

# EMBODIED CARBON ACTION PLAN

2023



# IMEG'S 2023 EMBODIED CARBON ACTION PLAN

A message from Laura Hagan, Structural Sustainability Lead at IMEG:

Welcome to our 2023 ECAP! This ECAP accounts for our second full year as an SE 2050 signatory firm, and as you'll soon read, we are targeting bigger goals that will increase our impact in the effort to reduce embodied carbon in IMEG projects. We have certainly learned a lot and gained much experience over the past year and a half and are looking forward to achieving these goals with all of you!

*Laura Hagan*

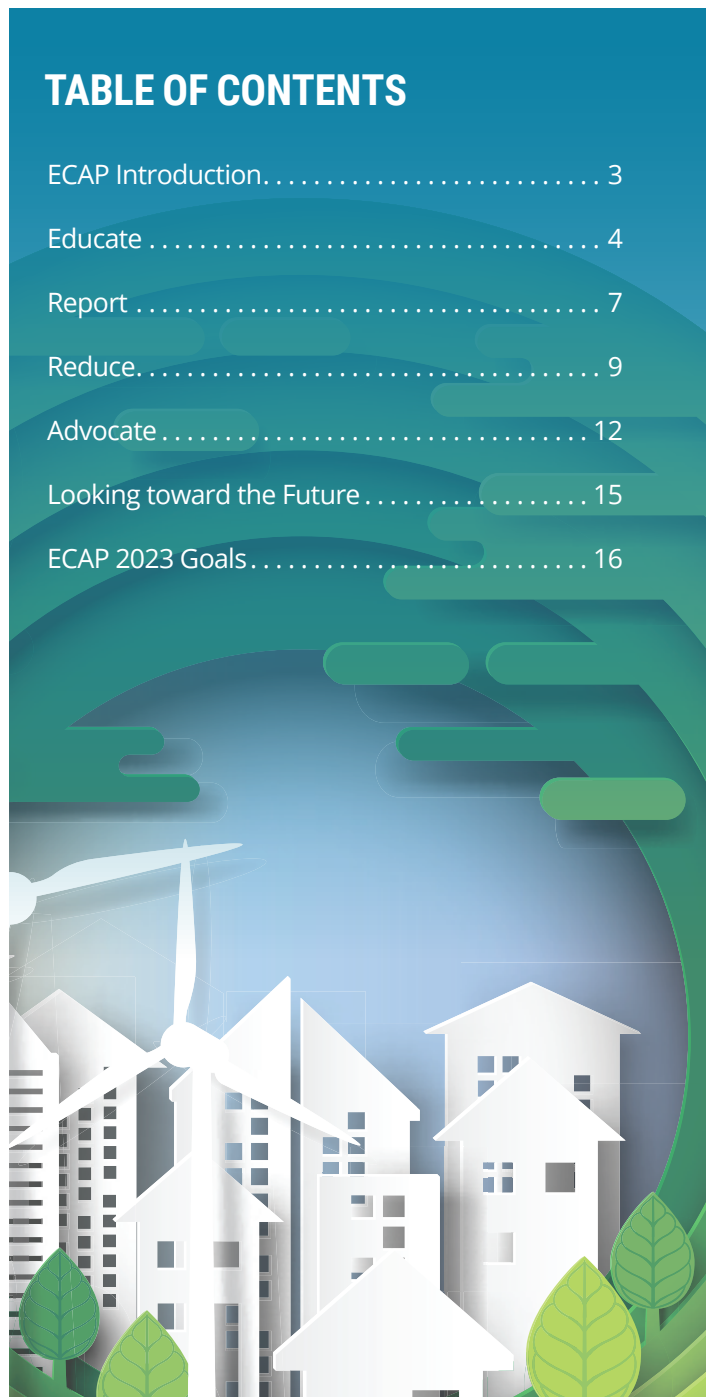


## EMBODIED CARBON DEFINED

According to the [Carbon Leadership Forum](#), embodied carbon refers to the greenhouse gas emissions arising from the manufacturing, transportation, installation, maintenance, and disposal of building materials. This refers to all the materials that go into a building, from the time they are extracted from their source all the way through their installation, removal, disposal, or reuse. These different periods of a building material's life translate directly to the building's life stages.

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# EMBODIED CARBON ACTION PLAN

The goal of the [SE 2050 Challenge](#) – to attain net zero embodied carbon structural systems by the year 2050 – is a tall order. Achieving this is possible, however, and we at IMEG can do our part to help the industry meet the challenge, guided along the way by this Embodied Carbon Action Plan (ECAP).

IMEG's ECAP is comprised of four sections, each of which examines a distinct aspect of the effort to reduce and sequester embodied carbon in the built environment.



in development. These resources will increase our knowledge about embodied carbon, life cycle assessment (LCA), and other related sustainability topics.

**EDUCATE:** This section provides information on the internal and external educational resources that are either already available or

**REPORT:** The reporting and tracking of embodied carbon data is a key piece of the SE 2050 Commitment. This section of the ECAP explains how we plan to calculate, track, and share project-based embodied carbon results.

**REDUCE:** This section explains IMEG's goals and how we will engage in the effort to make reductions in the embodied carbon of structural systems.

**ADVOCATE:** As the SE 2050 Challenge is firm-led, it is our responsibility as IMEG employee-owners to advocate for lower embodied carbon by all means available. This section delves into several ways IMEG plans to share knowledge about embodied carbon and promote its reduction within the structural industry and the adjacent construction and developer industries. We will be encouraging all employees to adopt these actions.

After reading this action plan, we hope you will be inspired to learn more, ask questions of your IMEG coworkers as well as your design teams and contractors, and share knowledgeable insight on embodied carbon reduction and associated sustainability topics.

# 1

EDUCATE

## EDUCATE

IMEG's corporate educational philosophy is one of continual learning and frequent sharing of knowledge and experience with each other. Our journey toward making a meaningful impact on embodied carbon in the built environment continues. We have incorporated learning about sustainability and embodied carbon into our internal education and training program. This blends our passion for people and engineering with our passion for the planet.



on-demand videos, written guides, handouts, blogs, and articles. These resources will be continually developed, expanded, and updated, and currently include:

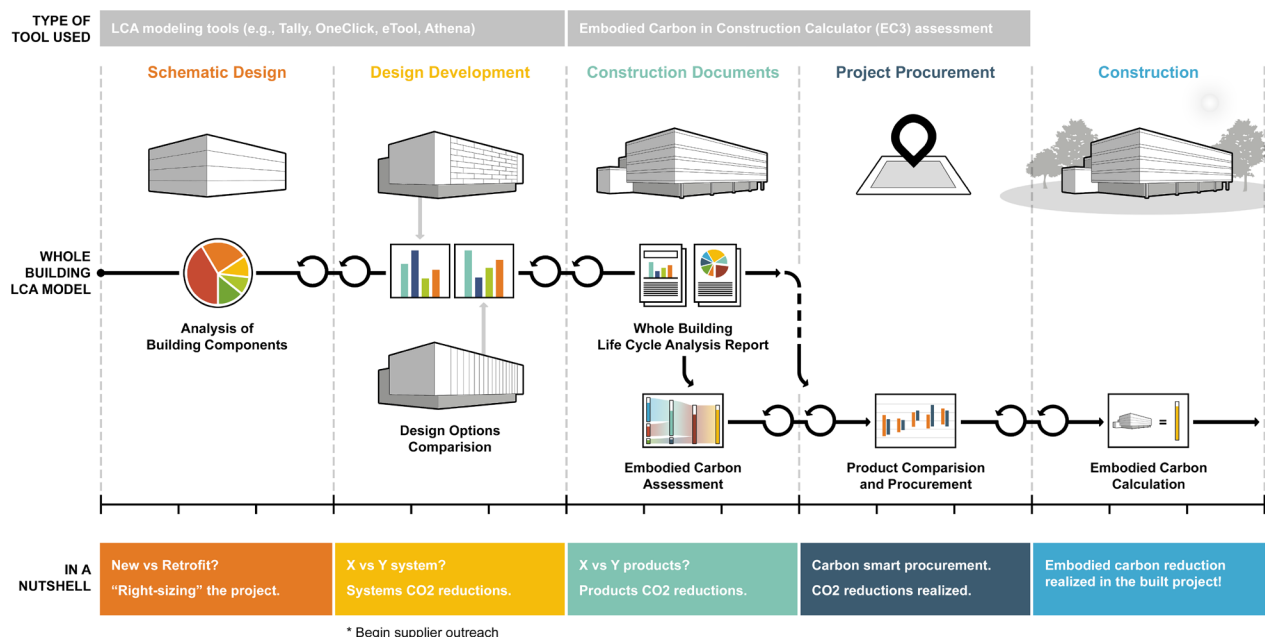
## RESOURCES

### Multi-media

IMEG strives to ensure our education program accommodates all types of learning styles. We are leveraging a combination of internal and external resources that include live presentations,

- Resources and presentations on IMEG's intranet, Compass Plus
- Internal database of IMEG project LCA results
- Blogs, guides, webinars, videos, and podcasts on [IMEG Insights](#)

### Whole-Building Embodied Carbon Modeling Workflow





## Task Force Support

IMEG has two firmwide groups that are committed to sustainable practices at the highest level and are available as constant resources in our embodied carbon reduction efforts.

**The Sustainable Design Task Force** is an interdisciplinary group of structural, mechanical, electrical, plumbing, technology, and civil peers who work to evolve our design practice toward low carbon solutions. The group continues to:

- Be leaders in the industry as a signatory firm of AIA 2030, MEP 2040 and SE 2050
- Tackle carbon disclosure reporting for our firm and create the framework, design practice, and education for embodied carbon reductions
- Further reduce MEP embodied carbon and evolve zero operational carbon initiatives as part of the MEP 2040 Challenge

Long term, the group looks to evolve its influence beyond design and toward operations and the decarbonization of buildings and campuses. To learn more or join the group, contact IMEG Director of Sustainability [Adam McMillen](#).

**The Structural Sustainability Task Force** is primarily responsible for emboldening the



structural embodied carbon reduction effort and driving the commitment to SE 2050. To this end, the Task Force is focused on researching and sharing its knowledge, expanding IMEG's resource base on embodied carbon and life cycle assessments, encouraging interest in sustainability in structural systems, and fostering healthy discussions.

This group continues to:

- Promote a holistic and sustainability-forward mindset when designing projects
- Develop and share useful guidance documents regarding embodied carbon
- Develop a group of trained LCA experts

Contact [Laura Hagan](#) if you would like to join this group of passionate and inquisitive people.

## ECAP 2023 Goals

- Give quarterly internal presentations to IMEG structural staff to share sustainability topics and provide information on the progress of our firm's embodied carbon reduction efforts
- Continue to update our internal resource center for structural sustainability strategies and educational information
- Institute mandatory structural sustainability training for all new structural employees
- Hold twice yearly townhall discussions to better understand what is happening in terms of sustainability in local regions

## Year One Reflections

Since our initial commitment to the SE 2050 Program in 2021, we have grown much and learned many things. When we first created our ECAP, we listed out several goals in each of the sections and had positive impressions that we would be able to achieve all of them.

As time passed over the course of the last year, we gained more experience and increased knowledge with regards to our embodied carbon calculations and development of reduction strategies, and our priorities in what information we shared and how we shared it evolved. We initially started off with education about embodied carbon and life cycle assessments, via internal presentations that focused mostly on knowledge sharing, with the goal being to get our staff comfortable hearing these terms. We then moved into presenting more practical knowledge in the form of strategies for low carbon concrete.

Overwhelmingly, we discovered that our staff wished for tips and advice on how to talk about embodied carbon reductions with clients. That meant we need to provide them with the tools and resources to bolster their knowledge and confidence to initiate conversations about embodied carbon on projects. This has informed us and helped us develop the goals in this ECAP, as well as develop a road map for expanding the resources we create for internal distribution. Committing to the SE 2050 Program has been vital to this evolution and we are

## EMBODIED CARBON REDUCTION CHAMPION



**Laura Hagan, PE**  
San Francisco  
Building Performance  
Consultant

Laura Hagan, IMEG's Embodied Carbon Reduction Champion, will work with all IMEG structural offices to embrace SE 2050 and advance IMEG's efforts in embodied carbon reductions.

Laura is passionate about sustainability in both her personal and professional lives. While she strives to make sustainable choices in her life outside of the office, she realizes the scale of change is much greater in her professional role at IMEG. When that is multiplied by IMEG's hundreds of structural employees and thousands of projects completed every year, the impact will be huge!

In addition to being the structural sustainability lead for IMEG, Laura also chairs IMEG's Structural Sustainability Task Force and is the leader of the embodied carbon services IMEG offers.

thankful for how it has guided and challenged us to really take a close look at how we design buildings and what we communicate on projects.

## 2

### REPORT

## REPORT

It is critical that we track the embodied carbon of completed IMEG projects so we can collect, organize, and report this data to establish not only our own baseline for project materials, building types, and other factors, but also contribute to the national benchmark that will be developed in the coming years by SE 2050. The following key steps and tools will assist us in our reporting.

### Determining embodied carbon of structural materials:

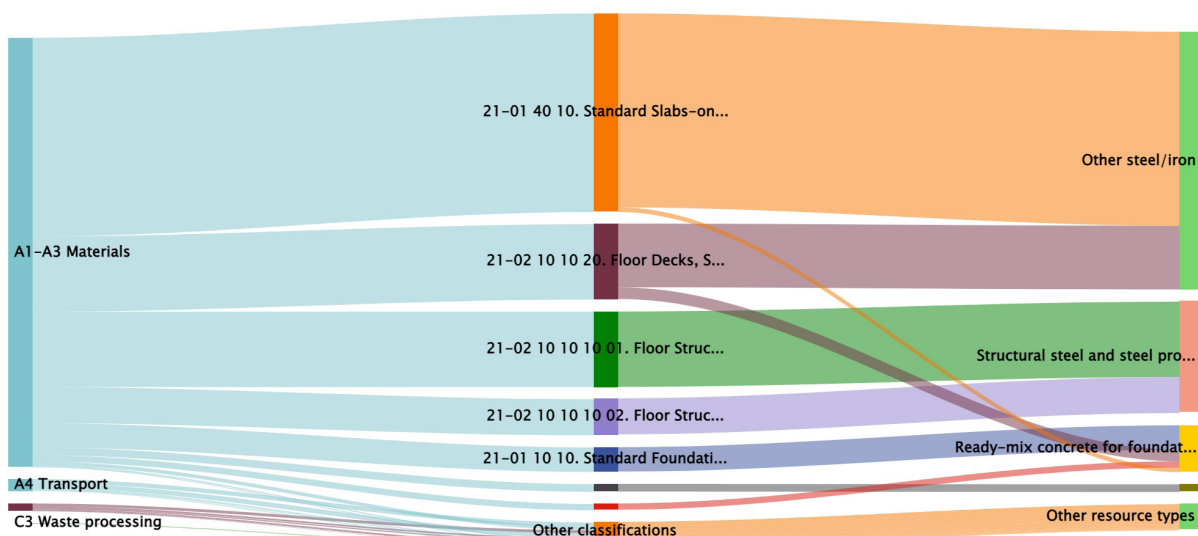
In order to provide an effective evaluation of structural materials and estimate the amount of carbon, generated and embodied, in a particular project, all phases of a material's production must be considered. An Environmental Product Declaration (EPD) outlines all the operations required in manufacturing a material and the carbon contribution of each process. As part of our reporting process, it is important that we understand which products to use for different projects and different regions of the

country. By tracking which EPDs are used, and what other options are available, we will be able to more effectively model and track the cost and environmental impacts of the different materials. We will use information from projects and also from various available material databases to expand our library of EPDs.

**Extracting material quantities:** In order to have consistent results from project to project and office to office, we have to start with a uniform template of naming conventions and types so that the output is also uniform and easily comparable between projects. IMEG is utilizing companywide Revit plugins and spreadsheets to pull quantities from the models and drawings that will be consistent with company standards and provide uniform results.

**Life cycle assessment methodology:** For our contributions to the SE 2050 database, we intend to focus our embodied carbon reductions in the A1-A5 stages of the life cycle. We will consider

Sankey diagram, Global warming



stages B1-B7, C1-C4, and all aspects of stage D when completing a whole building life cycle assessment as required for LEED or other building certification programs. A dedicated group of individuals across the company performs these assessments using [OneClick LCA](#) software. The assessment is set up using a standardized approach so that the input and output are consistent and more easily compared and contrasted, and so that trends can be observed and incorporated into the process in order to maximize proficiency.

**IMEG internal embodied carbon database:** We have developed an internal database to track the embodied carbon results for the projects for which we do life cycle assessments. This database is key in its purpose to track information for our reporting efforts. As the database grows, we will be able to identify trends as defined by project type, material, and geographic bases. We look forward to sharing this data externally when the time is appropriate.

**Annual project submission to [SE 2050 database](#):**

Once a project has been analyzed in OneClick LCA, the output will be documented and submitted to the SE 2050 database. IMEG is committed to contributing an increasing amount of embodied carbon data from life cycle assessments each calendar year. We will reevaluate these project submission goals and make appropriate adjustments for future years. In addition to the submission, this data will be used as IMEG's internal database to track our own efforts and to evaluate trends that will help us achieve our goals.

## 2023 ECAP Goals

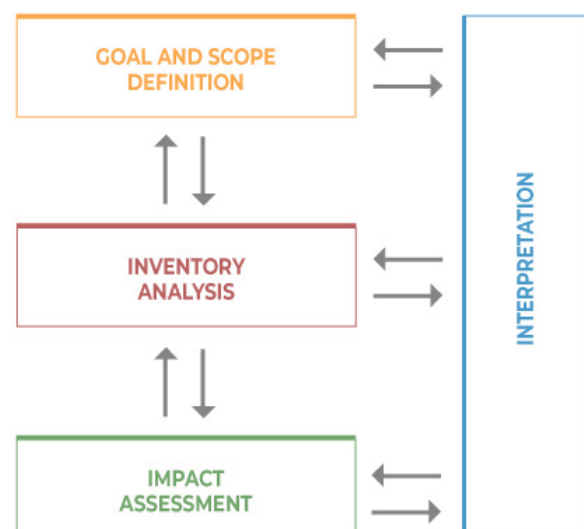
- Submit 30 additional projects to the SE 2050 database, an increase from 15 projects submitted in 2022
- Complete a structural LCA for at least one project from each of our 25 structural offices
- Add one additional staff member to complete LCAs full time

## Year One Reflections

Effective and consistent reporting is essential to tracking and understanding the effects of our efforts. As we have been performing LCAs and learning more about the different pieces that contribute to the results, it has helped us to identify areas that we need to focus on in our reporting. This focus will help us measure our progress and work more effectively toward measurable and increased embodied carbon reductions.

2  
REPORT

### LIFE CYCLE ASSESSMENT FRAMEWORK



## REDUCE

In the first year of our ECAP, like many firms, our embodied carbon reduction strategies primarily focused on education, measurement of the impact of our buildings' structural systems, and development of recommendations for lowering embodied carbon.

We began by educating IMEG employee-owners about carbon reduction through a variety of learning methods as outlined in the [EDUCATE](#) section and learned to measure embodied carbon in our buildings by means of life cycle assessments as outlined in the [REPORT](#) section. Additionally, we provided resources to our staff and client base through podcasts and additional presentations, as we indicate in our [ADVOCATE](#) section. And currently, we are working on developing standard specification language regarding reduced embodied carbon.

While seeking to learn more about what our fellow staff are seeing with regard to carbon reduction goals, we hosted two townhall discussions to better understand what is currently happening in different regions. We discovered we still have a long way to go before embodied carbon is a common term for every project, but we were able to determine critical next steps. Many designers and engineers requested a concise, material-specific list of considerations that could be incorporated into design. We are now creating a design guide that outlines reduction recommendations for all of our structural staff.

## Benchmarking

IMEG has already engaged in several initiatives to examine how embodied carbon and the structural engineering industry intersect. For example, IMEG's summer 2021 and summer 2022 structural interns participated in a group project in which they were tasked with establishing embodied carbon calculations and performing structural life cycle assessments with guidance from LCA staff for existing or soon-to-be-built projects. Through this and other ventures, we have completed numerous LCAs. In the next year, we want to increase IMEG's embodied carbon database to create a standard embodied carbon baseline which will encompass typical project types and materials. To do so, we are looking to encompass six different building materials and seven different building use types. We strive to ensure that our benchmarks will be comprehensive and consistent so as to be reliable for all future reduction efforts.

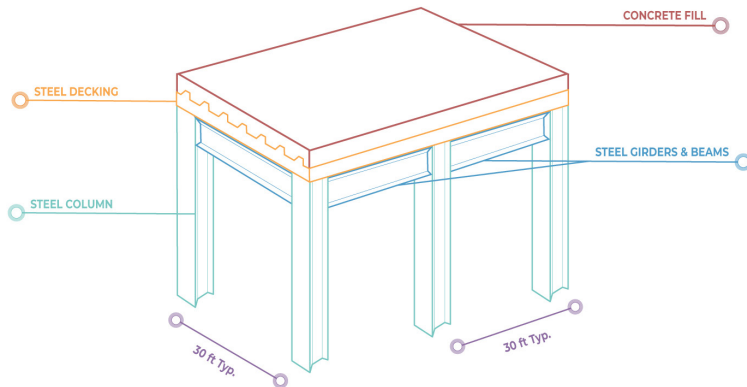
## Reduction Strategies

In combination with our benchmarking effort, we are looking to develop material-specific reduction strategies for all employees to implement so that our future buildings of the same materials and types can be lower in embodied carbon, eventually getting us to net zero. We will also develop resources to specifically address what reduction strategies can be implemented at corresponding design stages, as we fully understand there are differences in what can be done in the conceptual phase of a project versus the construction phase. In the effort to accomplish this, we have set our first specific reduction target to be a 30% reduction from the 2023 benchmark by the year 2030.



# EMBODIED CARBON ACCOUNTING\*

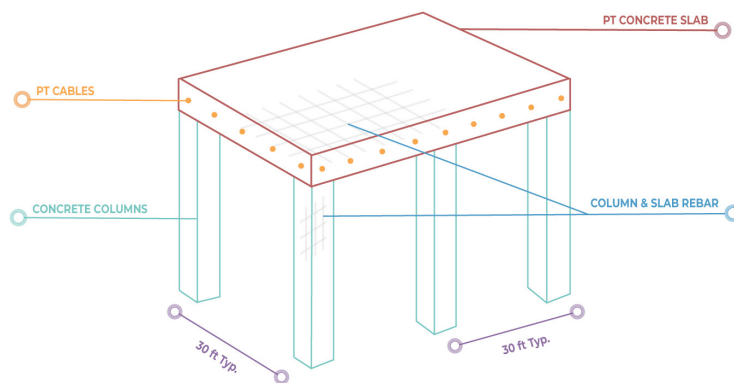
## Where Embodied Carbon Lives in the Structure: Steel



CONCRETE FILL 13.89 yd <sup>3</sup>	X	500.8 lb CO <sub>2</sub> e/yd <sup>3</sup>	=	6960 lbs CO <sub>2</sub> e
STEEL DECKING 2.97 tons	X	4740 lb CO <sub>2</sub> e/ton	=	14080 lbs CO <sub>2</sub> e
STEEL FRAMING 12.8 tons	X	2320 lb CO <sub>2</sub> e/ton	=	29696 lbs CO <sub>2</sub> e

50736 lbs CO<sub>2</sub>e TOTAL

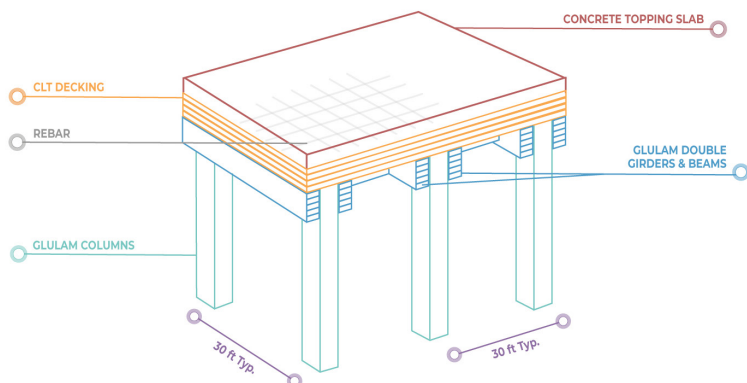
## PT Concrete and Its Embodied Carbon



6000 psi CONCRETE 3 yd <sup>3</sup>	X	792 lb CO <sub>2</sub> e/yd <sup>3</sup>	=	2380 lbs CO <sub>2</sub> e
5000 psi CONCRETE 50 yd <sup>3</sup>	X	752.4 lb CO <sub>2</sub> e/yd <sup>3</sup>	=	37670 lbs CO <sub>2</sub> e
PT CABLES & STEEL REINFORCEMENT 2.85 tons	X	1958 lb CO <sub>2</sub> e/yd <sup>3</sup>	=	5580 lbs CO <sub>2</sub> e

45630 lbs CO<sub>2</sub>e TOTAL

## And Now Mass Timber



CONCRETE 8.33 yd <sup>3</sup>	X	616.1 lb CO <sub>2</sub> e/yd <sup>3</sup>	=	5130 lbs CO <sub>2</sub> e
STEEL REINFORCEMENT 0.9 tons	X	1958 lb CO <sub>2</sub> e/yd <sup>3</sup>	=	1760 lbs CO <sub>2</sub> e
CLT 825 ft <sup>3</sup>	X	8.56 lb CO <sub>2</sub> e/ft <sup>3</sup>	=	7060 lbs CO <sub>2</sub> e
GLULAM 900 ft <sup>3</sup>	X	8.56 lb CO <sub>2</sub> e/ft <sup>3</sup>	=	7700 lbs CO <sub>2</sub> e

21650 lbs CO<sub>2</sub>e TOTAL

\* Graphics compare Cradle-to-Gate Embodied Carbon emissions for three different building materials, considering a simple two-bay system

## 2023 ECAP Goals

- By the end of 2022, develop and deploy IMEG structural specifications for lowered embodied carbon in concrete
- Develop an IMEG standard benchmark for project GWP for the following project parameters:
  - Building materials: steel, cold-formed steel, concrete, mass timber, light-frame wood, and masonry
  - Building use: public/corporate, science and technology, education, healthcare, residential, industrial, and mixed-use
- Create a material-specific embodied carbon reduction plan and share with our structural staff
- Create an embodied carbon reduction plan that lists out different strategies for reductions in each stage of the design process

- By the year 2030, achieve a 30% reduction in average embodied carbon for structural systems based on our 2023 benchmarks

## Year One Reflections

The path to full carbon reduction is a long one, but every path needs a roadmap, and that's what we're building now. Once we have a standardized benchmark, we will be able to fully track our progress as we move forward. We already have the ability to implement the carbon reduction strategies we are developing, and soon we will have the opportunity to track their effects. We will see where friction occurs and how we can counterbalance it. And lastly, we will see the reductions over time, falling far below our 2023 benchmark.



Wood Village City Hall, Wood Village, OR

IMEG's success in helping the industry reach the goal of SE 2050 is dependent not only on our technical expertise but also on our advocacy. During the first year of our ECAP, our advocacy efforts included the following:

- Publishing two podcasts to the public with the following topics:
  - o [SE 2050](#)
  - o [Life Cycle Assessments](#)
- Providing social media campaign material for use with personal and corporate accounts
- Publishing whitepapers and executive guides addressing structural sustainability topics
- Providing life cycle assessment service narrative as an insert on firm qualifications and marketing materials for use in pursuit of projects
- Engaging with higher education entities and presenting on the topic of sustainable design

and embodied carbon to a group of college students

It is important for us to communicate to clients what SE 2050 is, that it parallels the [2030 Challenge](#) (which targets operational carbon emissions) and the [MEP 2040 Challenge](#) (which targets reductions in the embodied carbon of mechanical, electrical, and plumbing systems), and the need for everyone to band together on a global scale. We must be diligent in explaining that IMEG's commitment to SE 2050 represents our stewardship of the environment through our design practices. We shall share that IMEG as a firm has integrated environmentally friendly policies and practices throughout its offices that promote energy, water, and carbon emissions conservation, and waste reduction.

We will advocate internally to continually communicate the importance of SE 2050 and the role we play. In addition, we will continuously expand our learning, abilities, and strategies as technology evolves and data is shared through



## THE FUTURE. BUILT SMARTER. The IMEG Podcast



**"The more we understand about how to make reductions in embodied carbon, the better the buildings will be for all."**

– Laura Hagan

[LEARN MORE AT IMEG.COM/INSIGHTS](https://www.imeg.com/insights)



## PLAN

## IMPLEMENT

## SHARE

1

### Embodied carbon action plan

Office action plan including supporting staff education efforts and internal SMQ and GWP tracking



2

### Implementation and accountability

Engage in sustainable goals of projects, specify low carbon impact materials and understand the GWP of each project using the LCA methods



3

### Data sharing and tracking

Share GWP and SMQ data of structural systems for benchmark establishment and development of annual reduction targets

## SE 2050 Commitment Program

Asks structural engineers and structural engineering firms to accelerate the embodied carbon reduction in structural systems and materials through three main activities.

life cycle assessments. We can then use this knowledge and information to guide our clients toward more informed decisions on the embodied carbon in various building materials. This parallels SE 2050's "Plan, Implement, Share" process that is critical to the commitment's overall success.

### 2023 ECAP Goals

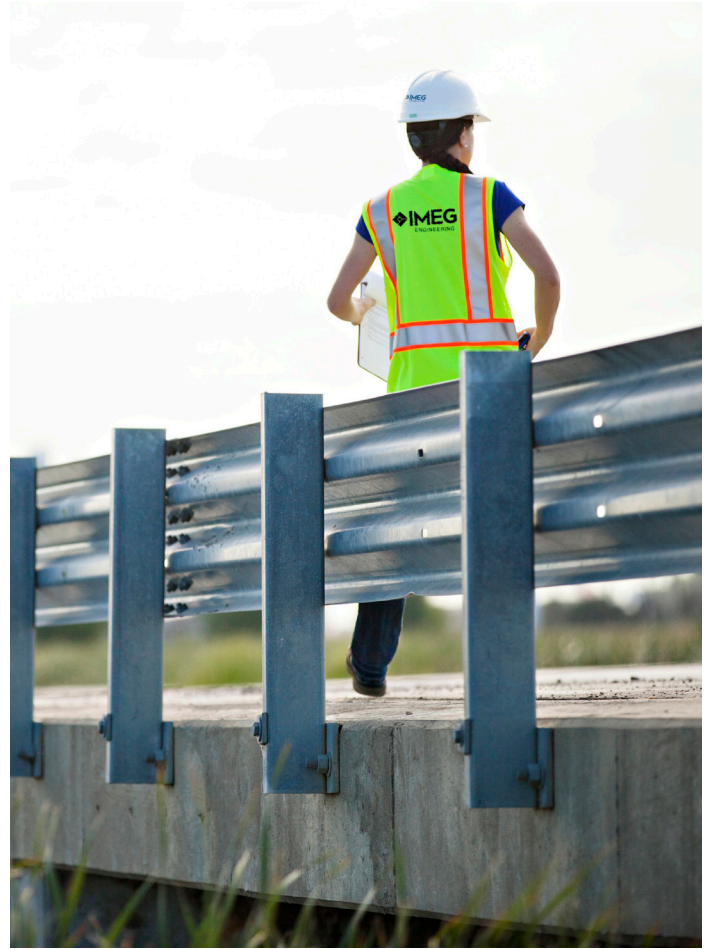
- Converse with our clients about opportunities to reduce embodied carbon in their projects, with the goal of six touchpoints per structural office per quarter
- Give two external presentations on structural sustainability topics
- Follow the Buy Clean Act legislation that is being proposed in our respective team and project locations, as well as at the federal level
- Continue to ask manufacturers to reduce the embodied carbon of their products and ask for EPDs to encourage the industry to provide them
- Attend external seminars and engage in discussions about project sustainability goals, the structural engineer's role, and promote the practice of sustainability in IMEG's structural designs
- Declare our company's commitment to SE 2050 as part of our boilerplate proposal language for all to use



## Year One Reflections

We have observed over the past year that embodied carbon discussions in different states and local regions vary quite widely in terms of occurrence and effectiveness. Some states are more proactive than others. We also found that some crucial information about procuring sustainable building materials from the industry is not yet standardized nor available. By advocating for swift development of new techniques, more resources, and better standardized practices, we can make net zero embodied carbon achievable for both ourselves and the industry.

In the words of education reformer John Dewey, “We do not learn from experience... we learn from reflecting on experience.” And so, moving forward to 2023, we turn our attention from education to action and reflection as we find ways to broadly engage our clients and external groups, and determine how to better implement our 2023 ECAP goals.



ADVOCATE  
4





## Looking toward the future

IMEG will continue to reflect on and build upon this document each year as we push to achieve net zero embodied carbon in our structures. We will continue to evaluate our progress and identify both successes and setbacks. We will update our ECAP based on our annual evaluation and per SE 2050 program requirements, including new information on sustainability as well as our expanding technological expertise for calculating and reducing embodied carbon.

Hopefully, this ECAP has piqued your interest in SE 2050 and embodied carbon reductions, as well as inspired you as an IMEG employee-owner, structural engineer, and steward of the planet. We are all in this together, and we look forward to working with you in this monumental sustainability initiative and doing our part to make a difference.

## Structural Sustainability Task Force



Adam Law



Anchila Monks



Heather Heidenreich



Laura Hagan (Chair)



Olivia Paxton

### Additional Structural Sustainability Task Force Members:

Craig Chamberlain

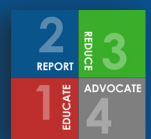
Harshith Kodumuru

Julie Hagelshaw

Priyanshi Soni

Smust Nipitkultong

Zarre Baldwin



# ECAP 2023 GOALS



## 1. EDUCATE

- ☐ Give quarterly internal presentations to IMEG structural staff to share more sustainability topics and provide information on the progress of our firm's embodied carbon reduction efforts
- ☐ Continue to update our internal resource center for structural sustainability strategies and educational information
- ☐ Institute mandatory structural sustainability training for all new structural employees
- ☐ Hold twice yearly town hall discussions about what is happening in the local regions

## 3. REDUCE

- ☐ By the end of 2022, develop and deploy IMEG structural specifications for lowered embodied carbon in concrete
- ☐ Develop an IMEG standard benchmark for project GWP for the following project parameters:
  - a. Building materials – steel, cold-formed steel, concrete, mass timber, light-frame wood, and masonry
  - b. Building use – public/corporate, science and technology, education, healthcare, residential, industrial, and mixed use
- ☐ Create a material-specific embodied carbon reduction plan and share with our structural staff
- ☐ Create an embodied carbon reduction plan that lists out different strategies for reductions in each stage of the design process
- ☐ By the year 2030, achieve a 30% reduction in average embodied carbon for structural frames based on our 2023 benchmarks

## 2. REPORT

- ☐ Submit 30 additional projects to the SE 2050 database, an increase from 15 projects submitted in 2022
- ☐ Complete a structural LCA for at least one project from each of our 25 structural offices
- ☐ Add one additional staff member to complete LCAs full time

## 4. ADVOCATE

- ☐ Converse with our clients about opportunities to reduce embodied carbon in their projects, with the goal of six touchpoints per structural office per quarter
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