



SE 2050

Embodied Carbon Action Plan 2025

CANNONDESIGN



Part of a Larger Firm-Wide Sustainability Strategy

Eric Corey Freed,
Director of Sustainability

Our commitment to SE2050 is part of a larger set of commitments and targets we've set to take responsibility for the impacts of our work.

The upfront emissions stemming from the extraction, manufacture, transport, delivery, and installation of the building structure itself can comprise the bulk of the overall embodied carbon related emissions from the building. Measuring and managing these structural impacts is critical in achieving the zero carbon buildings that CannonDesign has targeted as one of our five key sustainability targets. Tracking and evaluating the Environmental Product Declarations (EPD's) for the structure, therefore, is important for our teams and has elevated low carbon materials as a key driver in our work.

Our Watchlist for Embodied Carbon is utilized across all of our projects to change how we evaluate and select the structural systems to a minimum standard of carbon reduction. All of these targets are coordinated to help shape our direction and success as a firm leading the way in sustainability.

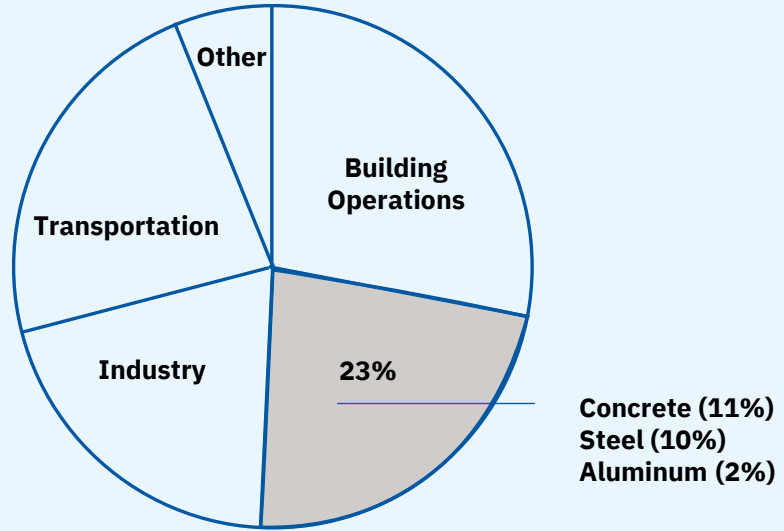
Eric Corey Freed,
RA LEED Fellow, EcoDistricts AP,
LFA, ActiveScore AP
Director of Sustainability

The Connection Between Buildings and Carbon

Historically, operational emissions have been the focus of sustainability efforts in the world of buildings and infrastructure. But what the industry has realized in the last decade is the critical need to also address embodied carbon emissions.

In fact, if we take a closer look at annual global carbon emissions, just three materials are responsible for 23% of these emissions: concrete, steel, and aluminum. The consumption of these materials is mostly due to the building industry, and thus the reduction of their embodied carbon emissions is critical to address.

Annual Global CO₂ Emissions



© Architecture 2030.
All Rights Reserved.
Data Sources: Global
ABC Global Status
Report 2018, EIA

The Urgency with Embodied Carbon

Embodied carbon is defined as the greenhouse gases emitted from the extraction, manufacturing, transportation, installation, maintenance, and disposal of building materials.

Since embodied carbon is released before and during the construction of a building, it's more critical to reduce than the carbon emissions from operating the building (which continues for years after completion). This is referred to as the "time value of carbon" since the greenhouse gas emissions cut today are worth more than any cuts promised in the future.

By the year 2030, all new buildings, infrastructure and renovations will need to cut their embodied carbon by at least 40% for us to achieve global targets. And by 2050, we'll have to cut our embodied carbon emissions by 100%.

Why This Affects Structural Design

The structural engineering profession needs to carefully reconsider design approaches. Life cycle analyses (LCAs) continue to show that the structural systems of buildings contribute most of a new building's embodied carbon. The majority of these emissions are



Skolnick Surgical Bed Tower – Miami, FL

from concrete, closely followed by steel. And most of concrete's emissions are due to cement (one of the main ingredients in concrete).

Simple material decisions can help to reduce embodied carbon. Given the high carbon footprint of steel and concrete, finding any way to reduce the carbon impact of these two materials is critical. Some of these strategies that structural engineers can implement include:

- Replacing the Portland Cement content with Type 1L cement or supplementary cementitious materials like fly ash, slag, or ground glass pozzolans
- Changing concrete specifications to performance based, to allow contractors to reduce the amount of cement required

- Using biogenic materials like Mass Timber
- Restricting the Global Warming Potential (GWP) of materials and verifying conformance through Environmental Product Declarations.



Coachella Fire Station – Coachella, CA

Executive Summary

The CannonDesign Embodied Carbon Action Plan lays out in detail our plan and goals to ultimately reduce our structural systems' embodied carbon emissions to zero by the year 2050. This Embodied Carbon Action Plan (ECAP) is a primary requirement of our commitment to the SE 2050 program and is organized into the four required sections: Education, Reporting, Reduction Strategies, and Advocacy.

Education covers our methods for spreading embodied carbon literacy and conversation throughout the structural engineering department, the firm and community.

The Reporting section addresses the other primary requirement of SE 2050: submittal of project life cycle assessments to the SE 2050 Database.

Reduction Strategies describes our proposed strategies for reducing embodied carbon in structural systems.

Lastly, Advocacy explains how we will spread awareness of reducing structural embodied carbon beyond our firm. We will need the entire construction industry on board with the SE 2050 cause if we are to have an actionable impact on carbon reductions.

At the end of each year, the CannonDesign structural group revisits our ECAP to reflect on what worked best, and what can be improved. It is through this honest reflection and our dedication to the strategies laid out in this plan that we can find our path to designing net-zero embodied carbon structures by the year 2050.

Education

A key component of CannonDesign’s culture is our belief that we work best as a group, uniting the unique knowledge of individual team members across the firm to seek out answers to difficult challenges whenever possible. We believe that the benefits of knowledge sharing are exponential. When multiple team members come together to work out a problem, their combined skill is greater than the simple sum of their individual abilities.

For this reason, CannonDesign has fostered many different avenues for knowledge sharing across our offices to tackle our greatest challenges, including the challenge presented by the impact of our work on the environment. Our educational initiatives include a mix of forums, meetings, and events—some started by firm leadership, and others as “grass-roots” movements led by passionate employees of any level. Below is a list of educational resources our team members regularly engage with to grow our effort to address our environmental impacts.

Structural Studio

This is a monthly meeting with all CannonDesign structural engineers to discuss our current work across offices. Time is set aside in each call for the Embodied Carbon Reduction Champion to update everyone across all offices on firm initiatives and strategies. We also use this time to share knowledge on effective carbon reduction strategies with each other during our ‘Tips & Tricks’ section.

Embodied Carbon Call

This is a voluntary firm-wide meeting with CannonDesign architects and structural engineers where the firm-wide initiative to reduce embodied carbon is discussed. Meeting topics range from discussions of lessons learned from projects and life cycle assessment demonstrations to education on new technologies aimed at reducing embodied carbon.

Embodied Carbon MOXIE Page

MOXIE is an internal intranet visible to all CannonDesign employees with sub-spaces dedicated to employee resources and project delivery methods, and a space specifically dedicated to sustainability. At any time, an employee can visit the “Sustainability - Embodied Carbon” page on MOXIE to see what others are currently doing to address

embodied carbon. Our colleagues can also watch employee-led tutorials on how to use tools such as Tally, read guides on performing life cycle assessments, browse documentation from SE 2050, access links to external resources such as the BSA’s “Embodied Carbon 101” webinar recording, and more.

It is within this space that we have shared the news of CannonDesign’s Commitment to SE 2050 alongside our previous Embodied Carbon Action Plans. We will also be posting this current year’s plan and all future plans on MOXIE.

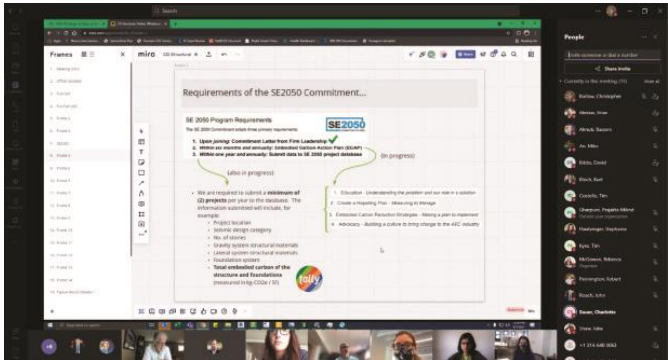
CannonDesign Academy

CannonDesign employees of every discipline are offered professional development opportunities through our internal CannonDesign Academy webinar series. These webinars cover a range of topics across the architectural, engineering, and construction spectrum. In the past, we hosted our own introductory

webinar on embodied carbon, as well as a follow-up webinar specifically covering embodied carbon in structures in collaboration with our architecture colleagues. A recording of this webinar, along with other webinars on embodied carbon, will continue to be hosted on MOXIE and promoted to all CannonDesign employees.

Improve Engagement with Architectural Colleagues

As engineers in an interdisciplinary firm, we have the unique advantage of working directly with architects as our fellow colleagues and partners. This setup also places an obligation on us to educate our design partners on embodied carbon in structures. While we will continue to grow our library of webinars and presentations, we also will keep in mind our wider audience and strive to bring them on board to the goals of the SE 2050 program.



CannonDesign structural studio session discussing the SE2050 commitment requirements.

2023-2024 Education In Review

LESSONS LEARNED

As engineers, we know that all our design decisions must be based on good data. If we don't have good data, we can't have good design. As the complexity and relative uncertainty of the data grows, a key qualifier to having good data emerges: good interpretation of the data. Good interpretation entails consistent use of the data from project to project. For example, in evaluating embodied carbon, there are frequent assumptions that must be made to complete the calculation. For these numbers to be useful, we must ensure awareness of these assumptions and how they influence the relative outcomes. For this reason, we have spent a lot of our time this year addressing what assumptions should be made in our analyses. We've also created guidance documents to ensure that everyone across the firm is educated on these assumptions and how to interpret the numbers with the proper level of insight and care.

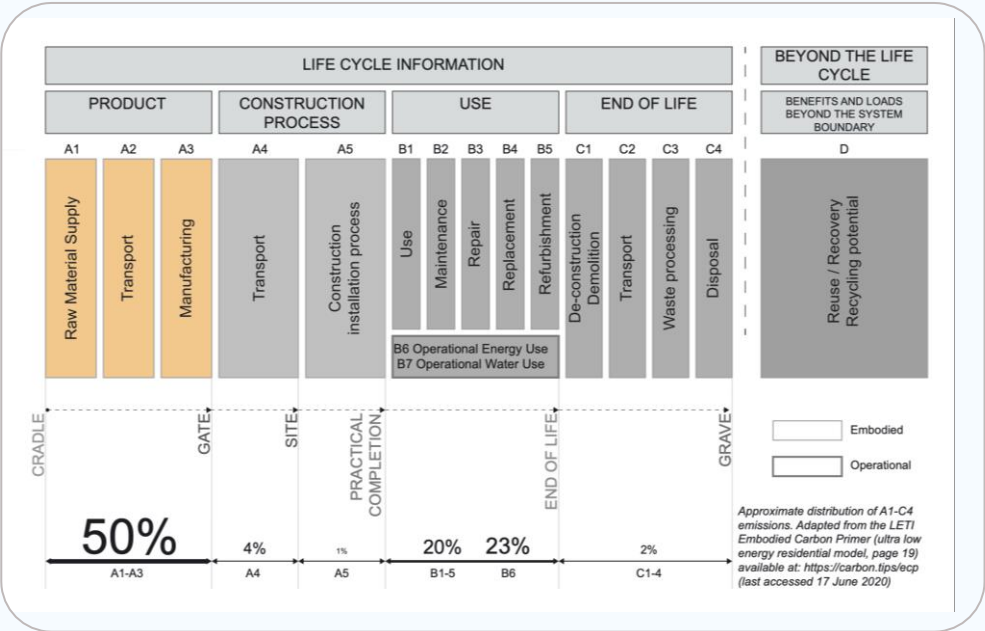
ACHIEVEMENTS

- Distributed our 2024 Embodied Carbon Action Plan firmwide
- Participated in Engineers Week presentations to highlight our recent project work and carbon reduction strategies to the entire firm
- Scheduled and attended several Lunch and Learn presentations focused on improving structural performance and carbon reduction such as SEAMass – High Strength Steel, Woodworks seminars, Pozzotive – Low Carbon Glass Pozzolan, and more
- Hosted Structural Studio every month, which includes an open forum to discuss sustainability topics within our discipline
- Held bi-weekly embodied carbon meetings to discuss firmwide embodied carbon strategies with MEP engineers, architects and planners
- Continually updated our Embodied Carbon MOXIE page with new resources and information to share with our colleagues
- Created a guidance document to assist architects and engineers in performing Life Cycle Assessments and uploading the data to the database
- Created a document on Structural Decarbonization for Healthcare that provides key insight and data on how to lower embodied carbon for healthcare projects

- 1 Structural engineer attended the Steel Conference and distributed webinar links to all other engineers
- 2 Structural engineers participated in the SEI Workshop: Towards Zero Carbon
- 2 Structural engineers participated in the Structural and GeoConfluence Conference

Reporting

CannonDesign is committed to measuring, tracking, and reporting embodied carbon data and contributing to the SE2050 database. We believe tracking and reporting this data is a critical step toward educating others on the impact the structure has on the total embodied carbon of a project and ultimately reducing the structural contribution to a project’s carbon footprint.



We will measure Embodied carbon through the product manufacturing stages (A1-A3) of the structure life cycle.

Measure and Report

To measure the embodied carbon of our structures, we will continue to utilize the Life Cycle Assessment software, Tally, and focus on the life cycle stages from cradle to gate (A1-A3). By using Tally in conjunction with our projects’ Revit models, we will assess a project’s embodied carbon at the end of the Construction Documents phase, when the structure is fully defined.

Our Specifications require Environmental Product Declarations (EPDs) on all projects. In the case that none are available we will work with the contractor to obtain them, and as a last resort we will utilize the standard values in Tally to inform our measurements. By using these methods for measurement, we anticipate contributing a minimum of five (5) projects to the SE 2050 database. In addition to reporting our GWP intensity, we will also continue reporting Structural Material Quantities (SMQs) to the SE 2050 database for all projects submitted to the database.

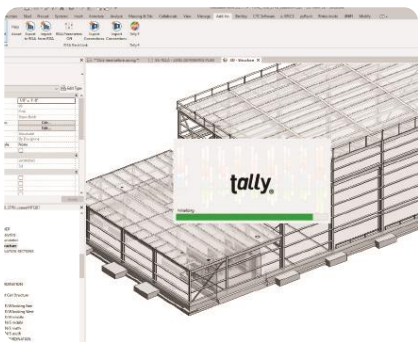
Material Mapping and Best Practices for LCAs

Over the last few years, we have updated our Revit materials library and studied options to map materials in our Revit models to make running LCAs using Tally more efficient. Now that we have explored multiple options, we will

continue to evaluate which is the most effective for our processes over time. In addition to mapping materials, we have also accumulated knowledge that we have shaped into a ‘best practices’ document. Our LCA Guidance Document encompasses many topics including, why and how to perform an LCA, effective BIM modeling techniques, defining materials in Tally, quantifying SMQs, and uploading information to the SE 2050 national database. This is intended to be a living document that we will continue to enhance. Our aim is that it will make the LCA process easier for new users in our firm and will continue to remove any barriers for running project LCAs in the future.

Internal Database

Now that we have an internal database tracking our life cycle assessment data, we will continue to decide how best we want to use the data we collect. At present, our database is simply a way for us to track how many projects we are able to run LCAs on in order to establish a baseline for embodied carbon intensity of our projects. As our dataset grows, this information will ultimately allow us to track progress in our journey to reduce embodied carbon.



The Revit plugin Tally will be used to measure structural embodied carbon.

ACHIEVEMENTS

We were able to achieve all of our 2024 reporting goals

Submitted five (5) life cycle assessments (LCAs) to the SE 2050 database

Submitted Structural Material quantities (SMQs) for all submitted LCAs

Consolidated the knowledge we have accumulated on LCA best practices into a Firmwide resource document

Trained (1) additional structural engineer to perform LCAs

Continued developing internal database of LCAs

Reduction Strategies

Continued Focus on Education

Setting a strong baseline of knowledge will allow us to develop meaningful carbon reduction strategies. Sustainability practices and goals will be highlighted at monthly structural group meetings with the aim of improving embodied carbon “literacy” so our engineers can confidently discuss the subject on project teams in the future.

Our past experiences with biogenic materials will help inform our education efforts moving forward. We plan to use past projects that incorporate biogenic materials as case studies to educate our peers on “lessons learned”, best practices, and strategies for incorporating biogenic materials in more projects in the future. This education effort will be targeted at both engineers and architects. We want our peers to have a level of comfort with biogenic materials so that they can promote them in the early decision-making stages of projects. We also want to teach best practices for biogenic materials so that we can execute projects at a high level and convince more designers and clients of their efficacy.

Tally is the LCA software of choice for CannonDesign. Our aim is to increase the number of individuals who have experience with Tally. We also plan to periodically share best practices for Tally to ensure that our LCAs are consistent and accurate. We will also study using OneClick LCA during the SD phase on one project to run bay studies for preliminary embodied carbon information.

Specifications

CannonDesign has an existing firm-wide Embodied Carbon committee, which has begun to implement changes to project manual specifications, primarily for architectural specifications. We have successfully completed a firm-wide revision to our structural specifications. We incorporated GWP limits and performance-based mix designs for concrete and updated our steel and concrete specifications to require EPDs.

We have revised our concrete specification by setting GWP limits per the achievable (low) baseline in the 2021 CLF Material Baselines Report. When comparing these limits to the NRMCA national benchmark GWPs we expect, on average, a 16% reduction in GWP across all normal-weight concrete strengths and a 7% reduction in GWP across all lightweight concrete strengths.

Additionally, we have updated our Structural Steel Framing Specification to include GWP limits based on the Buy Clean California Act. Based on our research, we believe that these limits are an achievable recommendation regardless of a project’s geographic location in the United States. For each type of steel in the specification section, we have provided limits for both unfabricated and fabricated products to ensure coverage for whichever EPD is available.

Our goal is to incorporate these specification modifications into all projects moving forward. Our structural group also has a demonstrated track record of periodic review and improvement of our specifications. We plan to use this regular review process to incorporate industry best practices related to embodied carbon into our specifications over time.

Biogenic Materials

The CannonDesign structural team will aim to incorporate biogenic materials on at least one project annually. Our engineers have experience with the design of mass timber, conventional wood framing, wood trusses, and exposed timber framing. We continue to pursue mass timber opportunities and aim to build our mass timber design experience.

Annual Reflections & Project Checklist

At the culmination of each year, a recap meeting will be conducted to collect thoughts and experiences to streamline successful strategies and formulate new ones. We will use the meeting notes to draft an annual review narrative which will help form our ECAP for the following year.

This reflections meeting will also be used to formulate a pre-design checklist to be used in the preliminary stages of each project. This checklist will help determine which carbon-reducing strategies are attainable and what additional goals we should be aiming for. Checklist items will include grid spacing, opportunities for biogenic materials, selected structural materials, project location, building program, embodied carbon reduction strategies, and other physical or geometric building characteristics.



At Wellspring Health Surgical and Critical Care Tower, the concrete mix designs utilized type 1L cement, and steel column sizes were reduced through the use of 65ksi steel.

2023-2024 Reduction Strategies In Review

LESSONS LEARNED

In 2024, we designed a mass timber project that unfortunately did not progress into construction. Although the project remains unbuilt, we gained valuable knowledge on how we can improve carbon reductions for future mass timber projects. First and foremost, we learned that with mass timber, getting the fabricator on board early is critical. Unlike steel design, which is primarily based on industry-wide standards for sizes (e.g. wide flange sections) and material properties (e.g. ASTM A992), there are no industry-wide standards for wood products at present. Each manufacturer provides a unique product. If you don't know what is available to you during design, your design can be inefficient. You may end up underestimating the strength properties and designing something overly conservative. Alternately, you may end up designing a bay size that's off the manufacturer's typical CLT module and end up with significant waste. Knowing these parameters up front is crucial to reducing embodied carbon.

ACHIEVEMENTS

Updated our Structural Steel Framing specification to set GWP limits

Used biogenic materials on (3) projects

Successfully trained at least one person from each of the four structural offices to conduct LCAs using Tally.



Children's Hospital of Philadelphia Morgan Center – Philadelphia, PA



Quail Valley Fire Station utilized light framed wood construction with structural steel to achieve structural performance in a high seismic zone

Advocacy and Knowledge Sharing

Advocacy for the SE2050 commitment is a crucial part of making industry-wide changes to reduce embodied carbon. Beyond sharing embodied carbon knowledge with our architecture colleagues, we plan to share our commitment to SE2050, and the greater impact our industry has on embodied carbon reductions, through several external media.



WashU
Jeffery T. Fort
Neuroscience
Research
Building – St.
Louis, MO

Advocacy in Media

Over the next year, we will strive to leverage our Instagram account and other social media platforms to share at least three posts that discuss the embodied carbon reduction strategies used on a project or the overall embodied carbon within structural materials to educate and promote the SE 2050 initiative. In addition to educating colleagues through our internal intranet (MOXIE), we will use CannonDesign’s external website to share knowledge on embodied carbon reduction strategies with our clients, our A/E/C partners, and the public. At the beginning of 2022 we announced our commitment to SE 2050 and provided a link to our first Embodied Carbon Action plan. An updated link to our 2025 Embodied Carbon Action plan will also be included for the public to view our next detailed commitment plan.

LCA Documentation

We plan to develop a short LCA report after each database submission that documents the projects GWP, the reduction strategies used, and quantity of materials used in an easy-to-understand layout to supplement our structural project spotlight documents. This report will help highlight embodied carbon reduction strategies and lessons learned for the specific project type and requirements which will help

inform sustainable decisions on future projects of similar program or scale.

‘Structure & Embodied Carbon’ Slip Sheet

Over the next year, we will focus on creating a more comprehensive list of guidelines for the use of mass timber. We will use this guide to determine whether mass timber is an appropriate building material choice given a projects’ requirements and program.

We also plan on sharing the importance of embodied carbon reduction strategies with our project teams, clients, and contractors to emphasize our responsibility of addressing this issue. This will be done with our creation of a “slip sheet,” intended to give outside stakeholders a glimpse into the scope of strategies structural engineers can take to make embodied carbon reductions. In addition to client outreach, we’d also be able to use these embodied carbon slip sheets during career fairs and general firm recruiting.

After the creation of this slip sheet, we plan to have our marketing team use the information presented to write formal proposal language detailing our structural engineering group’s dedication to embodied carbon reductions.

Industry Engagement

In 2024 we prioritized sending two structural engineers to the SEI Workshop: Towards Zero Carbon. By participating in this workshop, we aimed to ensure that we are contributing our practical industry knowledge and experiences to industry organizations that can help shape broader industry goals and promote the overall goal of reducing embodied carbon emissions from buildings. We believe this event was a meaningful way to contribute and hope to continue engaging in similar events in the future.

University Engagement

In 2024 engineers from our firm engaged with college students on university campuses in a variety of courses. Engineers from our Boston office taught a course on structures at the Boston Architectural college, and engineers from our Saint Louis office hosted a Senior Design Project for a group of students from Southern Illinois University Edwardsville. In each of these opportunities, we included learning about embodied carbon in the curriculum. We plan to continue to include this important topic in future engagements on university campuses.

2023-2024 Advocacy In Review

LESSONS LEARNED

This past year we focused heavily on collaborating with our architect and mechanical engineering colleagues to update our firm-wide Sustainability Impact Report and create initial technical documents on decarbonization to be used internally. Working on these documents is both advocating for the SE 2050 commitment and educating our colleagues on holistic decarbonization strategies. However, our future advocacy strategy continues to rely on the creation of technical and educational marketing materials such as the Embodied Carbon Slip sheet and LCA reports to append to our project Structural Spotlights.

ACHIEVEMENTS

Throughout the past year, our team has continued to focus on internal advocacy of SE 2050 within our firm, achieving the following advocacy goals.

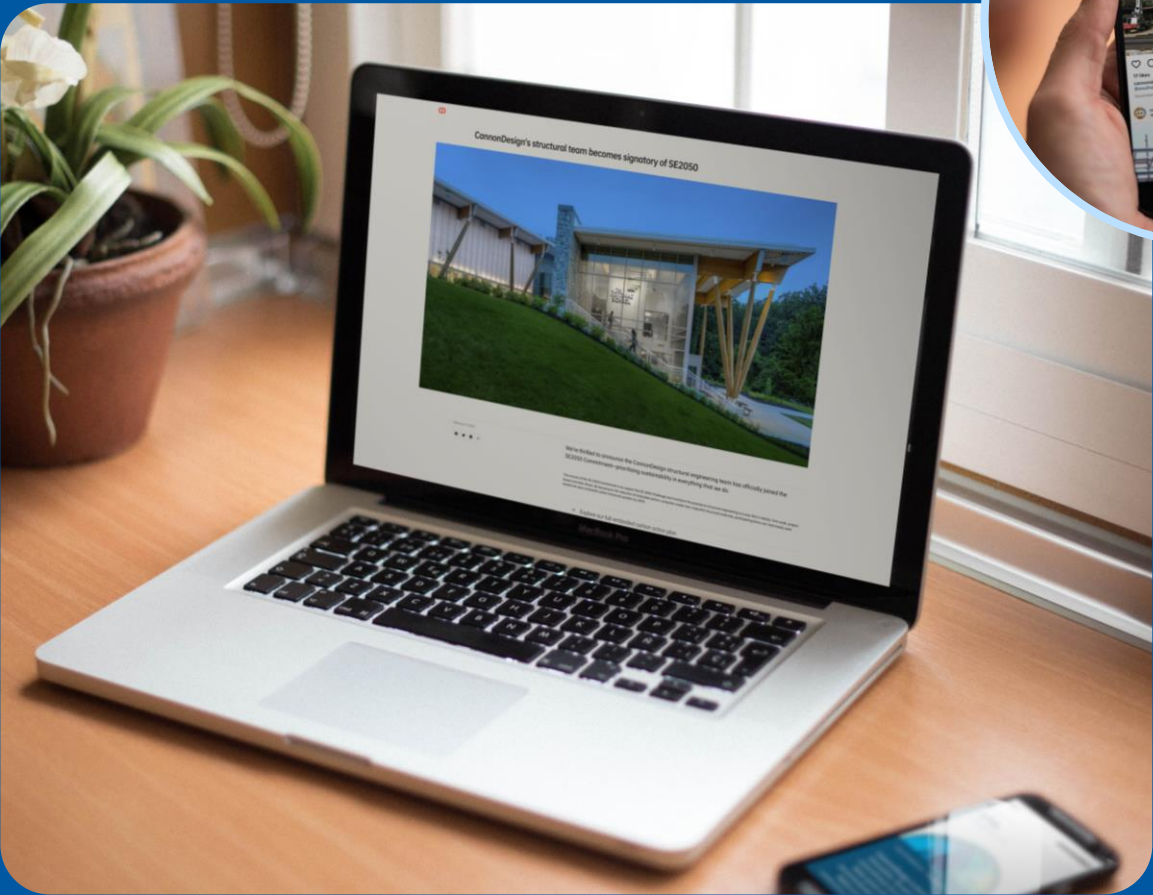
Posted an update on our external website about our commitment to SE 2050, linking to our 2024 ECAP

Promoted carbon-sequestering materials through utilization in project work

Utilized social media to highlight our involvement with SE 2050

Highlighted the goals and mission of the SE 2050 commitment within the firms Sustainability Impact Report: Planet 2100 and the firms State of Engineering presentation

Two structural engineers participated in the SEI Workshop: Towards Zero Carbon



Follow us!

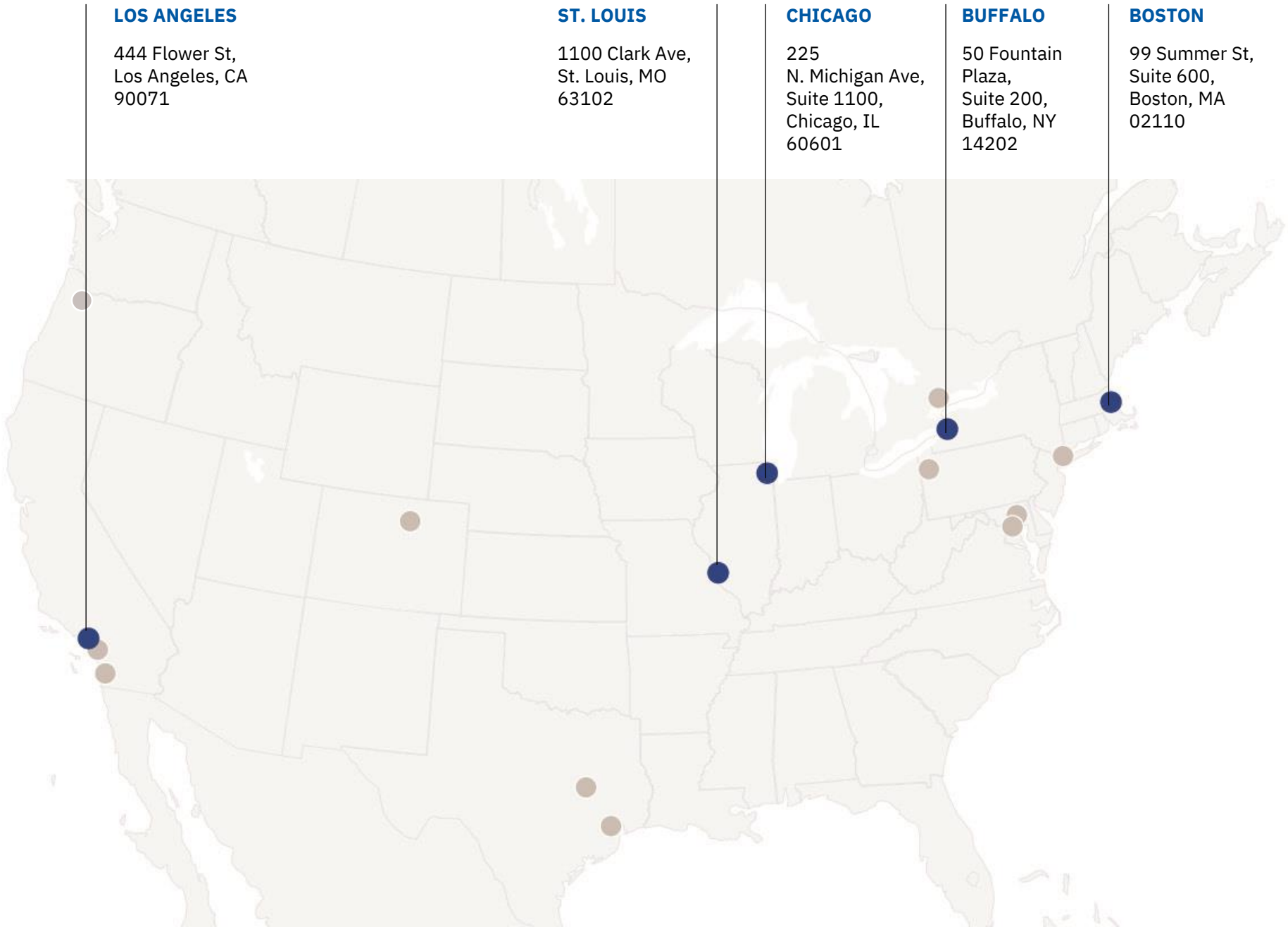
You can keep an eye on what we're up to on Instagram:

[cannondesign_structural](#)

Read more about CannonDesign's SE2050 initiative on our website [here!](#)

Contributors

CannonDesign is a global design firm with structural engineering in five of our U.S. Offices: Boston, Buffalo, Chicago, Los Angeles and St. Louis. Contact information for each of the structural offices are highlighted here.



Christopher Barlow
Boston



Julie Shaw, PE
St. Louis



Becca McGowan, PE
Buffalo



Bassem Almuti, PE
Boston



Sam Swislow
Chicago



Brian Alesius, PE
Firmwide Structural Engineering Leader
balesius@cannondesign.com

Eric Corey Freed, RA LEED Fellow, EcoDistricts AP, LFA
Director of Sustainability
ecfreed@cannondesign.com

www.cannondesign.com