Bayhealth Hospital, Sussex Campus, Milford, Delaware

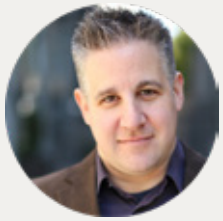
SE 2050

Embodied Carbon Action Plan 2021-22

CANNONDESIGN

Part of a Larger Firm-Wide Sustainability Strategy

From the desk of 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.

CannonDesign has a long history of innovation and deep expertise in sustainable design strategies. We are an initial signatory to the AIA 2030 Commitment, tracking our progress toward achieving zero carbon buildings in the next decade. We were also initial signatories for the AIA Healthy Materials Pledge, looking at the lifecycle and impacts of building materials. We're also supporting and invested in the Embodied Carbon Construction Calculator (EC3), and the Mindful Materials Healthy Database (where we are a pilot member).

We are continually working to reduce the energy that our buildings consume have been tracking and reporting our progress annually on that effort. EUI is, therefore, a very important metric for our teams and has elevated building energy use as a key design driver in our work. Our Energy Design process is utilized across all of our projects to achieve a certain baseline of high performance. All of these targets are coordinated and help shape our direction as a firm. Our CEO, our Core Team, and our Board of Directors are all involved framing in these bold strategies to set our firm's growth.

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

The Connection Between Buildings and Carbon

Buildings are currently responsible for 39% of global energy-related carbon emissions. Of that 39%, 28% is from operational emissions (energy needed to heat, cool and power them) and the remaining 11% is from materials and construction*.

And if we factor in **all** emissions—including the electricity used, and the operational waste produced—buildings are responsible for more than half the world's carbon emissions.

The Urgency with Embodied Carbon

Embodied carbon refers to the greenhouse gas emissions arising from raw material extraction, manufacturing, transporting, installing, maintaining, and disposing of building materials. Embodied carbon is a significant percentage of global emissions and requires urgent action to address it.

Since embodied carbon is released during construction, it is more critical to reduce than 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 cuts promised in the future. Unlike operational carbon, there is no chance to decrease embodied carbon with efficiency updates later on.

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

*Source: https://www.worldgbc.org/embodied-carbon
**Source: https://architecture2030.org/2030_challenges/embodied/

Penn State Health, Hampden Medical Center

Potomac School, Center for Athletics & Community

Allegheny College, North Quad Residential Village

Why This Affects Structural Design

The structural engineering profession needs to carefully reconsider design approaches. Embodied carbon of structural systems in buildings has been established to be a considerable influence on the detrimental environmental impacts of construction.

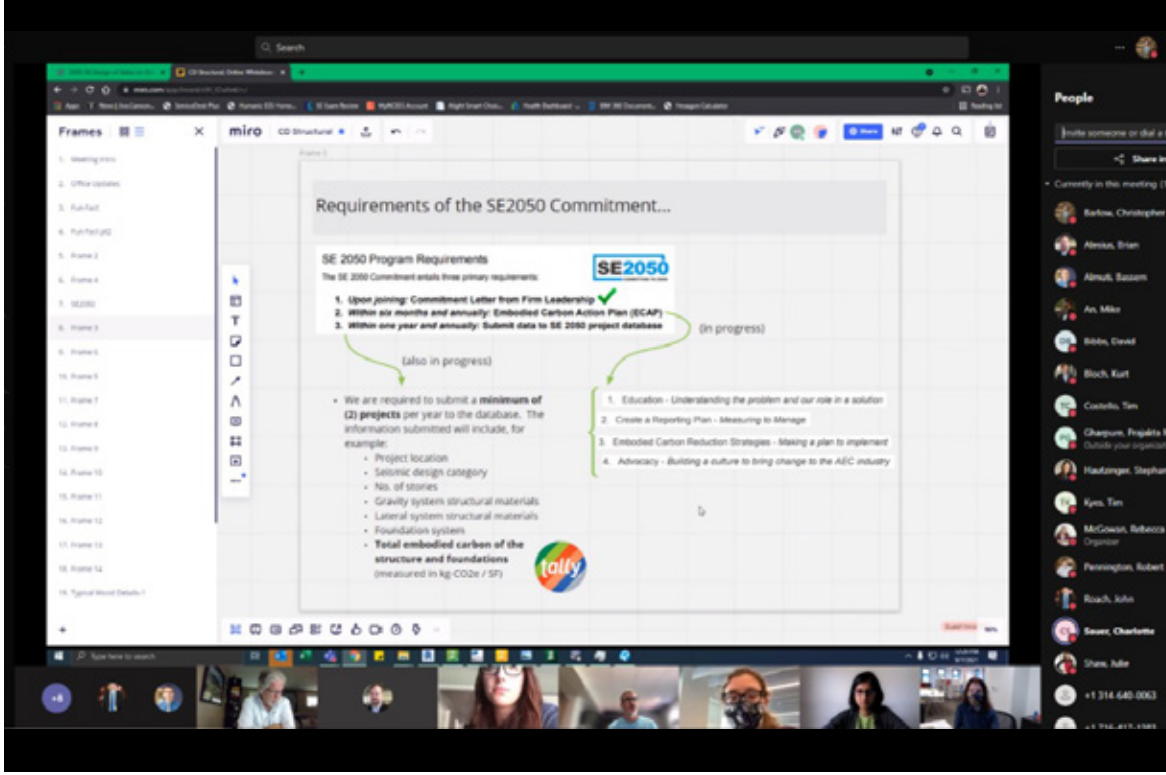
The embodied carbon impacts of a building's structural system are primarily associated with the different life cycle stages: material extraction, manufacturing and production, construction, damage and repair during service life, and end-of-life.

Material decisions can help reduce embodied carbon. Given the high carbon footprint of steel and concrete, finding ways to reduce their carbon impacts is critical. Some of these strategies include:

- Replacing the Portland Cement content with supplementary cementitious materials (SCM) like fly ash or slag
- Exploring alternative structural systems like Mass Timber and CLT
- Researching the Environmental Product Declarations (EPD's) for the structural materials to source better manufacturing

Embodied carbon is essential for structural engineers to address. As we work towards achieving net-zero with operational emissions, embodied carbon will become drastically more critical to address and reduce.

Education



CannonDesign structural studio session discussing the SE2050 commitment requirements.

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 discussion on sustainability to ensure everyone in the group is up-to-date on firm initiatives and strategies.

Embodied Carbon Call

This bi-weekly call 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 JIVE Page

JIVE is an internal "social media" webpage 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 JIVE 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 SE2050. Our 2021-2022 Embodied Carbon Action Plan and ECAPs from subsequent years will also be posted within this space for any CannonDesign employee to access.

CannonDesign Academy

CannonDesign employees of every discipline receive e-mails offering professional development opportunities through our CannonDesign Academy (CDA) webinar series. These internally developed webinars cover a range of topics across the architectural, engineering, and construction spectrum. To educate more of our employees about embodied carbon reduction strategies, we plan to host our own "Embodied Carbon 101" webinar in collaboration with our architecture colleagues before the end of 2022. In the meantime, employees will be directed to the BSA Embodied Carbon 101 webinar located on our internal JIVE page.

Education Beyond the Structural Engineering Group

CannonDesign is an interdisciplinary firm with experts from a range of disciplines outside engineering. As signatories of SE2050, we believe it is our responsibility to reach out to our architecture colleagues to share and grow our knowledge of embodied carbon reduction strategies. During our first year of commitment, we plan to post informational posters in each of our offices with tips for how to reduce embodied carbon at the earliest stages of design, to get the conversation started within offices. In the following years of our commitment, we will work to expand our educational efforts into webinars and internal presentations.

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.

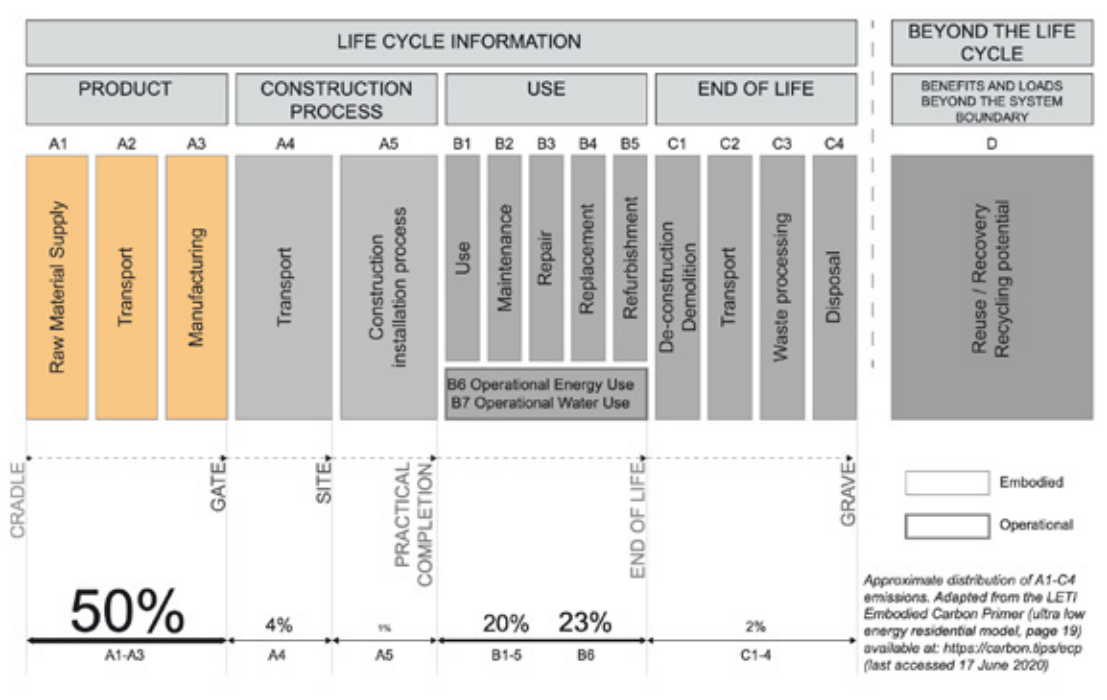
Measure and Report

To measure the embodied carbon of our structures, we will 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.

Where possible, we will use manufacturer specific Environmental Product Declarations (EPDs) to quantify a material's embodied carbon. If none are available, we will utilize the standard material values in Tally to inform our measurements. By using these methods for measurement, we anticipate contributing a minimum of five projects to the SE2050 database in our first year.

→

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



Source: https://www.istructe.org/IStructE/media/Public/TSE-Archive/2020/A-brief-guide-to-calculating-embodied-carbon.pdf

Update Revit Material Libraries

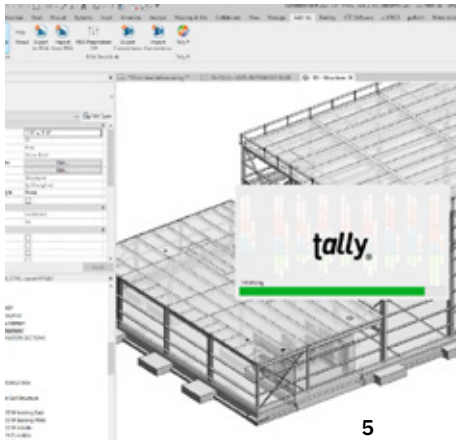
We plan to further streamline the LCA process by thoroughly updating our structural BIM families with accurate and current material information. This will reduce time spent running LCAs by expediting the material definitions portion required by Tally. With a more efficient process, it will help to encourage the incorporation of Life Cycle Assessments into our standard design process. This will also make our future goal of using our schematic models to inform early-stage decisions related to embodied carbon reduction more achievable in years to come.

Internal Training

To promote our measurement, tracking and reporting goals, we have started a space on our internal intranet to help educate our firm on embodied carbon and how to measure it. To date, we have provided guidance documents and video tutorials on how to use Tally, as well as given live demonstrations on using Tally to the structural engineers in the firm.

↘

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

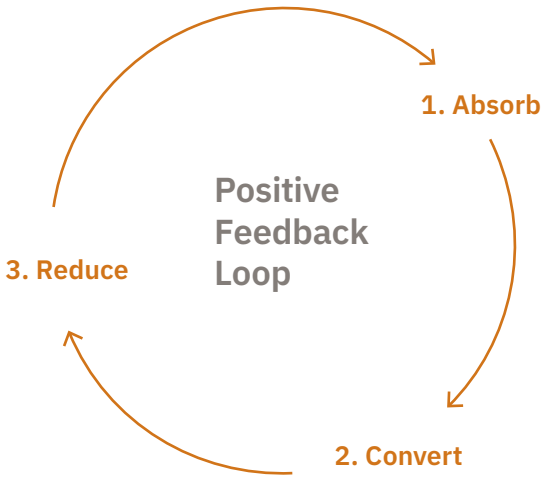


Reduction Strategies

As a committed signatory of SE2050, CannonDesign aims to provide meaningful and intelligible carbon reduction strategies in concert with our global community.

It is imperative that we move away from the stagnant industry standards and antiquated design strategies that govern our built environment. Instead of continuing to rely on old practices, we believe it is possible to begin a new and innovative design cycle—one that continues to develop and strengthen carbon reduction strategies as we work towards our zero emissions goals.

Our idea for a sustainable and perpetual design cycle begins with gathering resources and accumulating knowledge. Step one is to **absorb** as much information as possible and to understand what means exist to aid in the organization of embodied carbon data. We must first educate ourselves on *what* embodied carbon is, *where* it is in our built environment, *how* it affects the world we live in, and *why* it is important that we take steps to remove it. It is equally important for us to learn what tools are available to measure embodied carbon and how to use these tools to synthesize our data into something useable.



Once information is absorbed, it is then possible to **convert** this knowledge into several practical action items. Some carbon reduction strategies may require the direct engagement of a contractor or manufacturer. Alternate approaches might be more indirect, such as including emissions-reducing language as part of the project manual specifications. It is also possible to have reduction strategies that involve community outreach or the education of a larger group within the firm.

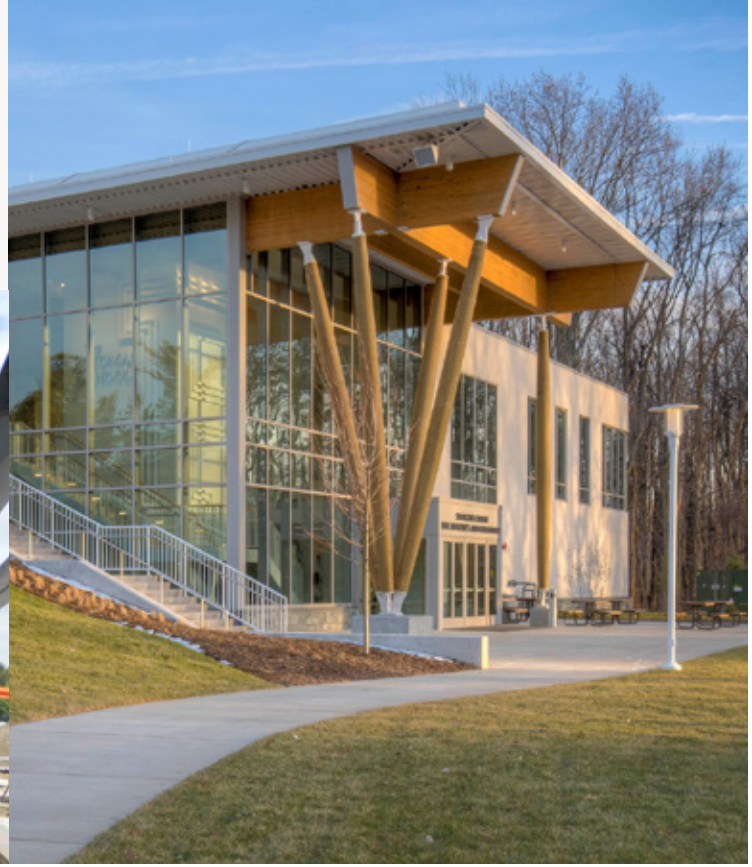
Regardless of what strategies are chosen, the goal of each should be to **reduce** the amount of embodied carbon that is present in the structural materials used on a given project. After the completion of a project, the design cycle begins again by reflecting on the process and searching for ways to improve. A project assessment allows us to **absorb** the latest data and convert this fresh knowledge into new or amended strategies that aim to further **reduce** embodied carbon.

Embodied Carbon Actions

Achieving zero embodied emissions will require adopting the principles of **reuse**, including renovating existing buildings, using recycled materials, and designing for deconstruction; **reduce**, including material optimization and the specification of low to zero carbon materials; and **sequester**, including the design of carbon sequestering sites and the use of carbon sequestering materials.

Reduction Strategies:
An Initial Focus on Education

Burbank School District, Luther Burbank Elementary School. Our steel framed structures will require steel made with a minimum 85% post-consumer recycled content.



The Potomac School Center for Athletics and Community incorporated biogenic material into the structure. Glulam beams at the roof level are supported by pairs of sloping and tapered, round glulam columns at the mezzanine level.

For the first year of our commitment, goals will be focused on embodied carbon education. Setting a strong baseline of knowledge will allow us to develop meaningful carbon reduction strategies the following year.

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.

Tally is the LCA software of choice for CannonDesign, and we will require one person from each of the four structural offices to complete an LCA using Tally for a project within this first year to spread knowledge of the program beyond just a few individuals.

Specifications

CannonDesign has an existing firm-wide Embodied Carbon committee, which has begun to implement changes to project manual specifications, primarily for architectural specifications. Conversations have begun between the structural engineering group and Embodied Carbon committee regarding updates to the steel and concrete specifications; converting this dialogue into meaningful specification modifications is a primary goal within the first few years of our firms' commitment to SE2050. For the first year, our goal is to successfully implement one specification update (using a suggested strategy from the SE2050 resources) for both the steel and concrete sections to get the process started.

Biogenic Materials

CannonDesign structural will aim to incorporate biogenic materials on at least three projects annually. Our engineers have experience with the design of conventional wood framing, wood trusses, and exposed timber framing. Our team has not yet designed a mass timber building, but we are actively pursuing opportunities and aim to win this design experience within our first few years of commitment to SE2050. In the mean time, we've been growing our internal knowledge of mass timber design and are fully prepared to deliver on this approach.

Concrete Mix Design Optimization

Design a minimum of one project (with a goal of three projects) that uses concrete mix design optimization (either by utilization of supplementary cementitious materials, blended cements, or carbon dioxide mineralization) to reduce concrete global warming potential. Nearly all structural designs use some quantity of concrete, and cement contributes more to global warming than any other structural material. Beginning to reduce the embodied carbon of our concrete is imperative to meaningful carbon reductions by our firm.

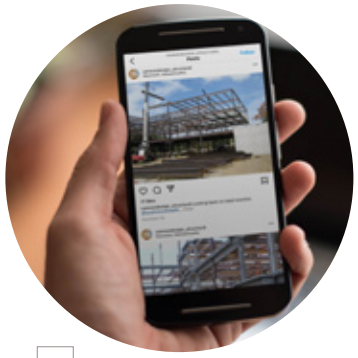
Annual Reflections & Project Checklist

At the culmination of each year, including the 2021-2022 program 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.

The first-year reflections meeting will also be used to create material-specific embodied carbon reduction plans for use in the 2022-2023 commitment year. Additionally, we will use first-year information 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 be based on such things as the selected structural materials, project location, building program, and other physical or geometric building characteristics.

Advocacy

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.



↗

Follow us!

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

cannondesign_structural

Social Media

The CannonDesign structural group has an existing Instagram page that highlights both current and past structural design projects. Once per year (minimum), we will have one post that discusses the embodied carbon of structural materials.

External Web Posts

In addition to educating colleagues through our internal website, JIVE, 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. An external announcement that we have signed the SE2050 Commitment will be posted to the external CannonDesign website before the summer of 2022. A link to our Embodied Carbon Action plan will also be included for the public to view our detailed commitment plan.

Structural Involvement at Sustainability Kickoff

CannonDesign already incorporates a Sustainability Kickoff meeting into the start of every project. However, this meeting has typically been restricted to the architects and energy modeling team. Advocating for regular structural engineering involvement in these kickoff meetings to provide input related to embodied carbon reduction strategies is a primary goal within our first year of the SE2050 Commitment. Our participation in these meetings will help establish our clients' priorities toward reducing embodied carbon and gauge interest in these strategies, including mass timber or alternative concrete mixes.

'Structure & Embodied Carbon' Slip Sheet

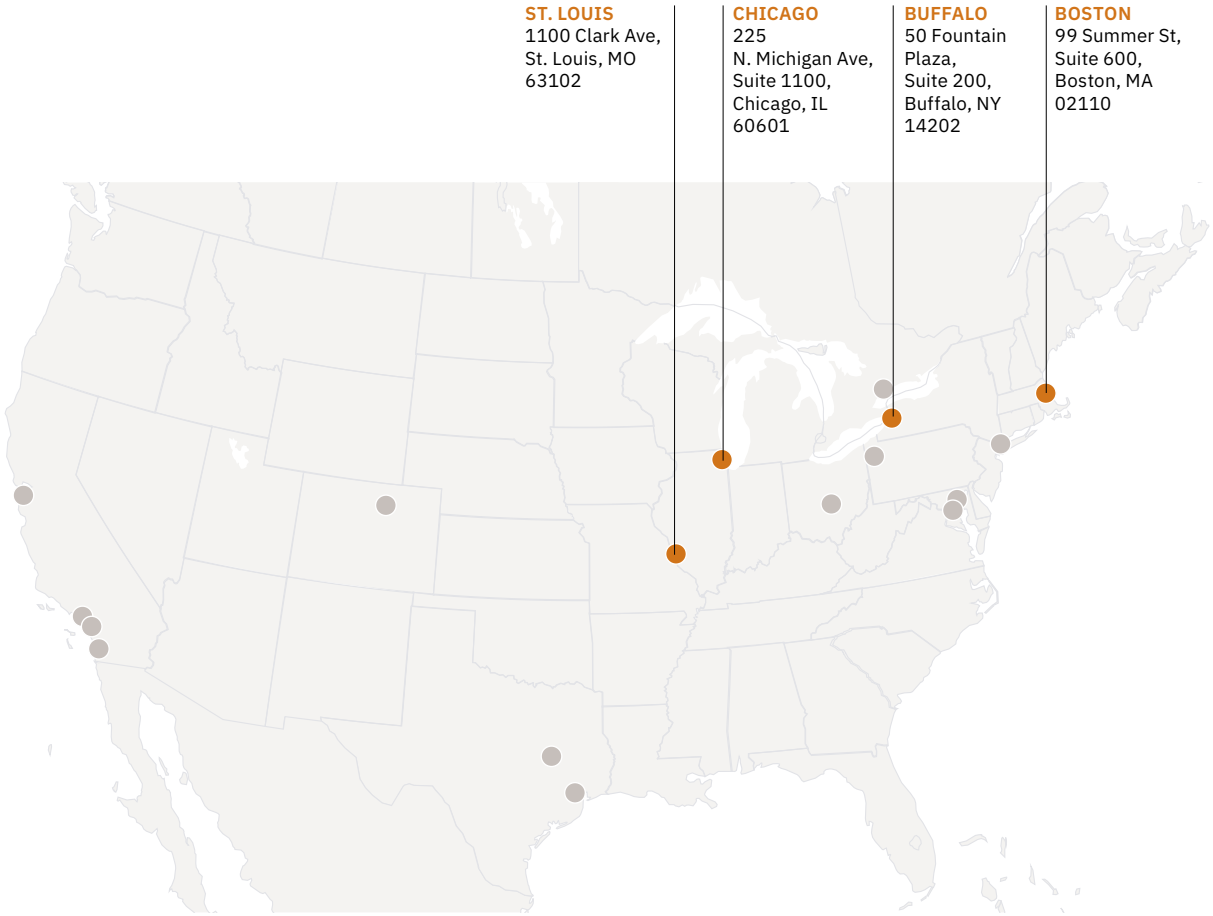
We also plan on sharing the importance of embodied carbon reduction strategies with our project teams, clients, and contractors to emphasize our responsibility of addressing this issue. This will be done with our creation of a "slip sheet," intended to give outside stakeholders a glimpse into the scope 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.

Our current existing marketing documentation regarding the sustainability of structural systems is a brief "Mass Timber Design Guide." This includes basic information on mass timber as a structural system mainly for use in advocating mass timber construction during project pursuits.

Beyond our first year of commitment, we plan to have our marketing team use this slip sheet to write formal proposal language detailing our structural engineering group's dedication to embodied carbon reductions.

Contributors

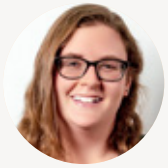
CannonDesign is a global design firm with structural engineering in four of our U.S. Offices: Boston, Buffalo, Chicago, and St. Louis. Contact information for each of the structural offices can be found below.



Development Team for the CannonDesign 2021-2022 ECAP:

Christopher Barlow
Boston

Julie Shaw, PE
St. Louis



Becca McGowan
Buffalo

Embodied Carbon Reduction Champion:

Charlotte Sauer,
LEED AP BD+C
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