



Old Irving Park Medical  
Office Building

SE 2050  
Embodied Carbon  
Action Plan 2024

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.

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.

A white handwritten signature of Eric Corey Freed on a dark green background.

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.

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

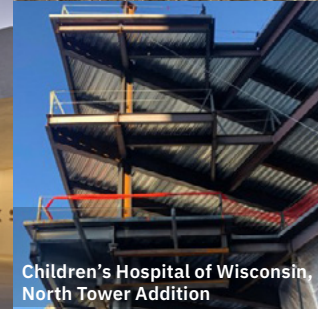
Simple material decisions can help to reduce embodied carbon. Given the high carbon footprint of steel and concrete, finding any way to reduce the carbon impact of these two materials is critical. Some of these strategies that structural engineers can implement include:



Ascension Women's and Children's Hospital

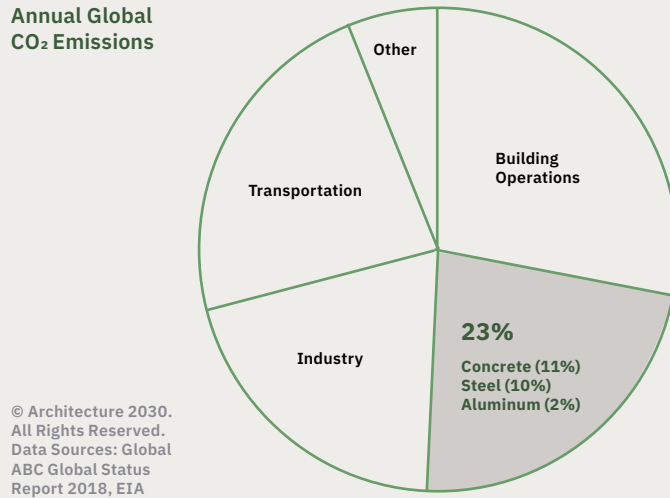


Mount Sinai Medical Center, New Surgical Bed Tower



Children's Hospital of Wisconsin, North Tower Addition

Annual Global CO<sub>2</sub> Emissions



- 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.

## 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 SE2050 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 SE2050: submittal of project life cycle assessments to the SE2050 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 SE2050 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 discussion on sustainability to ensure everyone in the group is up-to-date 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 SE2050 program.

## 2022-2023 In Review

### ACHIEVEMENTS

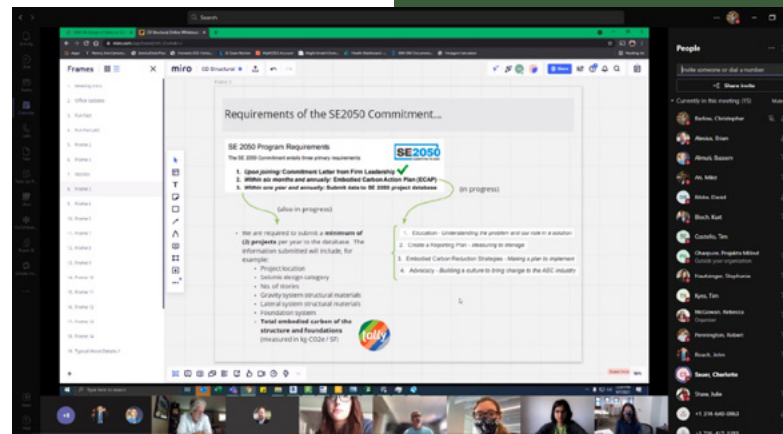
- + Distributed our 2023 Embodied Carbon Action Plan firmwide
- + Participated in Engineers Week presentations to highlight our recent project work and carbon reduction strategies to the entire firm
- + Scheduled and attended several Lunch and Learn presentations focused on improving structural performance and carbon reduction such as ArcelorMittal’s XCarb™, Woodworks seminars, Themec fluid-applied coatings, 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

↓ CannonDesign structural studio session discussing the SE2050 commitment requirements.

### LESSONS LEARNED

Equally as important as honing our own technical skills, improving our ability to communicate that knowledge plays a critical role in pursuing our sustainability goals. Communication to our internal project leaders about our goals ensures that we maintain focus on carbon reduction strategies throughout the project. Communication to our architectural partners also ensures that we start on the best possible footing in early design. Lastly, communication to clients early helps us pursue more aggressive strategies with confidence, knowing that the client is with us on this journey.

We also found this year that, despite seemingly identical educational backgrounds, each member of our structural design team possesses a unique skill set. Unfortunately, it can sometimes be difficult to share in front of a group of highly educated peers. The tendency seems to be that the potential sharer assumes their expertise is already common knowledge. To combat this, we introduced a ‘Tip & Tricks’ section into our monthly Structural Studio call during which we encourage anyone to share a handy tip or trick that they have used to make their work more efficient. In the end, carbon reduction is all about improving efficiency in our work, accomplishing the most with our designs with the least environmental impact.



# 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 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 have been updated to 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. Our Cast-in-Place Concrete Specification has also been updated to include GWP limits based on the 2021 Carbon Leadership Forum Baselines v2, published July 2021. 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 take this year to decide which is the most effective for our processes moving forward and implement the selected option. In addition to mapping materials, we have also started to accumulate knowledge that we can share and shape into a 'best practices' document for defining materials in Tally. This initiative 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.

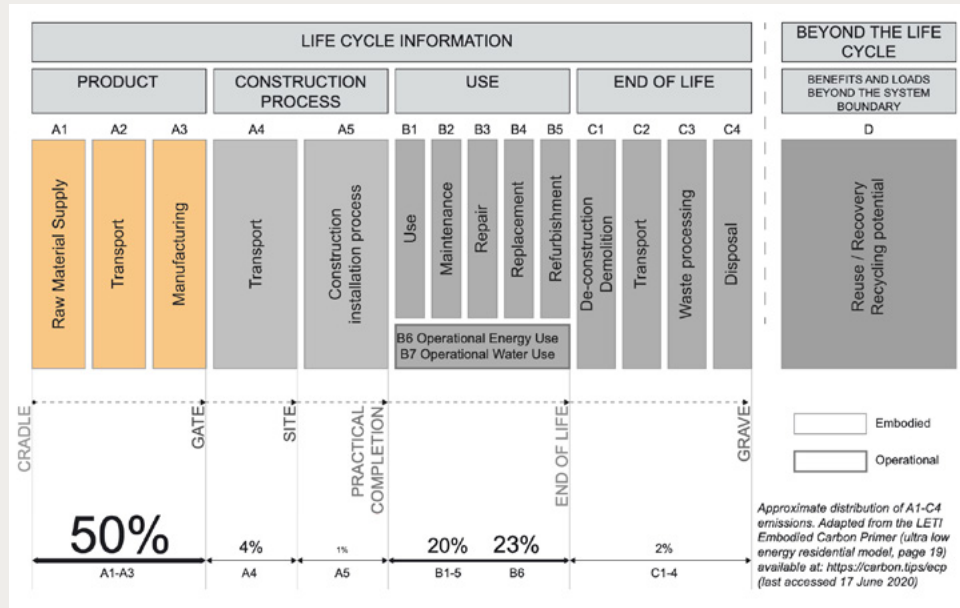
## Internal Database

Now that we have an internal database tracking our life cycle assessment data, we will take this year 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. This information will ultimately allow us to track progress in our journey to reduce embodied carbon.

## ACHIEVEMENTS

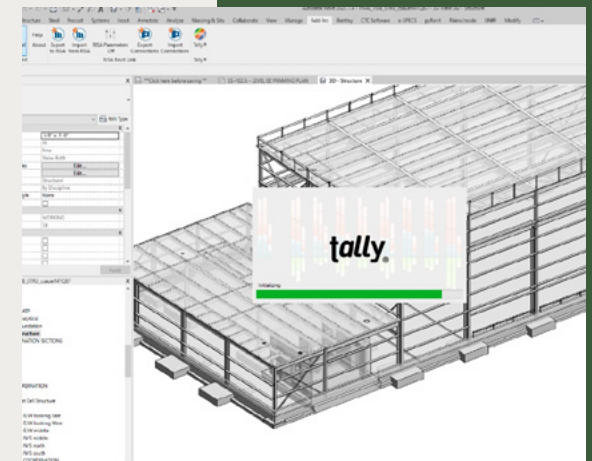
This past year we were able to achieve all our reporting goals:

- + Submitted five (5) life cycle assessments (LCAs) to the SE 2050 database
- + Submitted an additional (5) LCAs to the SE 2050 database (due to the shift to a collective due date)
- + Submitted Structural Material quantities (SMQs) for all submitted LCAs
- + Successfully used custom concrete mix specific material definitions for (1) project LCA
- + Updated our specifications to require EPDs and set cast-in-place concrete GWP limits
- + Continued to update our Revit Material Library and tested material mapping options
- + Trained (3) additional structural engineers to perform LCAs
- + Started an internal database of LCAs for tracking purposes.
- + Completed the design of a large Mass Timber project



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

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



# 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. We successfully reached our 2023 goal to train at least one person in each of our four offices to use Tally. 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.



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.

## 2022-2023 In Review

### ACHIEVEMENTS

- + Updated our project manual specifications for steel and concrete (updates are undergoing final reviews at the time of this publication)
- + Used biogenic materials on (3) projects
- + Successfully trained at least one person from each of the four structural offices to conduct LCAs using Tally.

### LESSONS LEARNED

- + We studied the use of Epic to run bay studies on preliminary embodied carbon information. We determined that Epic was not the right tool for a bay study.

## 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. These specification updates are currently in final review, but we have already begun using these updated specifications on projects. 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.

## Biogenic Materials

The CannonDesign structural team will aim to incorporate biogenic materials on at least one projects 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 within our first few years of commitment to SE 2050.

## 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 Ascension Women’s and Children’s Hospital, the concrete mix designs used Type 1L cement, and the LCA was able to incorporate custom concrete mix material definitions for a more accurate GWP intensity.

# 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.

### Advocacy in Media

Over the next year, we will strive to leverage our Instagram account 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 2024 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.

Read more about CannonDesign's SE2050 initiative on our website here!



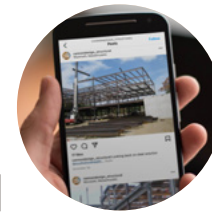
Washington University School of Medicine in St. Louis – Neuroscience Building

### 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.



Follow us!

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

cannondesign\_structural

### 2022-2023 In Review

#### 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 2023 ECAP
- + Promoted carbon-sequestering materials through utilization in project work
- + Utilized social media to highlight our involvement with SE 2050
- + Shared the goals and mission of the SE 2050 commitment within the firms inaugural Sustainability Impact Report: Planet 2100
- + Updated our Schematic Design narrative to include language about carbon reductions

#### LESSONS LEARNED

This past year we focused heavily on collaborating with our architect and mechanical engineering colleagues to create our firm-wide Sustainability Impact Report and 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.



# Contributors

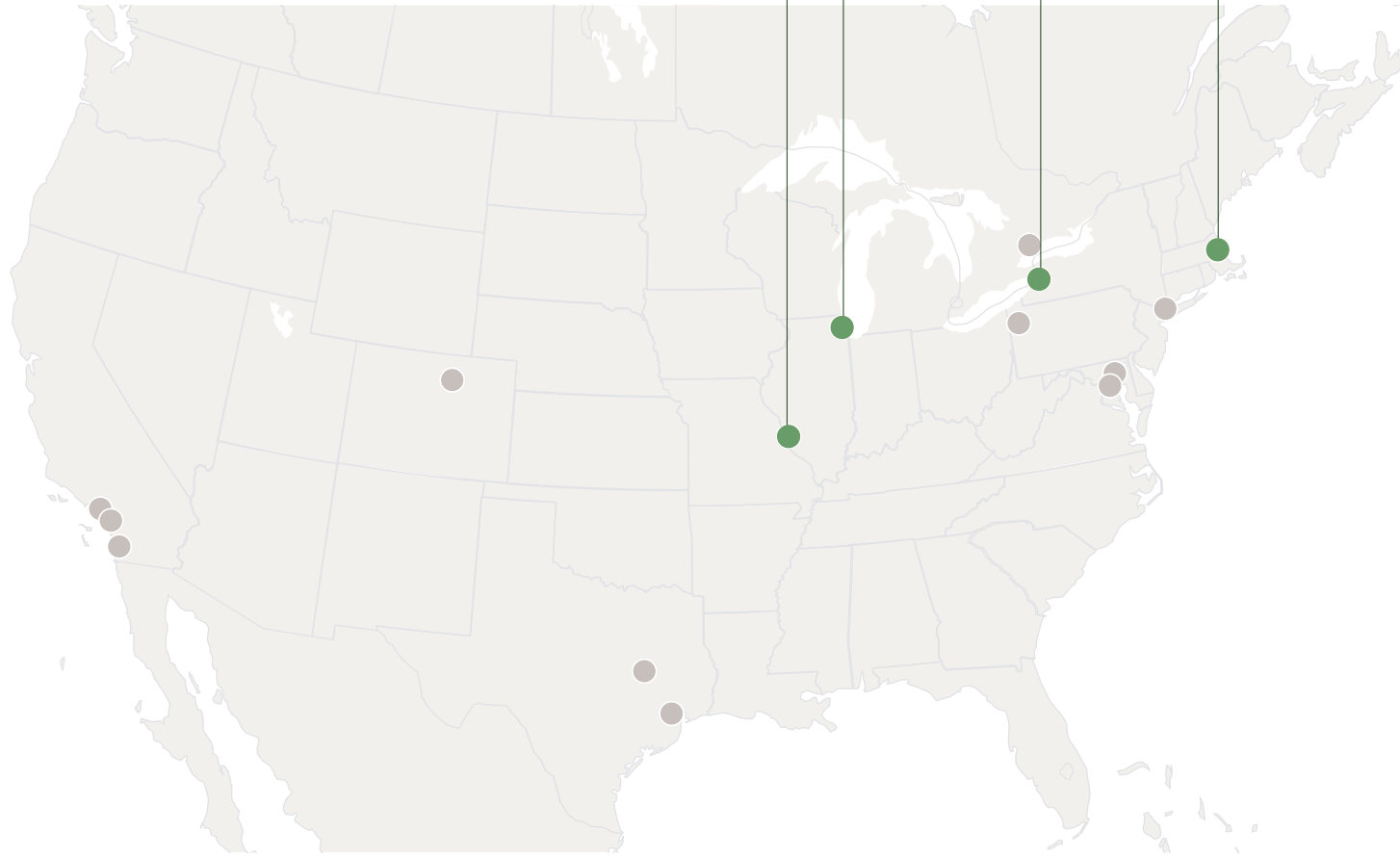
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