



# schaefer

SE2050

EMBODIED CARBON  
ACTION PLAN (ECAP)

PREPARED ON:  
February 12, 2024

team

# hi. we're Schaefer's sustainability team.



**lara stroup, PE, LEED AP BD+C**  
PROJECT MANAGER

With post-graduate degrees in both structural engineering + architecture, Lara has a unique perspective when it comes to marrying necessary structural elements + desired facility aesthetics. Lara has 14 years of industry experience and has spent about half

of her career at Schaefer. She works on diverse projects with differing size, geography + purpose. Lara is passionate about sustainability and making an impact on the world around her, and began leading Schaefer's sustainability initiative in 2021. As initiative champion, she's contributed thought leadership + provides resources to those designing according to sustainability goals and/or interested in expanding their knowledge in the area. Lara is a member of the National Council of Structural Engineers Association's (NCSEA) Sustainable Design Committee and founded the Structural Engineers Association of Ohio (SEAoO) Sustainable Design Committee.



**aaron pajestka**  
PROJECT ENGINEER  
columbus office

focus: research + development  
of sustainable steel strategies



**jacquelyn miller**  
PROJECT ENGINEER  
remote

focus: documentation +  
approaches to sustainable  
wood design



**john thesing**  
PROJECT ENGINEER  
cincinnati office

focus: embodied carbon  
calculations + reporting

education

# how we're leading the field.

## internal inclusion

It's important that everyone has the opportunity + access to be involved in our sustainability initiative. Our sustainability team stretches across our firm's geography with team members present at two of our three offices, and one as a remote representative. The sustainability team is available for advice on how to address sustainability concerns.

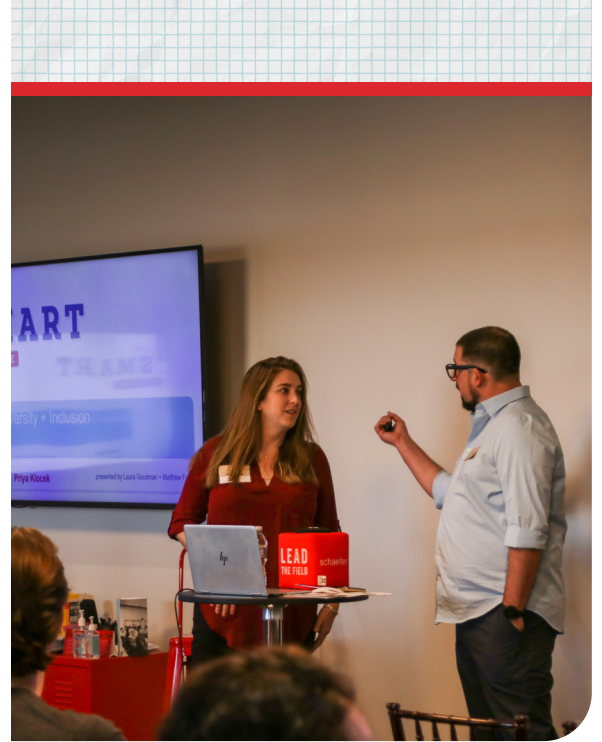
We regularly shine a light on our efforts by providing updates + educational opportunities at firm-wide staff meetings. In addition, we post about an article per month to our firm knowledge management tool, ranging in content + knowledge level from a glossary of sustainability terms to an article from a structural magazine to a short video on life cycle analysis.

## SMART conference

2022

Each year, Schaefer hosts a conference for all team members to engage in an educational, social + collaborative two-day experience. In 2022, our sustainability initiative team hosted three keynote speakers from MA Design to discuss the importance + relevance of sustainability in today's market. They presented:

- > Types of sustainability certifications
- > Measurements of a building's sustainability
- > New technologies
- > Ways we can implement sustainability into our everyday lives



## SMART conference *continued*

2023

We built on 2022's foundation by hosting another educational session presented by two of our own sustainability team members, Aaron + John. This session focused on:

- > Life cycle analysis
- > Environmental product declarations (EPDs)

It educated our team members on what to look for within an EPD and how this data can be used to make sustainable design decisions. The session was available to all Schaefer team members, and a recording was provided for any who could not be in attendance.

## 2024 + BEYOND

Our team is preparing an embodied carbon 101 presentation to be delivered firm-wide and included in the new engineer onboarding process moving forward. This presentation will:

- > Explain embodied carbon + the impact it has on our society
- > Reiterate our SE 2050 commitment + why Schaefer joined
- > Discuss how to approach sustainability with our clients
- > Provide a base knowledge + information on where to find appropriate resources for client discussions

In order to fuel that discussion, we conducted an internal survey to collect client perception of sustainability. The results found that 32% of Schaefer respondents had previously discussed sustainability goals with a client!

## knowledge sharing initiative

We met with some of our clients that have expressed sustainability goals to discuss potential collaboration in the years to come. Our clients told us that they want:

- > Earlier collaboration on sustainability goals
- > Innovative solutions
- > Assistance on embodied carbon calculations and life cycle assessments (a service we're developing)



education

## knowledge sharing initiative *continued*

In 2024, we plan to connect with all of our clients on our SE 2050 initiative and what it could mean for them. We decided a long-form presentation would provide us the space to have a nuanced discussion. It was important to our team that our clients know they are our priority, and they can be as involved (or not) as they want.

We believe in knowledge sharing amongst other structural engineers as well. Our initiative champion, Lara, is a member of the National Council of Structural Engineers Association's (NCSEA) Sustainable Design Committee and founded the Structural Engineers Association of Ohio (SEAoO) Sustainable Design Committee.



# let's get to work.

## one-year reduction strategy

We're starting with high benefit/low energy solutions; we feel it's important to make our solutions practical.

- > Some existing technologies can be applied to a project simply by discussing with the client + changing the specifications. Ideas like this will build early confidence internally and start conversations with our clients.
- > We'll start to include alternative, sustainable choices in our general notes. We'll provide guidance for the master specifications and how to include sustainability within those.
- > We'll review + update typical details used on projects to eliminate waste + maximize adaptability. From this, Schaefer structural engineers will discern the appropriate detail for their situation.
- > We'll perform an embodied carbon study on five projects, creating our internal library. By creating a library of past projects, we'll have data to support our clients + provide recommendations on the best choices for their specific projects.

## five-year reduction strategy

Over a five-year period, our sustainability team hopes to impact multiple aspects of our firm, from the work we do to our own offices.

- > The work depends largely on our clients and aligning with their goals. For this reason, a member of our firm will meet with clients annually to discuss their sustainability goals. We'll learn what's most important to them and amplify the sustainability conversation as a whole.
- > Our team will perform embodied carbon studies on at least five projects every year. Our goal will be to increase the number of projects per year to eight by 2029. Projects will be chosen from diverse markets + locations to maximize our inclusion + create comprehensive data.
- > We'll complete embodied carbon calculations at three times: early design, end of design + during construction. This will help us track how changes made to the project impacted the overall embodied carbon.

# how we'll continuously improve.

## life cycle assessment tools + reporting

Over the last two years, we have investigated multiple life cycle assessment tools – we decided TallyCAT and EC3 were best for our workflow.

- > We'll complete life cycle analyses for stages A1-A3. Our plan is to use nationwide data for the first two projects, and then use more specific data as available in subsequent projects.
- > We'll prioritize calling manufacturers for EPDs when unknown. When unavailable, we'll utilize industry + regional data.
- > We'll complete an embodied carbon calculation once at the end of the design phase and before the construction administration phase. To determine quantities, we'll utilize Revit, as we do on most projects. This will easily show quantities, but in some project types, will require a higher level of detailing than we normally draft.





firm profile

view our work at [schaefer-inc.com](http://schaefer-inc.com)

# schaefer

We are open-minded in our approach + thinking — thought leaders with diverse experience.

Our clients partner with us for our collaborative structural engineering services: planning, design, inspection, investigation.

- > 90+ team members
- > Licensed in EVERY state
- > 15+ years into full implementation of BIM
- > Founded in 1976, offices in Cincinnati + Columbus, Ohio, and Phoenix, Arizona

We believe in collaborative teams — partnership with owners, architects, developers + construction team members.

With a creative approach supported by an understanding of market trends, we can design adaptive structures that meet owners' needs. Our people enhance communities through smart, innovative structures.



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## COLUMBUS OFFICE

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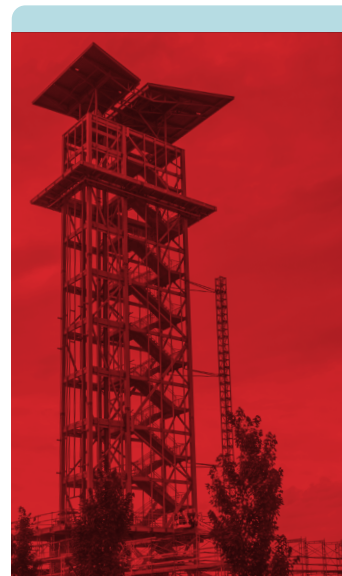
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March 6, 2023

**schaefer**

CONNECT

Laura Champion  
Structural Engineering Institute

Re: Letter of Commitment to the SE 2050 Program

## GREETINGS!

Schaefer, a 96 person firm located in Cincinnati, OH; Columbus, OH; and Phoenix, AZ, is hereby signing on to the SE 2050 Commitment Program. We support the vision that all structural engineers shall understand, reduce, and ultimately eliminate embodied carbon in their projects by 2050.

At Schaefer, we are committed to deliver sustainable design to enhance our communities of today + tomorrow. As part of our vision to Lead the Field, we believe we need to look for ways to reduce the embodied carbon in our structural designs.

Therefore, we commit Schaefer to take the following steps as a part of the SE 2050 Commitment Program:

- > Within six months and annually going forward, we commit to reporting an Embodied Carbon Action Plan (ECAP). We permit the ECAP document be made public on the SE 2050 website.
- > Within one year and annually going forward, we commit to submit data to the SE 2050 project database in a collaborative effort to understand embodied carbon in structural engineering projects and to set attainable targets for future projects.

We look forward to joining this coalition and industry effort to achieve the goals of the SE 2050 Program.

Sincerely,



Greg Riley, PE

President

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## Schaefer joins SE 2050 commitment program

On March 6, 2023, Schaefer submitted its commitment letter to join in [Structural Engineers 2050 Commitment Program \(SE 2050\)](#).

### What is SE 2050 Commitment?

SE 2050 is a program focused on minimizing (+ eventually reaching net zero) embodied carbon in structures by collaborating with the people who design them: structural engineers. The program was developed by American Society of Civil Engineers (ASCE) Structural Engineers Institute (SEI) Sustainability Committee with the goal of net zero embodied carbon structural systems by 2050.

### What is embodied carbon?

Embodied carbon is the sum of greenhouse gas emissions associated with the manufacture + use of a product or service. You may see this measured by the unit global warming potential (GWP). All structures have embodied carbon that is created through their construction, maintenance + demolition.

### How do we reduce embodied carbon?

There isn't one easy way to reduce embodied carbon. Here are a few techniques.

- Deliver efficient designs (over-designed projects often use more material). This is already part of Schaefer's culture and can be a win-win for the team – less material can lower overall construction cost.
- Design with lower carbon materials.
- Use recycled materials and/or reuse materials.
- Renovate existing facilities vs. building new.
- Use biomimicry – design to mimic efficient structures in nature.

### Why is Schaefer joining the SE 2050 Commitment?

SE 2050 aligns with Schaefer's sustainability initiative to deliver sustainable design enhancing communities of today + tomorrow. Embodied carbon emissions affect the health of our communities. The architecture/engineering/construction industry, and we as structural engineers, can make a difference.

- Our industry contributes to roughly 30% of all global carbon emissions.
- Structural material production contributes to 10+% of global carbon emissions.
- 50+% of the embodied carbon in a building comes from the structure.

As structural engineers, we can make an impact on the triple bottom line of sustainability: economic, social + environmental.

## What will Schaefer do next (as part of SE 2050 Commitment)?

We'll submit structural embodied carbon data from several of our projects. This information, collected from structural engineering signatories across the country, will give data points for the industry to analyze + determine impacts + trends with the ultimate goal to find opportunities to reduce embodied carbon.

We'll also complete an embodied carbon action plan (ECAP) that will be published on the SE 2050 Commitment's website (we'll post it on our site in September 2023). The ECAP will outline:

- Our efforts for firmwide embodied carbon education + reduction strategies
- How we'll report our projects' embodied carbon emissions
- How we'll advocate for sustainability + SE 2050 within our industry

We're committed to learning + leading sustainable design through innovative + accessible strategies + client collaboration. By championing sustainability in our projects + business practices, we can educate our communities on designs that meet the demands of today, while being conscious of the demands of the future.

# greenhouse gas + structural engineering | how life cycle assessments can change the built environment

Nearly 40% of global greenhouse gas emissions are due to the construction + use of buildings, and nearly 50% of construction emissions are attributed to the structure itself. As the world recognizes the impact of carbon emissions on our climate, and ultimately the health + wellbeing of our communities, we're more aware of the need for change. But how? Let's start with how we measure a building's environmental impact using whole building life cycle assessments or embodied carbon calculations.

## Whole building life cycle assessment

A whole building life cycle assessment (WBLCA) considers stages A1 through C4 or D. This type of life cycle assessment could be referred to as "cradle to grave" or "cradle to cradle." It measures embodied + operational carbon throughout the life of a building.

A1-A3 PRODUCT STAGE	A4-A5 CONSTRUCTION STAGE	B1-B7 USE STAGE	C1-C4 END-OF-LIFE STAGE	D BENEFITS + LOADS BEYOND THE BUILDING LIFE CYCLE
A1 raw material supply	A4 transport	B1 use	C1 deconstruction/ demolition	D reuse/recovery/ recycle
A2 transport	A5 construction installation process	B2 maintenance	C2 transport	
A3 manufacturing		B3 repair	C3 waste processing	
		B4 replacement	C4 disposal	
		B5 refurbishment		
		B6-B7 operational use		

A WBLCA can inform the design team where we can reduce carbon emissions and help make decisions throughout the design process. In addition, it helps us understand holistic carbon emissions related to various building systems and trade-offs between embodied + operational carbon.

(Did you know that LEED certification now awards points for performing a WBLCA and for showing emission reduction from a baseline project?)

## When to perform a whole building life cycle assessment

WBLCA should be performed at various stages of a project starting in schematic design and during construction to verify initial assumptions. WBLCA should be used when a project wants to consider more than just upfront embodied carbon. This is especially important for projects with net zero carbon goals.

## Who leads a whole building life cycle assessment

It's generally led by a sustainability consultant or the architect depending on their services.

### Pros

- There's a plethora of free + paid subscription-based tools on the market to choose from. Many of these tools can work with Revit or other software used daily. The software is continuing to evolve and will only get better in the future.
- It can inform decisions early in the design process.
- It helps to understand holistic carbon emissions related to various building systems and the trade-offs between embodied + operational carbon.

### Cons

- One of the biggest challenges is getting accurate data and addressing uncertainties in the future/end of life stage for the building.
- There are a lot of variables to consider which can lead to incompatibility of baseline comparisons. For example, in WBLCA, the main emission we measure is carbon dioxide. However, the types of emissions to evaluate should be based on your overall sustainability goals. Check that the same types of emissions are being evaluated across all material types used in the building for an apples-to-apples comparison.
- We continue to learn more about the impact of our industry on our planet. Guidelines continue to evolve based on new research and as we identify appropriate comparison values.

Whole building life cycle analysis can be an involved process and might not be right for you or your project. Luckily, it's not the only option.

## Embodied carbon calculation

An embodied carbon calculation is the sum of carbon emissions for each material focusing on stages A1-A3. This is often referred to as “cradle to gate” phase. It only measures upfront embodied carbon.

As part of [our SE 2050 Commitment](#), we're providing embodied carbon calculations on several of our structures.

### When to perform an embodied carbon calculation

Embodied carbon calculations can be done at any stage in design or construction; it's helpful when it happens at multiple stages.

- During design, it can inform the team on which system to use. Performing preliminary bay studies can help determine the optimum structural material + system to use.
- During construction, it can confirm the right material was chosen for the project goals.

### Who leads an embodied carbon calculation

It depends on the scope.

- If you only want to calculate embodied carbon in the structure, the structural engineer can lead.
- If you want to include architectural materials, then an architect that provides sustainability services or a sustainability consultant can lead and bring in the structural engineer/other consultants as needed.
- If the calculation is performed during construction, the contractor can lead.

### Pros

- This assessment relies on environmental product declarations (EPDs) – they're like nutrition labels for products + materials, but instead of calories + nutrients, they provide important information about the products' environmental impacts. They can range from industry average for a material to product-specific information provided from the manufacturer. The database of EPDs provided by manufacturers is growing rapidly as requirements for them increase across the nation.

- There are several free tools online through [EC3 Home](#) or [ECOM tool](#) on the SE 2050 site.
- It's a more simplified method with less speculation if you're able to obtain the product-specific EPDs.

## Cons

- Embodied carbon calculation misses out on key interactions between the structure and the building's whole life cycle by only focusing on phases A1-A3.
  - The thermal properties of the material and insulation in the building's envelope will impact the energy required to heat and cool the building, affecting the operational carbon.
- Only considering the embodied carbon of the structural materials can miss out on other materials used.
  - A steel-framed building that requires a two-hour rated fire assembly will also need fireproofing or architectural finishes to cover the steel.
  - A concrete building that requires a two-hour rated fire assembly could provide the fire-rated assembly itself, requiring no/less additional material.

Lastly, it's important to realize that any life cycle assessment is a team effort. Participation from the architect, MEP + structural engineer from early in the design process is key. Remember: the structure alone accounts for nearly 50% of embodied carbon in a building. The structural engineer can have a key role in reducing the embodied carbon of a building from material specification to the design. We can define the building's structural materials including the amount + specifications of the material. We can also provide alternate structural system options to review or provide insight into what the structural requirements are for a project. While a sustainability consultant or other expert may be the one performing the assessment, teaming with consultants that understand what the assessments are + how they're used, and how the consultant's involvement can add value to the process from an early stage will make the most impact.