, best practices on carbon accounting and reporting, and local events related to embodied carbon. **(Education Elective 3/5)**
- ✓ Onboarding of new staff includes training material on embodied carbon, as well as an overview of the SE 2050 Commitment and the firm's reduction efforts as outlined in the ECAP. **(Education Elective 4/5)**
- ✓ Members of the working group regularly attend webinars & workshops on embodied carbon and engage with the CLF Portland Hub. **(Education Elective 5/5)**

Education Timeline

2022

2023

Structural department begins to research embodied carbon in structural materials

Research presented to staff at firm-wide 'MackU' meeting

Mackenzie formally joins the SE 2050 Commitment Program

September 2023

2024

1st Annual **Embodied Carbon Action Plan (ECAP)** submitted to the SE 2050 Program

March 2024

ECAP Introduced to engineering staff in **department-wide presentation**

Fall 2024

Structural staff attend the following seminars and **embodied carbon workshops:**

- SEI's North American Structural Engineering Sustainability Symposium
- CLF Portland Hub presentations / events
- 2024 SEAOC Conference
- 2024 NCSEA Summit
- 2025 International Mass Timber Conference

2025

Overview of SE 2050 + AIA 2030 efforts presented to architectural and engineering staff at **annual cross-discipline meeting.**

- Reflection on 1st year efforts
- Embodied carbon reduction strategies, research, and educational resources
- Integrating with the Unified Design Process

Spring 2025

2026

Annual Presentation on SE 2050 Progress & Embodied Carbon Reduction Strategies

Spring 2026

3 Reporting

This Reporting Plan outlines how our firm will measure, track, and report EC data. Measuring the EC of structural materials is the first step to understanding the impacts of various structural systems, and the data that is gathered will help to inform future design decisions.

Methodology

Utilization of EPDs and Material Specifications

- Embodied carbon of structural materials will be measured using published values from the **2023 Carbon Leadership Forum (CLF) North American Material Baselines Report**. The report provides a snapshot of the state of Environmental Product Declarations (EPDs) for construction materials in North America, and baseline values represent an estimate of industry-average greenhouse gas (GHG) emissions for those materials.
- Product-specific EPDs will be used if the product is known and an EPD is available.

Life Cycle Assessment (LCA) Software

- The **BIM Climate Action Tool** (**bimCAT**—formerly tallyCAT) will be used for estimating EC in projects during the construction documentation (CD) phase. The tool can measure EC based on CLF baseline values or product-specific EPDs from the Embodied Carbon in Construction Calculator (EC3) database.
- LCA results will be compared with estimates from the design development (DD) phase and used to improve early design phase estimates.

Estimating EC by Project Phase

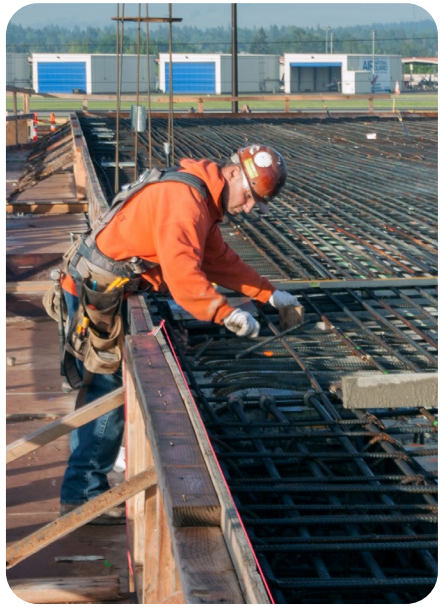
	Schematic Design	Design Development	Construction Documents
Measuring EC in Structural Materials	N/A	CLF baseline values	Product-specific EPD if available, otherwise use CLF Baseline values
Estimating total project EC	Not required - Early EC estimates should be based on data collected from previous projects	Use preliminary member sizes to est. material qty and calculate total EC without LCA software	Use bimCAT to export material quant. frm Revit model and calc. total EC using EC3 database

3 Reporting

Continued

LCA Scope

- Only A1 – A3 scope emissions, otherwise known as 'cradle-to-gate' emissions, will be included in LCA results.
- Each year, we will evaluate whether it is appropriate and beneficial to include A4 and/or A5 scope emissions in LCA results. Inclusion will be based on feasibility, availability of data, and standard industry practices.
- Data reported for SE 2050 will only include EC from structural materials; however, we will encourage other departments to measure EC of non-structural materials.
- Structural material quantities are to be included with submission to SE 2050 Database. **(Reporting Elective 2/3)**



Best Practices

- Each year, we will evaluate our methodology for measuring EC and performing LCAs based on lessons learned from the previous year.
- Consideration will also be given to best practices and guidance available from publications such as *The Structural Engineering Institute (SEI) Prestandard for Assessing the Embodied Carbon of Structural Systems for Buildings* as well as publications from the *Embodied Carbon Harmonization & Optimization (ECHO) Project*.

Reporting Timeline

*(Reporting Elective 1/3) †(Reporting Elective 3 / 3)

2024

For **year one**, we have prioritized Industrial and Public Projects, which represent a consistent and repeatable portion of our firm's business. Our first year was a learning year for our engineers. Projects selected for reporting were relatively simple so engineers could focus on understanding the LCA process and achieving accurate results.

2025

Five projects submitted to the SE 2050 database*

March 2025

Compare EC for **year one** projects & present findings to staff at annual cross-discipline meeting†

Spring 2025

In **year two**, we will expand reporting to include project types from other business units.

2026

Submit up to 40% of new construction projects, but not less than ten (10)*

March 2026

2027

Submit up to 50% of new construction projects, but not less than fifteen (15)*

March 2027

4 Reduction

The Reduction Plan outlines the actionable steps our firm will take to reduce embodied carbon in project work and reach our ultimate goal of achieving net-zero embodied carbon by 2050. The plan includes short-term goals focused on education and data gathering, as well as specific and measurable long-term goals to meet reduction targets and assess progress along the way. We understand the importance of implementing large-scale changes in the way our firm approaches structural design beginning in early design phases and continuing through construction.

Short-term Reduction Strategy (Reduction Elective 1/4)

Prioritize EC Education within Structural Department *beginning in **year one***

- Educate engineering staff on the basics of EC accounting & reduction strategies
- Encourage engineers to adopt a mindset that considers the environmental impact of design decisions

Encourage a Unified Approach to EC Reduction in New Projects *beginning in **year two***

- Expand education to architectural staff, emphasizing the significance of upfront embodied emissions relative to operational impacts over a building's life cycle
- Encourage design teams to collaborate early, as EC impacts are heavily influenced by early design decisions
- Develop tools to facilitate conversations with clients about the importance of reducing embodied carbon in our projects

Note From EC Champion

Did you know that upfront **EC emissions from structural materials often account for 50% or more of a building's total carbon impact** when considering both embodied and operational emissions over the life cycle of a building?

Reduction Timeline

Reduction strategy outlined in 2024 ECAP prioritizes **embodied carbon education & data collection.**

March 2024

During the schematic design phase for one of our public projects, **a bay study was conducted to compare the EC impacts of various structural systems.** Impacts were presented to the client alongside equivalent emissions from cars on the road using the *EPA's GHG Equivalency Calculator.*

Spring 2024 (Reduction Elective 2/4)

Presentation on SE 2050 / AIA 2030 Initiatives will **emphasize the need for a unified approach to EC reduction** at annual cross-discipline meeting.

Spring 2025

Begin to incorporate EC into the **Unified Design Process** and develop material specifications with EC performance and EPD reporting requirements.

Mid 2025

2024 | **2025**

4 Reduction

Continued

Integrate Embodied Carbon into Mackenzie's Unified Design Process

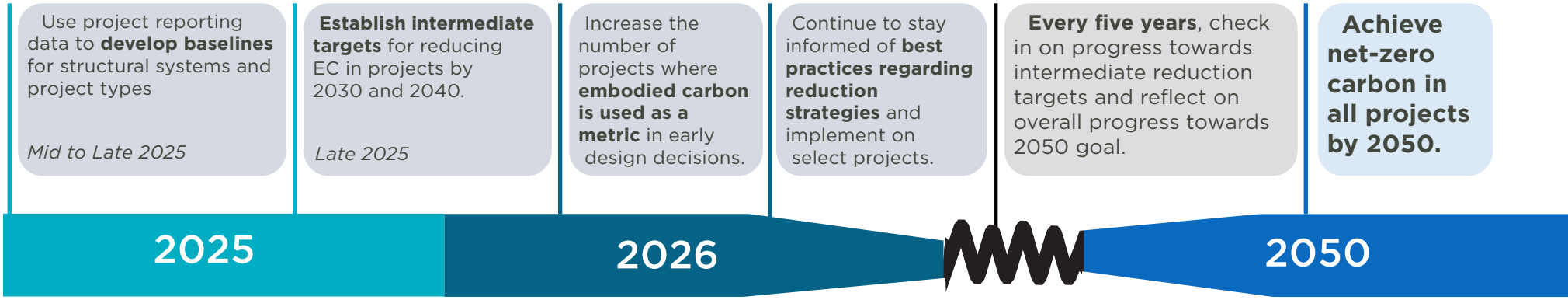
- Utilize reporting data to establish baseline values for structural systems and common project types
- SE 2050 Team to engage with Design Leadership Team to incorporate EC into design principles and an optional workflow matrix for each projects **(Reduction Elective 3/4)**

The workflow matrix will allow design teams to incorporate the following strategies into the design process for projects with sustainability goals and/or where EC reductions are required by code:

- Use embodied carbon as a metric when considering design options and structural systems in early design phases
- Determine appropriate reduction strategies for projects, emphasizing a holistic approach that considers both embodied and operational carbon
- Incorporate EC performance in material specifications with requirements for EPD submittal review **(Reduction Elective 4/4)**

A unified process is working together in a holistic, collaborative, communicative environment, and is based upon mutual respect and understanding of each of our perspectives and experiences.

Reduction Timeline Continued



5 Advocacy

This Advocacy Plan details our firm's strategy to communicate our embodied carbon reduction work externally, engaging with our clients, contractors, other design professionals and community.

The Plan

Advocacy begins with educating staff on the benefits of reducing embodied carbon in our designs. In addition to the following strategies outlined in our Education and Reduction Plans, prompted discussions around client messaging will provide staff with the necessary tools to have informed conversations with our clients and advocate for reducing embodied carbon in our projects.

- Educate staff on the significance of upfront EC from structural materials relative to total carbon impacts over the life cycle of a building
- Encourage a unified approach to reducing EC in our projects, educating staff on reduction strategies and the importance of collaborating early
- Develop tools to facilitate conversations with clients about the importance of reducing EC in our projects.

How does SE 2050 provide value to our clients?

As noted in the Reduction Plan, upfront EC from structural materials can be substantial when considering total carbon impacts over the life cycle of a building. We know that greater EC reductions are realized by prioritizing efficient design and collaborating early, and we know prioritizing EC reductions almost always translates to a more cost efficient design.

In fact, we completed two studies during **year one** where we found that the design option with the least EC was also the most cost effective solution. We intend to highlight our findings at our upcoming cross-discipline meeting as part of our messaging strategy.

Note From EC Champion

(Advocacy Elective 1/3)

Advocacy Timeline

2023

"The More You Know" video series. First video released about low carbon concrete.

2024

Mackenzie declares their commitment to the SE 2050 Program and shares 2024 ECAP on LinkedIn

April 2024

Company website's "Sustainability" page is expanded to include embodied carbon reduction goals

April 2024

The results of our **bay study** completed in Spring 2024 (see the Reduction timeline) are presented to the client alongside a cost estimate of each design option, highlighting that the lowest embodied carbon design option is also the most cost effective.

Spring 2024

5 Advocacy

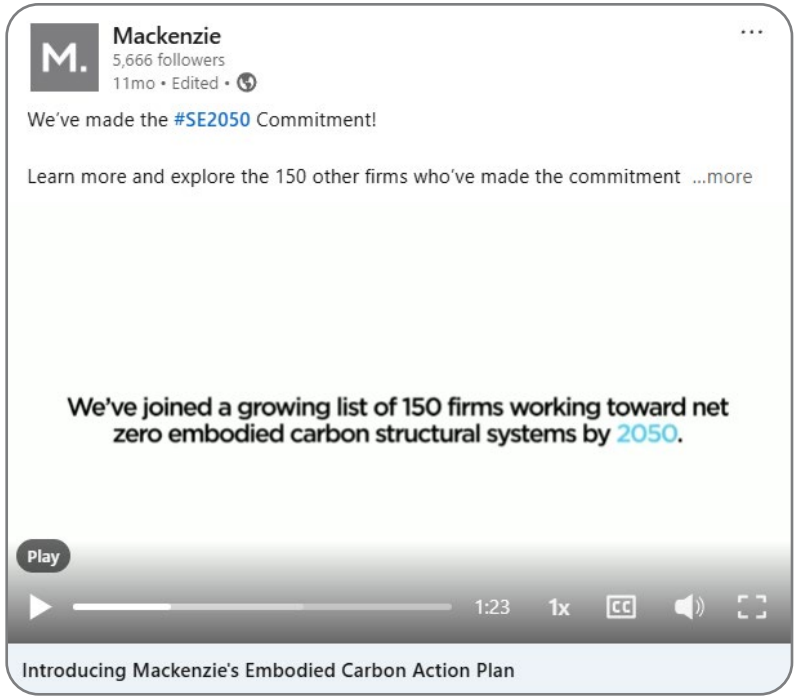
Continued

- ✓ Our annual ECAP submission is published on Mackenzie's company website and shared via LinkedIn and other social media channels. We are proud to be a Signatory Firm of the SE 2050 Commitment Program.

  (Advocacy Elective 2/3)

- ✓ Staff are encouraged to participate in professional organizations that advocate for sustainable design within the engineering profession and prioritize embodied carbon education. Staff currently serve on the NCSEA and SEAO Sustainable Design Committees, and we expect to widen this type of participation. The EC Champion engages with local and state governments to communicate the importance of low-carbon procurement and construction policies and to advocate for the inclusion of embodied carbon provisions in state building codes.

  (Advocacy Elective 3/3)



Advocacy Timeline Continued

2025

A **baseline study** was completed comparing the EC impacts of VE efforts. The results will be presented at the annual cross-discipline showcasing strategies which resulted in the largest EC reductions.

Early 2025

Begin to develop tools to facilitate discussions with clients about EC of different structural systems.

Expand ongoing EC education for all staff to include strategies for client messaging.

2026

Continue to develop tools and visual aids that effectively demonstrate the EC impact of different structural systems. Tools can be used for internal education and external communication with clients and contractors.

6 Lessons Learned

Elective Documentation

Education Electives: *(2) Required / (4) Recommended /* **(5 Total)**

- Electives 1 & 2 are required electives completed and/or updated annually in the ECAP
- Electives 3-5 represent ongoing efforts that began in 2024 and are expected to continue in the following years

Reporting Electives: *(1) Required / (2) Recommended /* **(3 Total)**

- Elective 1 represents the required annual reporting commitment
- Electives 2 & 3 are optional, but expected to be completed at the end of each year starting in 2025

Reduction Electives: *(1) Required / (4) Recommended /* **(4 Total)**

- Elective 1 represents reduction strategy that is required to be included in each year's ECAP. It is evaluated annually and updated as needed.
- Electives 2-4 are optional and were noted as future electives in the 2024 ECAP. Although not planned until 2025, we had an opportunity to present EC impacts to the client in a creative manner (Elective 2) in 2024. We expect to do this more often in 2025.

Advocacy Electives: *(2) Required / (4) Recommended /* **(3 Total)**

- Electives 1 & 2 are required electives completed and/or updated annually in the ECAP
- Elective 3 represents an ongoing effort that began in 2024 and is expected to continue in the following years

Lessons Learned

Education was our primary focus for **year one**. Not only did we use resources from the Carbon Leadership Forum and the SE 2050 Program to educate engineering staff on all things embodied carbon, we kept track of current research and reports published in 2024. We found information in *CLF's 2024 California Carbon Report* to be particularly useful going into **year two**, where we will emphasize a unified approach to carbon reductions across all disciplines.

Reflecting on **year one**, it is clear that our reduction strategy is strongly tied to our education, reporting, and advocacy efforts.

- We need the data generated from our Reporting Plan to inform our reduction strategy.
- We need to educate staff on the significance of embodied carbon and the importance of collaborating early.
- We need to provide staff with the tools and the knowledge to have informed discussions with clients and advocate for reducing embodied carbon in our designs.

As we head into **year two**, we'll use the knowledge gained in **year one** to create actionable steps our firm will take to reduce embodied carbon in project work and reach our ultimate goal of achieving net-zero by 2050.

About Mackenzie

Mackenzie is a design firm for the built environment. Over the past 64 years in business, Mackenzie's services have evolved, and the firm now offers specialized services across a range of disciplines, including architecture, interior design, structural and civil engineering, land use planning, and landscape architecture.

Mackenzie's integrated design approach skillfully navigates the entirety of a project, from studies and assessments to technical challenges and innovative solutions. Collaborative partnerships are integral to Mackenzie's approach.

The firm proudly advocates for its clients to ensure every project achieves its goals and is delivered with the highest level of service. Mackenzie is in Portland, Oregon, Seattle and Vancouver, Washington, and Sacramento, California. For more information, visit mackenzie.inc.

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