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A close-up photograph of a green leaf, showing the intricate vein structure and a vibrant green color, serving as a background for the top left portion of the page.

Introduction

As a single-discipline structural engineering firm, PCS Structural *Solutions* understands our structural systems' impacts on the environment—now and for future generations. We recognize the importance of measuring and tracking structural embodied carbon nationally, setting benchmarks, and working towards future carbon reduction levels. By offering sustainable project solutions, educating staff and clients, and actively participating in national programs, PCS Structural *Solutions* will join other structural engineering firms around North America to progress towards our collective goal of net-zero embodied carbon by 2050.

The Embodied Carbon Action Plan (ECAP)

In PCS Structural *Solutions*' Embodied Carbon Action Plan (ECAP), we outline our internal and external pledges for 2024 and what we learned from our previous year of commitment. Our pledges will be the launching point for PCS to further efforts toward net-zero embodied carbon by 2050.

For the first few years, PCS's ECAP focused on educating our staff and clients on embodied carbon. Internally, we elevated our knowledge about embodied carbon, how we measure it, and what strategies exist to reduce it. This education has allowed PCS engineers to measure carbon on our projects for our clients and the SEI SE 2050 Commitment Program. Externally, we continue to teach our clients what embodied carbon is and how structural engineers play a pivotal role in its measurement and reduction.

A solid foundation is crucial as PCS Structural *Solutions* embarks toward net-zero embodied carbon by 2050. Along the path, PCS will share accomplishments and lessons learned regarding education, measurement, reduction strategies, and advocacy to aid in developing future ECAPs.

Sustainability Team Members

PCS Structural Solutions formed an internal Sustainability Team in 2021. It's purpose is to educate and develop resources within the company to help engineers learn, incorporate, and advocate for embodied carbon reductions within our daily work. The PCS Sustainability Team also ensures that the company meets the SE 2050 Commitment Program requirements every year.



Chris Jeseritz, Team Leader

Chris champions PCS's Sustainability Team and the SE 2050 Commitment Program. He is active with the Carbon Leadership Forum, SEAW Sustainability Committee, SEI Sustainability Committee, and the SE 2050 Commitment Committee. His focus is measuring and reducing embodied carbon and incorporating it into the project workflow of structural engineers.



Brian Phair, Subject Matter Expert

At PCS we generate energy for carbon reduction throughout our industry in the Pacific Northwest. We start at the top by having Brian, our CEO sit on our sustainability committee to ensure support throughout the company and to encourage discussions among the board. We have many clients in our industry asking PCS for guidance as we combine visions and continue on this carbon reduction journey.



Jared Plank, Quality Control Liaison

Jared is the Engineering Team Leader at PCS and serves as a resource to ensure collaboration and quality control. He works with the Sustainability Team to connect with associated material or code teams, help set up presentations, give guidance with future white papers, or suggest educational opportunities to help the team or PCS as a whole.



Annabel Shephard, Member

Annabel is an in-house educator on embodied carbon reduction strategies and performing life-cycle analysis to quantify project embodied carbon. She has been a member of the SEI Sustainability Committee since 2019 and a member of the SE 2050 Commitment Program since its inception. Annabel currently serves on the SE 2050 Leadership Group as the Program Mechanics Lead.



Jaycob Greissl, Member

Jaycob has been involved with creating educational content for external and internal audiences (include the last few ECAPs) as well as gathering sustainability data for multiple PCS projects. As a member since 2022, Jaycob is intrigued by the impact structural engineers can have on creating a more sustainable building environment and incorporating that into the projects he works on.



Lessons Learned

Life-Cycle Assessment (LCA)

PCS has learned how complex an LCA can be when using a structural building information model (BIM). This complexity comes from the BIM's level of development, knowledge of the building's structure, and the evolving understanding of conducting and standardizing LCAs. Over the past three years, we've learned that engineers knowledgeable about the structural system over the LCA process tended to complete an LCA quicker than engineers familiar with the LCA process and not the project. In addition to the introduction tutorial we provide engineers conducting their first LCA, we have authored an internal guide that walks engineers through the LCA process, assigning parameters for different structural materials and other valuable tips and tricks. This internal guide has been updated annually to incorporate engineer's feedback and keep current on the latest LCA developments.

Incorporating Embodied Carbon Reduction

PCS's internal sustainability team is starting to focus more on making resources and documents that allow every engineer to easily incorporate embodied carbon reduction strategies on any project type. Some of the resources will provide step-by-step instructions for measuring or implementing reduction strategies into a project. Others will fit into an engineer's project workflow. One item currently under development is adding options and notes to the different structural materials listed in our structural general notes that can be incorporated into a project to reduce that material's environmental impacts.

Embodied Carbon Reduction Advocacy

PCS has created documents that are shared with clients to summarize and illustrate different strategies to help reduce embodied carbon. One of these is a list of carbon reduction strategies that can be considered for several structural systems and materials, allowing clients to make informed and sustainable decisions from the beginning of the project. Clients have received this list well, and it helps to begin a conversation on embodied carbon reduction and what strategies can be implemented for the project.

PCS advocates for considering and measuring a structural system's embodied carbon as early as possible in the design process. By selecting the appropriate structural system early in the design phase, meaningful reduction strategies can be used as the project progresses through the design phases into the construction phase. Whenever a project is looking to perform a whole building life-cycle assessment (LCA), we advocate that PCS measures the embodied carbon of the structural system.

With these tactics, we have provided embodied carbon reduction with little to no increase in the project's budget and our design fees. We hope to implement these strategies with more consultants.

Education

Education Plan

PCS Structural *Solutions* understands that the key to significant and sustained reductions in structural embodied carbon is providing our staff with the necessary education. Sustainable design is not taught in typical civil engineering university curricula. PCS acknowledges that we must start with the basics and work towards advanced and nuanced topics about embodied carbon reduction strategies and measurements.

Throughout the year, the Sustainability Team provides opportunities for staff to educate themselves on different topics regarding sustainability. These educational opportunities occur in internal presentations conducted by Sustainability Team members or informing staff about webinars by national associations. Presentations created and provided internally are not only given live over Microsoft Teams but are also recorded. This helps us create a library of presentations that can be rewatched by staff who would like to review the content, watched by new staff during their company training, or for staff to watch later who were not able to attend the live presentations. This year, team members will be presenting on embodied carbon credits in Green Rating Systems such as LEED, Green Globes, ILFI that structural engineers can help the design team achieve and upcoming technologies and common myths regarding embodied carbon in structural engineering.

The PCS Sustainability Team has created a library of presentations, documents, and websites regarding embodied carbon and sustainability on our internal website. Staff can go to the page to find helpful resources such as our standard sustainability design practices and guides that help engineers learn and incorporate sustainable design practices in their daily work.

In addition to attending presentations and webinars internally and externally, PCS welcomes and encourages its staff to participate in external events and be active on professional committees. Within our company, we have staff involved in professional committees on a varying level of involvement, ranging from attending events to actively participating in national organizations. With our staff's external participation, they can bring back information to the company to advance our understanding and practices of sustainability in structural engineering. Some organizations our employees are a part of include the Carbon Leadership Forum at the University of Washington, the Structural Engineers Association of Washington's Sustainability Committee, the Structural Engineering Institute's (SEI) Sustainability Committee, and the SEI Structural Engineering 2050 Commitment Program.

ECAP Educational Commitments and Goals

Commitment 1: Provide a narrative of how the Embodied Carbon Reduction Champion will engage in embodied carbon reduction at each office.

- Status at the time of ECAP Publication: **Complete**

The embodied carbon reduction champion will engage and aid with embodied carbon reductions at each PCS office through members of the company's internal sustainability team. At least one team member will represent each office and learn about new developments and studies in embodied carbon reduction through the team's meetings, discussions, and research. The team members will share knowledge obtained from the sustainability team with each other employees at each office. For complex or difficult inquiries about reducing embodied carbon, a team member can bring the question to the entire group to decide on the best answer.

Commitment 2: Present one webinar focused on embodied carbon available to all PCS employees.

- Status at the time of ECAP Publication: **In progress**

PCS's internal sustainability team plans to present two embodied carbon presentations. The first presentation is "Green Rating Systems in the Building Industry" which will be given on April 3, 2024. The presentation will inform attendees about the different green rating systems in the building industry and how structural engineers can help the project team achieve credits related to embodied carbon for each rating system. The second presentation to be given on April 17, 2024, is titled "Structural Sustainability: The Fundamentals, Upcoming Technologies, and Myths." This presentation will provide a quick overview on the fundamentals, highlight the latest technologies, and dispel myths regarding embodied carbon.

Commitment 3: Incorporate embodied carbon education in your onboarding process for all new engineers.

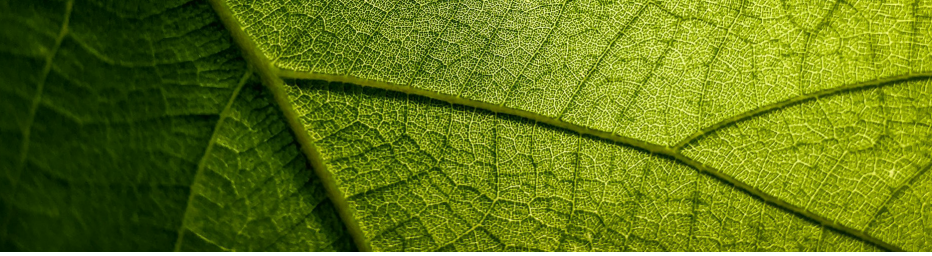
- Status at time of ECAP Publication: **In progress**

Currently, PCS is brainstorming ways to incorporate embodied carbon education into the onboarding process for newly hired engineers. We intend to have a process in place in time for our next round of new hires this summer/fall.

Commitment 4: Initiate an embodied carbon interest group within your firm and outline their goals. This group may more broadly address sustainability, but they must include embodied carbon.

- Status at time of ECAP Publication: **Complete**

PCS has created a sustainability team comprising members from each office. The team's mission is to share information company-wide on all aspects of structural solutions for buildings by staying current on industry changes, maintaining up-to-date engineering resources, and advising on company design standards. The team's efforts included embodied carbon and broad sustainability within our offices' processes within engineering and general office practices.



Commitment 5: Create an Embodied Carbon digital resource wiki and/or forum on your firm's internal website for staff to create, share, and discuss Embodied Carbon educational resources.

- Status at time of ECAP Publication: **Completed**

PCS has created an internal website containing valuable documents, resources, and links for structural engineers. The website and resources are reviewed and updated annually.

Commitment 6: Engage with a CLF Regional Hub.

- Status at time of ECAP Publication: **Ongoing**

PCS employees actively attend and interact with the local Carbon Leadership Hub.

Reporting

Reporting Plan

PCS Structural Solutions follows the LCA methodology provided in the latest version of ISO 14040 and ISO 14044. At a minimum, the LCA scope analyzed for all projects is Cradle to Grave (EN 15978 life-cycle phases A to D). We publish reports internally, with biogenic carbon included and excluded, to the SE 2050 database.

PCS calculates embodied carbon for structural materials using the Autodesk Revit application, Tally. This application was selected since most EN 15978 LCA phases A-D are included in the analysis, material quantities can be extracted directly from Revit during different design phases, and it allows PCS to collaborate with our clients using Tally. The database in Tally offers industry-wide and manufacturer-specific Environmental Product Declarations (EPDs). The US Life Cycle Inventory Database, GaBi, and ASTM EPDs provide the life-cycle inventory (LCI)/LCA data in Tally. PCS has created an internal Tally User Guide to standardize how our staff performs a life-cycle analysis.

Material quantities can be extracted through the Revit model using Tally during any project phase. We plan to extract these quantities during the key milestone phases of the project, including Design Development, Permit, and Construction Documents. During construction, we will transition to material quantities supplied by the contractor. PCS's typical Embodied Carbon Workflow is shown in the Embodied Carbon Reduction Strategies section.

PCS has created an internal database for concrete-specific environmental product declarations (EPDs). This database has helped us track the embodied carbon values for various mix designs we have used on past projects from multiple regions and concrete suppliers. The data helps us recommend global warming potential limits or reduction targets for different types of concrete mixes used on the project using the internal database numbers as a benchmark.

ECAP Reporting Commitments & Goals

Commitment 1: Submit an annual minimum of (2) projects per U.S. structural office but need not exceed (5) total projects for the firm to the SE 2050 Database.

- Last year PCS submitted the minimum program requirement of five projects to the SE 2050 database.
- Status at time of ECAP Publication: **Complete**

PCS has completed LCAs for multiple projects in the healthcare, high end residential, and K-12 sectors. Additional LCAs are currently in progress for projects throughout the Pacific Northwest, with the goal of covering a wider range of project types and materials.

Commitment 2: Compare the embodied carbon emissions from multiple projects across your firm. Analyze and document what data or pieces of information are most important and communicate the findings to your firm.

- Status at time of ECAP Publication: **In progress**

PCS plans to take data from all our projects submitted to the SE 2050 database to compare and analyze. With the findings, we will either create an internal presentation or white paper to communicate the findings with staff.

Embodied Carbon Reduction Strategies

Reduction Plan

As structural engineers, we can be pivotal in reducing embodied carbon within the built environment. Selecting sustainable building materials, increasing the efficiency of structural design, and collaborating with architects and material providers to quantify embodied carbon are just a few ways PCS is working towards net-zero embodied carbon by 2050. PCS will continue developing practical, sustainable solutions to meet client and owner needs as we implement lessons learned from projects of the past and present.

Concrete is the most consumed building material in the world, and PCS is committed to developing strategies to reduce embodied carbon associated with the production of ingredients used in concrete mix designs. Internal white papers were written to outline effective strategies that can be implemented on all PCS projects utilizing concrete. These include replacing traditional cement with Type 1L cement and implementing performance-based concrete specifications to allow for greater collaboration with concrete producers to meet embodied carbon reduction goals. Also included are strategies to utilize Life Cycle Assessments and Environmental Product Declarations to be well-informed on the quantities of embodied carbon associated with a specific project.

Implementing carbon reduction strategies in the design phase of a project can be challenging due to the already busy nature of the design process. To make this easier, PCS has developed a workflow (see Appendix C) clearly outlining the specific carbon reduction strategies that should be considered at each stage in the design process. This workflow outline makes it easier for designers to understand when conversations about carbon reduction need to occur and how to better implement these strategies earlier in the design process to allow for a more streamlined project schedule.

ECAP Reduction Commitments & Goals

Commitment 1: Develop and implement a workflow that makes it easier to make early design decisions based on embodied carbon.

- Status at time of ECAP Publication: **Complete**

PCS has developed a workflow to outline the embodied carbon considerations that should be taken at each stage of the design process. See the Appendix C of this document for a visualization of this workflow.



Commitment 2: Incorporate biogenic materials on at least one project annually.

- Status at time of ECAP Publication: **Ongoing**

As a Pacific Northwest firm, incorporating biogenic materials in our projects is a natural fit. The timber industry played a significant role in the region's history and continues to innovate and evolve. Using wood products from local suppliers will help reduce the embodied carbon associated with transporting the material and support our local economy.

The incorporation of biogenic materials into a project will typically lead to a reduction in the embodied carbon. Carbon savings come from several sources. It takes less energy to process the raw wood into building elements compared to the equivalent steel or concrete member. A wood element will also generally weigh less than the equivalent steel or concrete member, which results in lower emissions from transporting the material to the construction site.

Another advantage of biogenic materials is they provide carbon storage. During the tree's growth, it absorbs carbon dioxide from the atmosphere. It will store this carbon until the wood either burns or decays. Since this carbon is eventually released, it may not be considered in the LCA. However, the delay in the release of carbon is valuable. Carbon present in the atmosphere currently will have a much more significant impact on climate change than carbon released years into the future.

Commitment 3: Participate in a LEED, ILFI Zero Carbon, or similar project design charrette and speak to potential design considerations impacting embodied carbon.

- Status at time of ECAP Publication: **Complete**

PCS has helped and provided clients with embodied carbon reduction strategies for projects seeking LEED or ILFI Zero Carbon certification. These strategies have helped the team reduce embodied carbon to help achieve the desired credits/certification.

Commitment 4: Integrate embodied carbon mitigation strategies in your General Notes.

- Status at time of ECAP Publication: **Complete**

PCS has implemented Type 1L cement into all projects' general notes. This update allows concrete providers to use Type 1L cement in all concrete mixes. Type 1L is a blended cement that reduces the amount of cement in the concrete mix by the addition of limestone. Since cement is the largest contributor to the global warming potential of concrete, reducing cement will directly reduce the embodied carbon associated with the concrete mix.

Commitment 5: Publish a document outlining best practices for reducing cement in concrete mixes.

- Status at time of ECAP Publication: **In progress**

PCS is working on a paper discussing different ways structural engineers can reduce cement content within concrete mixes. Since cement is the largest contributor to the global warming potential of concrete, reducing cement will directly reduce the embodied carbon associated with the concrete mix. This paper will be published in Mid-2024. We've also published an internal white paper outlining how to utilize performance-based concrete specifications on a project.

Advocacy

Knowledge Sharing Plan

PCS Structural Solutions recognizes that structural engineers are vital in addressing climate change. We have the tools to track and measure embodied carbon, which allows us to quantify our carbon reduction strategies. However, this work cannot be done by one company alone. A key component to achieving our goals is creating awareness and amplifying the work done by SEI SE 2050 and similar organizations. The SEI SE 2050 Commitment community is a fantastic place to grow and learn. Structural engineers bring a unique perspective to the world and the built environment. PCS must take its place in providing solutions and sound judgment in advocating for embodied carbon reductions to our clients, material suppliers, and peers. Our advocacy will be accomplished through involvement with outside organizations, outreach through media outlets, and the marketing material/project proposals PCS provides clients.

ECAP Commitment Advocacy Commitments and Goals

Requirement 1: Share your commitment to SE 2050 on your company website.

- Status at time of ECAP Publication: **Complete**

Requirement 2: Describe the value of SEI SE 2050 to clients. How can we collaborate to reduce embodied carbon? At your option, attach any associated marketing materials.

- Status at time of ECAP Publication: **Complete**

PCS sees the most significant value of the SEI SE 2050 Commitment Program to clients as the ability to inform project decisions in early conceptual and schematic design phases. By establishing industry benchmarks and leveraging the national database, PCS can help design partners evaluate the impact of structural system options on the embodied carbon associated with the project.

PCS has created a qualifications page focusing on our commitment to SEI SE 2050 and other sustainability efforts included in project proposals.

Requirement 3: Give an external presentation on embodied carbon demonstrating project success and lessons learned. Get connected at a CLF regional hub near you.

- Status at time of ECAP Publication: **Complete**

PCS employees have given multiple external presentations to clients and organizations regarding embodied carbon and how structural engineers play a vital role in its measurement and reduction.

PCS is actively involved with the Carbon Leadership Forum at the University of Washington.

Requirement 4: Engage with local, state, and federal governments to communicate the importance of low-embodied carbon procurement and construction policies.

- Status at time of ECAP Publication: **Complete**

PCS has attended and participated in several hearings discussing legislation and building code amendments in Washington State regarding carbon reduction in the construction industry.

PCS will continue participating in public hearings to communicate the importance of carbon reduction policies.

Appendix A: Education

Background

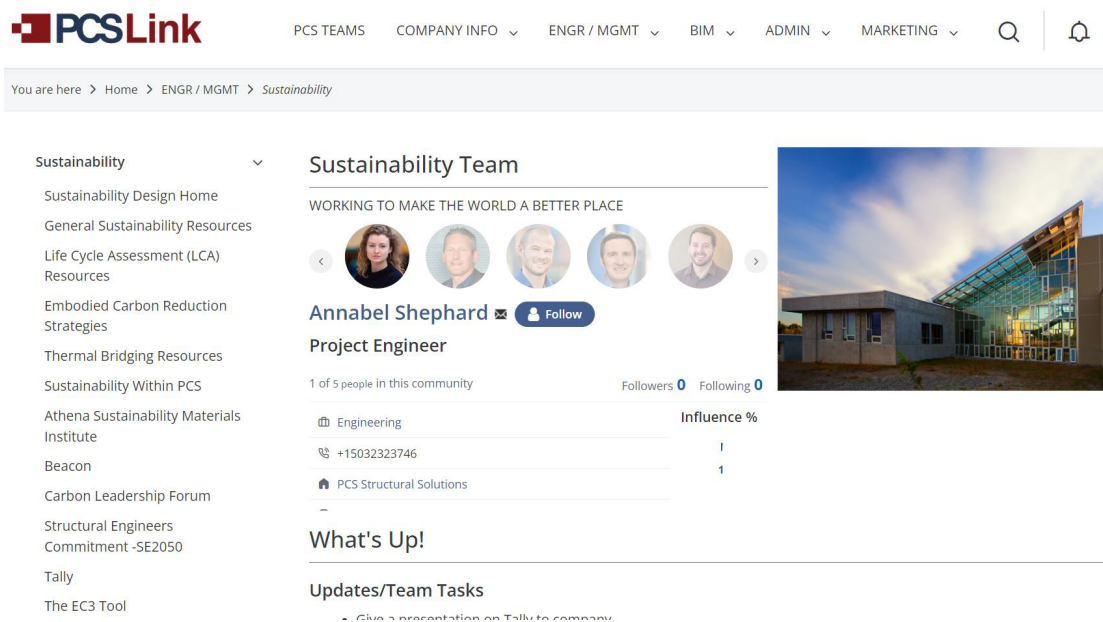
- PCS designs with timber
- Increasingly due to “sustainability”

↳ What does this mean?



4

Figure above: Slide from an internal presentation on Forestry Practices in Structural Wood.



The screenshot shows the PCSLink internal website. The top navigation bar includes 'PCSLink' and various departmental links like 'PCS TEAMS', 'COMPANY INFO', 'ENGR / MGMT', 'BIM', 'ADMIN', and 'MARKETING'. A breadcrumb trail indicates the current location: 'You are here > Home > ENGR / MGMT > Sustainability'. The main content area features a 'Sustainability Team' profile for Annabel Shephard, Project Engineer, with a 'Follow' button and a 'What's Up!' section. A sidebar on the left lists various sustainability resources such as 'Sustainability Design Home', 'General Sustainability Resources', 'Life Cycle Assessment (LCA) Resources', 'Embodied Carbon Reduction Strategies', 'Thermal Bridging Resources', 'Sustainability Within PCS', 'Athena Sustainability Materials Institute', 'Beacon', 'Carbon Leadership Forum', 'Structural Engineers Commitment -SE2050', 'Tally', and 'The EC3 Tool'. A large image of a modern building with a glass facade is also visible on the right side of the team profile.

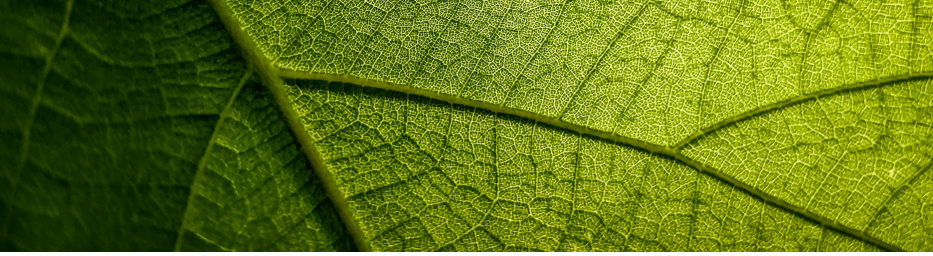
Figure above: PCS Structural Solutions internal sustainability and embodied carbon resource library.



Appendix A: Education



Figures above: Organizations PCS Structural Solutions are actively involved in.



Appendix B: Reporting



2023 Carbon Leadership Forum
North American Material Baselines

BASELINE REPORT v2 | AUGUST 2023



Athena Sustainable Materials Institute www.athenasmi.org

A Cradle-to-Gate Life Cycle Assessment of Ready-Mixed Concrete Manufactured by NRMCA Members – Version 3.2

This project report and its results are used to support the development of an industry wide or sector average Environmental Product Declaration for the production of 72 concrete mix designs

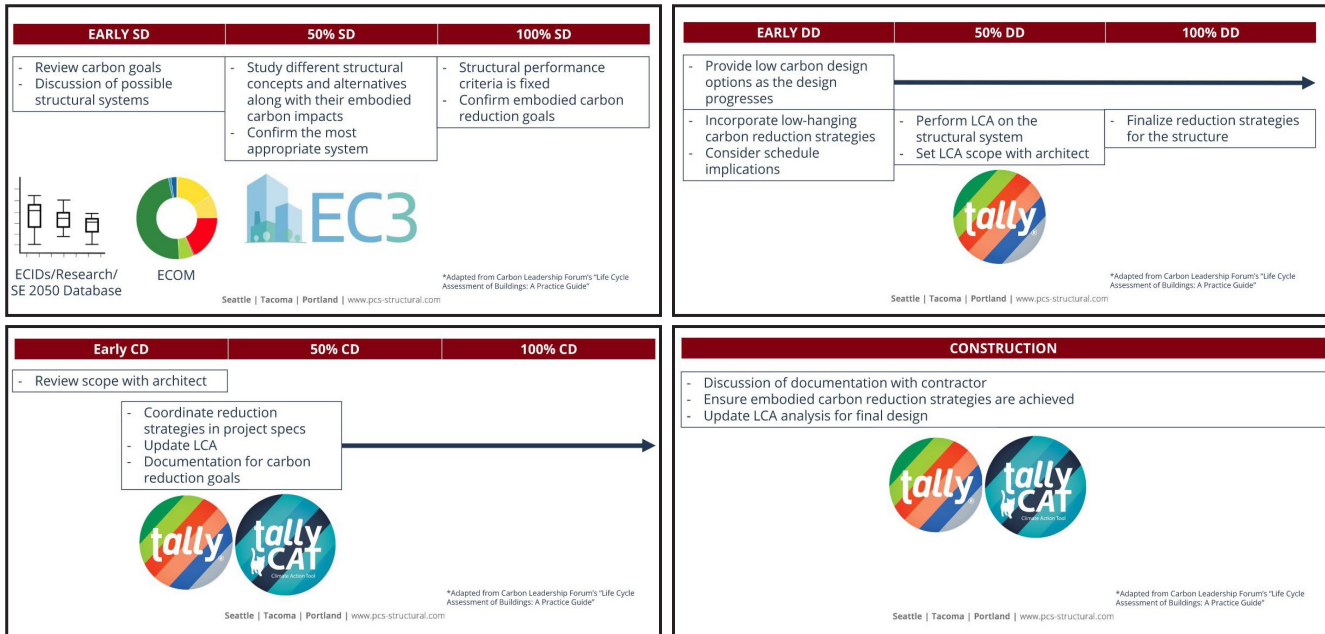
Comissioner: National Ready Mixed Concrete Association (NRMCA)
EPD Program Operator: NSF International
Prepared by: The Athena Sustainable Materials Institute

July 2022



Figures above: Concrete baseline publications referenced by PCS in project specifications and internal databases.

Appendix C: Reduction Strategies



Figures above: PCS Structural Solutions Embodied Carbon Workflow.

Appendix D: Advocacy



Figures above: Organizations PCS Structural Solutions helps spread knowledge to others in the industry.



STRUCTURAL
ENGINEERING
INSTITUTE



SEI SE 2050 works to educate, engage and report the impacts of the built environment and its associated embodied carbon. The Goal—to achieve net zero embodied carbon by 2050.



Sustainability at PCS

PCS has been an official signatory of the **Structural Engineering Institute's Structural Engineering 2050 (SEI SE 2050)** Commitment Program since 2021. As a signatory, PCS publishes an **Embodied Carbon Action Plan (ECAP)** and submits embodied carbon data to the SE 2050 Database annually. Our ECAP summarizes our past years' accomplishments and highlights our goals for the coming year in regards to embodied carbon. Data submitted to the Database aids us and the structural engineering profession better understand the impacts our structural systems have on the environment.

PCS's internal sustainability team provides employees with resources and tools that help our structural engineers learn, measure, reduce, and engage in embodied carbon and sustainability conversations with our clients. PCS utilizes multiple tools internally to help the company track and measure embodied carbon. These tools include Tally, internal Databases, and the EC3 Tool.

Externally, PCS helps support and advocate for embodied carbon measuring and reduction. PCS was an early adopter of the Embodied Carbon in Construction Calculations (EC3) Tool, a sponsor of the Carbon Leadership Forum, and has several employees actively involved in multiple professional organizations' sustainability committees.



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