

EMBODIED CARBON ACTION PLAN



Oct. 20, 2021



Dear IMEG Structural Staff:

We are excited to introduce you to IMEG's Embodied Carbon Action Plan (ECAP), a requirement of the Structural Engineers 2050 Commitment Program. This document is the product of many hours of hard work by the Structural Sustainability Task Force with invaluable help from others as well.

The [SE 2050 Commitment](#) was developed in response to the [SE 2050 Challenge](#), which calls on all structural engineers to "understand, reduce, and ultimately eliminate embodied carbon in their projects by 2050." IMEG joined the SE 2050 Commitment in April of 2021, pledging our firm to reduce the amount of embodied carbon produced by our projects, with the goal of reaching net zero. Our owner and architectural clients also are prioritizing this issue and it is important for IMEG's employee-owners to embrace this next evolution in our design practice.

As a Top 5 engineering firm and leader in the industry, IMEG has been working diligently for many years on reducing operational carbon (or carbon emissions) in the buildings we design. We've made great strides and it is now well within our ability to reach net zero energy on projects that are committed to that goal. With our MEP toolbox well stocked to address operational carbon, it is now time to set our sights on the embodied carbon of our buildings' structural and architectural systems.

As structural engineers who are concerned with the built environment's effect on climate change, it is our opportunity and responsibility to make beneficial changes in our design to lessen the impact of embodied carbon. In so doing, we can realize the goals we set forth in this ECAP and provide a more sustainable structural product for our clients.

Our hope is that you can see how important it is to reduce embodied carbon and why we need to consider it in our designs. We feel the goals in this ECAP are well within reach through the smart design practices, innovation, and leadership that already exist within our firm.

This guide provides information about embodied carbon and its reduction, life cycle analyses, and much more. We hope you enjoy reading it and encourage you to reach out with any questions. Know, too, that there is more to come, as this plan is just the start of something big.

Sincerely,

A handwritten signature in black ink that reads 'Laura Hagan'.

A handwritten signature in black ink that reads 'Adam McMillen'.

Laura Hagan & Adam McMillen

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.





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 analysis (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. Right now, our goals are mostly educational, but look for this to change in the coming years.

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 co-workers 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. Since education is a critical first step in our journey toward making a meaningful impact on embodied carbon in the built environment, learning about sustainability and embodied carbon will become integral to our internal education and training program. This blends our passion for people and engineering with our passion for the planet.

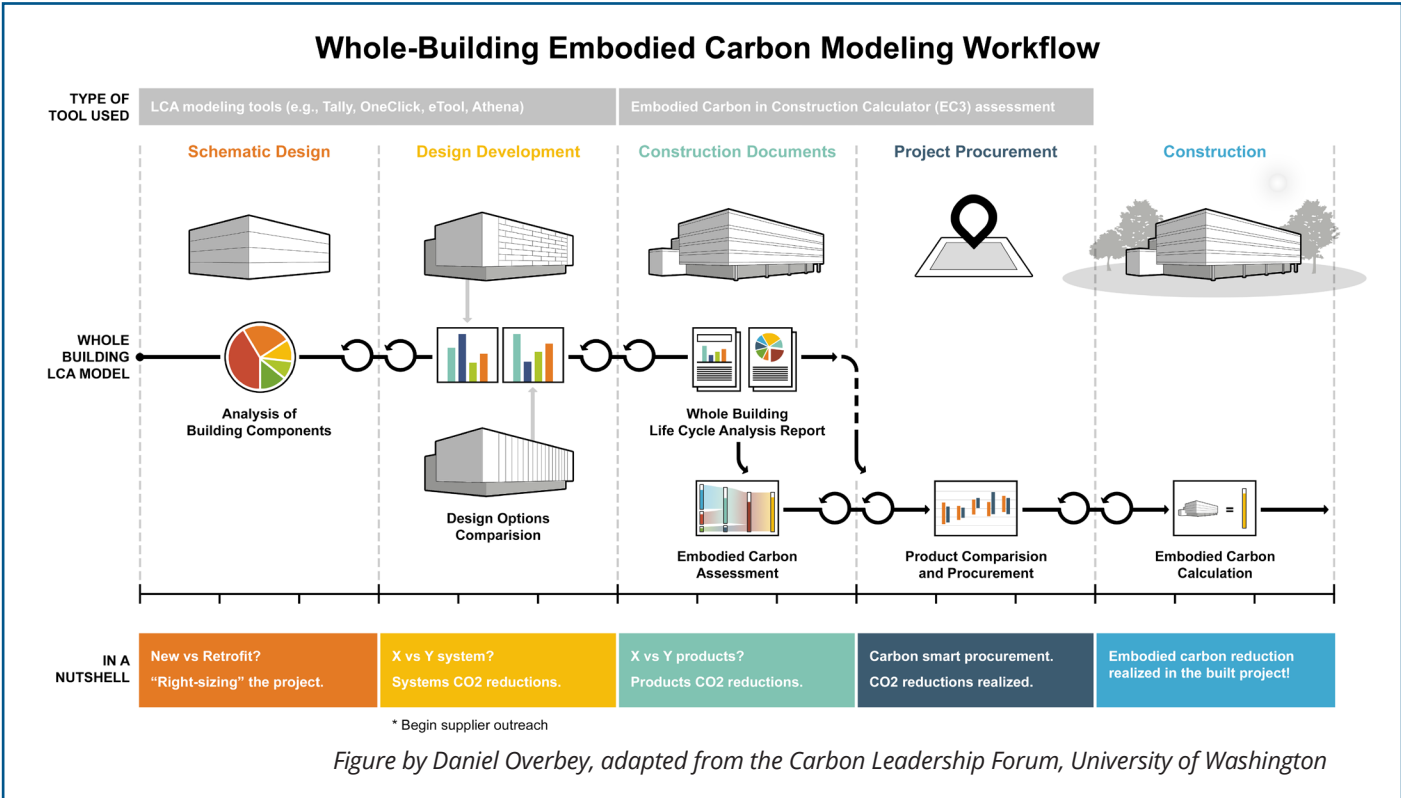


presentations, on-demand videos, written guides, handouts, blogs, and articles. These resources will be continually developed, expanded, and updated, and currently include:

Multi-media resources

IMEG strives to ensure our education program accommodates all types of learning styles. Therefore, we will leverage a combination of internal and external resources that include live

- "Embodied Carbon and Sustainability in Building Structures," an internal presentation by Eddy Santosa, IMEG Senior Building Performance Consultant. Multiple live events along with a recording will be available.



- [SE 2050's library of resources](#)
- SE 2050's "Top 10 Carbon Reducing Actions for Structural Engineers"
- The presentation, "How to Calculate Embodied Carbon"
- Blog: [Defining a Whole-Building Embodied Carbon Workflow](#)
- Demonstration of an LCA-based tool for calculating embodied carbon
- LCA software training for select staff

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. In the near term, the group will:

- Tackle carbon disclosure reporting for our firm and create the framework, design practice, and education for the SE 2050 Challenge
- Explore reduction in MEP embodied carbon and further evolve zero operational carbon initiatives

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](#).

EMBODIED CARBON REDUCTION CHAMPION



Laura Hagan, PE
San Francisco
Project Engineer II

Laura Hagan, IMEG's Embodied Carbon Reduction Champion, will work with all IMEG structural offices to embrace the SE 2050 Commitment Program and advance IMEG's Embodied Carbon Action Plan.

Laura is passionate about sustainability and does what she can to help promote sustainable practices in her own life. She prefers to travel by bicycle when possible and is a fan of making things herself instead of buying them (from the food she eats to the clothes she wears). Her knowledge of structural sustainability enables her to reduce embodied carbon not only in her projects but to also assist other structural engineers to do the same in their projects. She also works within IMEG's internal channels to collect and submit embodied carbon project data.

In addition to being the point person for all things SE 2050 and ECAP related, Laura also leads IMEG's Structural Sustainability Task Force and is enthusiastic about these causes.

The Structural Sustainability Task Force

is primarily responsible for emboldening the structural embodied carbon reduction effort. 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 analyses, encouraging interest in sustainability in structural systems, and fostering healthy discussions. Key goals include:

- Promoting a holistic and sustainability-forward mindset when designing projects
- Developing and sharing useful guidance documents on embodied carbon
- Creating and enacting best practices for sustainability in structural systems
- Developing a group of trained LCA experts
- Collaborating with local and regional material suppliers on sustainable material specifications as they relate to EPD requirements
- Advocating for structural sustainability within our local communities

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



It is critical that we track the embodied carbon of completed IMEG projects so that 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 the SE 2050 Challenge.

The following key steps and tools will assist us in our reporting.

Determining embodied carbon of structural materials

| To reasonably 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 producing a material and the carbon contribution of each process. The summation of these operations equals the embodied carbon per unit of material. Many of these EPDs are certified and catalogued by national agencies and institutes and can be used for initial LCA calculations.

For example, the Carbon Leadership Forum's [Embodied Carbon in Construction Calculator \(EC3\)](#) tool was built with data from nearly 50 industry partners and utilizes building material quantities from construction estimates and/or BIM models and a robust database of digital, third-party verified EPDs. The calculator can be implemented in both the design and procurement phases to look at a project's overall embodied carbon emissions, enabling the specification and procurement of the low carbon options. As a project progresses from early conceptual stages into design or construction, local vendor data can be substituted in the LCA to refine the embodied carbon calculations. Material strengths and quantities are the most important information to have when deciding whether to use less material at a higher strength or vice versa.

Life cycle analysis methodology | For our contributions to the SE 2050 database, we intend to focus our embodied carbon reduction on the A1-A5 [stages of the life cycle analysis](#). We will consider stages B1-B7, C1-C4, and all aspects of stage D when completing a whole building life cycle analysis when required for LEED or other building certification. A dedicated group of individuals across the company will perform these analyses using OneClick LCA software. These individuals will coordinate their efforts to create a useable database of projects and an optimized process for incorporating this into our workflow

Extracting material quantities | A major portion of the information required to complete an LCA is already incorporated in a BIM model. Using the OneClick LCA plug-in for Revit, IMEG's

BIM platform, material quantities and types can be automatically imported and mapped into the platform's extensive database. This will be a standard procedure for projects throughout the firm.

Annual project submission to SE 2050 database | IMEG is committed to contributing embodied carbon data from life cycle analyses for five projects by the end of the first year of participation, and increasing project-based embodied carbon data to 15 projects by the end of the second year. We will reevaluate these project submission goals and make appropriate adjustments for following years.

REDUCE 3 REDUCE

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

To begin, we will educate IMEG employee-owners about carbon reduction through a variety of learning methods as outlined in the EDUCATE section and learn to measure embodied carbon in our buildings by means of life cycle analysis as outlined in the REPORT section. We also will provide presentations and resources to spread the knowledge among our client base as indicated in our ADVOCATE section. Standard specification language regarding reduced embodied carbon also will be developed.

Left: 1040 W. Fulton, Chicago, IL



Embodied carbon research

IMEG has already engaged in several initiatives to examine how embodied carbon and the structural engineering industry intersect. For example, Summer 2021 structural interns participated in a group project in which they were tasked with establishing embodied carbon calculations for five existing projects. The IMEG Structural Sustainability Task Force established guidelines for the project, including the following parameters:

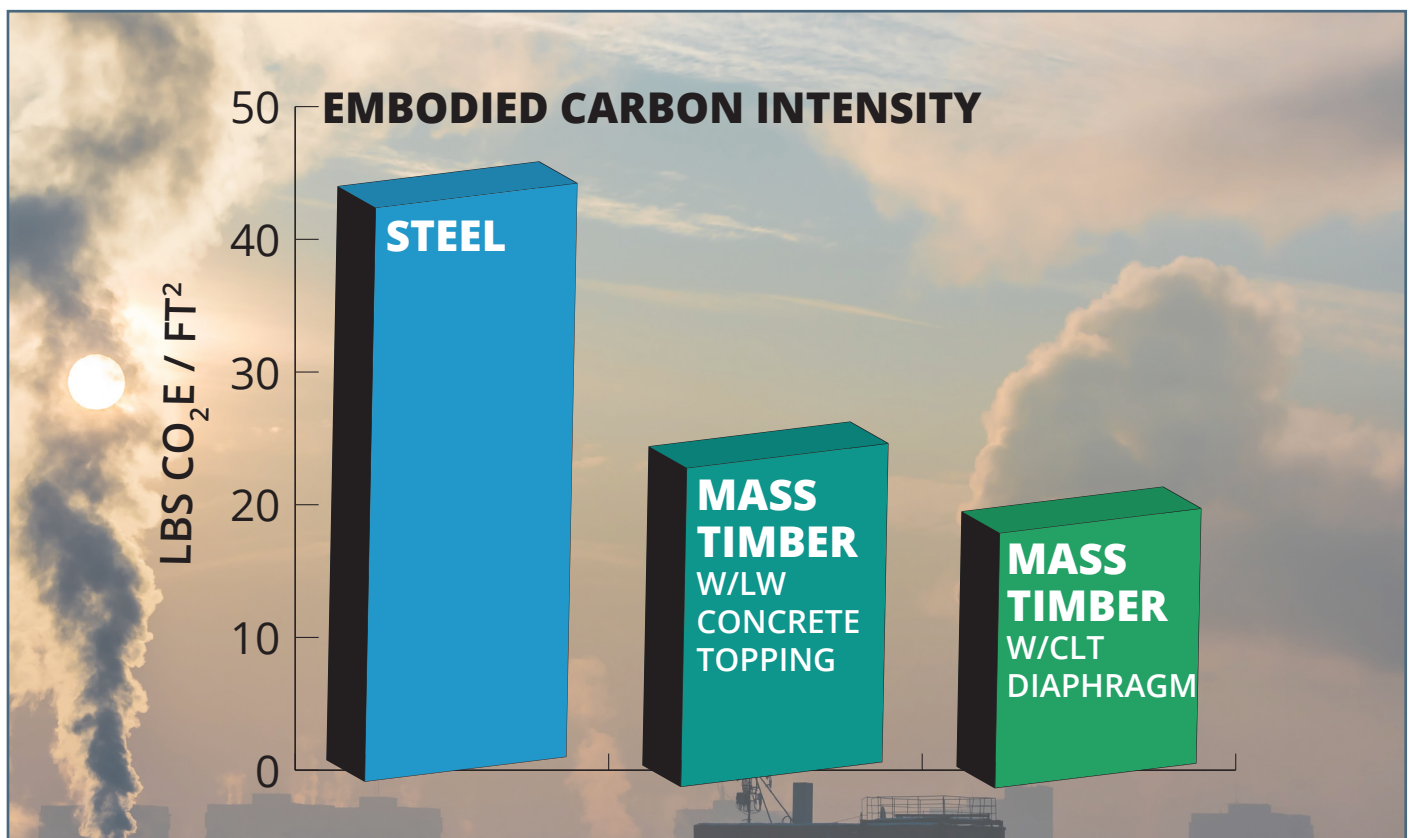
- Each of the buildings were to be of a different material: concrete, cold-formed steel, mass timber, wood over concrete podium, and steel
- The buildings were to represent a range of common IMEG building types, from single-story to 14 stories tall

- A select group of available LCA software tools were to be used and compared

The intent was to determine the amount of embodied carbon these different buildings contributed to their surroundings. The findings were highly informative and helpful, and we are grateful for all the work the structural interns put into their LCAs and final reports. (To access the interns' reports and group presentation, contact [Laura Hagan](#).)

Case studies

IMEG also has completed several comparisons of shifting a concrete or steel structure to a lower carbon option on various projects. Two example case studies follow.





FireKeepers Casino Hotel, Battle Creek, MI

Project A: The owner of a designed, six-story concrete office building was considering switching to a different material for the gravity systems. The material comparisons considered were the original cast-in-place concrete design, steel, and mass timber – in this case, glulam beams and columns with cross-laminated timber (CLT) decks. Preliminary embodied carbon calculations for each option (as well as several different configurations within the mass timber option) showed that any gravity framing option involving a CLT deck with glulam columns and beams had about 50% lower embodied carbon than the steel or concrete options. This estimate did not include the lateral systems or foundation systems for the project, but demonstrated the possibilities that can be revealed when thinking critically about different elements in a structural system.

Project B: This conceptual-level comparison showed the carbon impact of switching parts of a previously designed steel office building at the CD phase – retaining the steel below-grade structure

and long-span grid system but using mass timber beams and CLT decks at the above-grade structure. An analysis using [ECOM](#) was performed with the material quantities imported from the Revit file for the steel building and switching the respective quantities to mass timber options. Several steel elements had to be retained due to the seismic forces, and concrete was required as a topping for acoustical purposes, but the majority of steel and concrete was removed. As a result, the above-grade structure netted a 40% to 50% embodied carbon reduction, the equivalent of taking 440 to 580 cars off the road for a year.

IMEG anticipates that comparisons like those done for these two projects will become more commonplace. Therefore, we are preparing to utilize OneClick LCA and BIM models to deliver comparisons at early stages for any future project. This will provide clients, contractors, and architects with the embodied carbon impact of each option considered – and help educate all of us at IMEG on the different impacts as well.

IMEG's success in helping the industry reach the ultimate goal of the SE 2050 Commitment Program is dependent not only on our technical expertise but also on our advocacy. This will include reaching out to our clients, owners, developers, contractors, material suppliers, and peers to increase awareness of embodied carbon reduction and sequestration. We need everyone's involvement in this advocacy effort and will provide many materials and avenues for doing so, including:

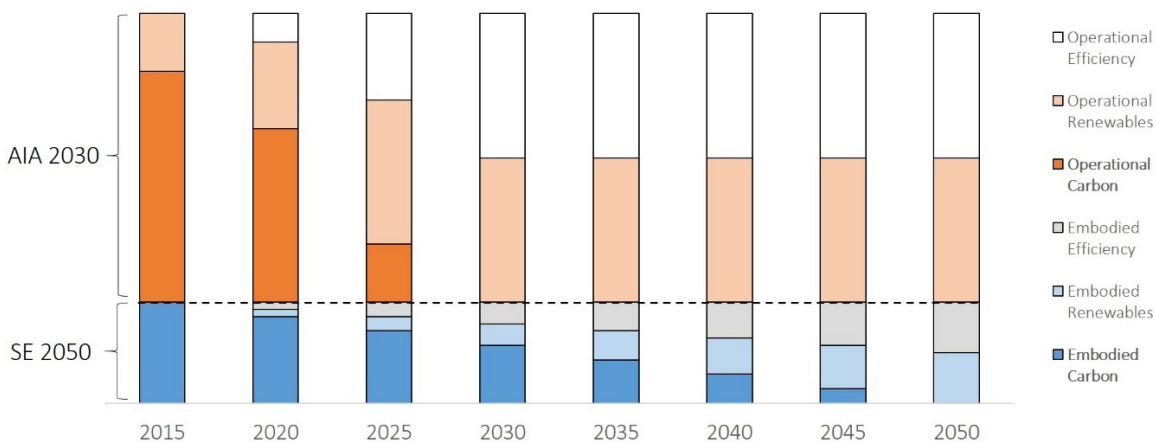
- A PowerPoint presentation that highlights key points of technical importance and interaction with sustainable practices
- Project case studies that compare and demonstrate the embodied carbon impact of different materials
- Project kick-off questions, such as:
 - o Does the project have any specific sustainable goals?

- o Will a contractor be brought in during design?
- o Can the contractor provide concrete with reduced embodied carbon?
- o Is mass timber an option?
- Social media campaign material for use with personal and corporate accounts
- Webinars and podcasts to be shared live or on demand
- Whitepapers (for a technical audience) and executive guides (geared toward clients and owners)

IMEG also will declare our company's commitment to the SE 2050 Commitment Program as part of our boilerplate proposal language for all to use.

It's also important to communicate to clients just what SE 2050 is, that it parallels [The 2030 Challenge](#) (which targets operational carbon emissions), and emphasize the need for everyone to band together on a global scale. We also encourage you to explain to others that SE 2050

SE 2050 + AIA 2030



2018 SEI Sustainability Committee

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.

represents IMEG's latest sustainability initiative and that the firm has been a steward of the environment through its design practices for many decades. You should share as well 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 also advocate internally to continually communicate the importance of the SE 2050 Commitment and the role we play. In addition, we will continuously expand our learning, abilities, and strategies as technology evolves and data is shared through life cycle analyses. We can then use this knowledge and information to guide our clients toward more informed decisions on the global warming potential in various building materials. This parallels SE 2050's "Plan, Implement, Share" process that is critical to the commitment's overall success.

Looking toward the future

IMEG promises to reflect on this Embodied Carbon Action Plan in April 2022, one year after our commitment to the SE 2050 Challenge. We will identify areas of both success and failure, and in the case of the latter we will revise the ECAP as necessary in areas that did not provide the expected outcome. We also will update the plan per SE 2050 requirements and include new information on sustainability as well as our expanding technological expertise for calculating embodied carbon.

Hopefully this ECAP has piqued your interest in the SE 2050 Commitment and inspired you as an IMEG employee-owner, structural designer, 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



Laura Hagan (Chair)



Adam Law



Anchila Monks



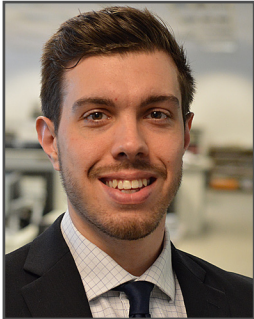
Bethany Jones-Kent



Harshith Kodumuru



Heather Heidenreich



Jim Buban



Julie Hagelshaw



Kyle Jackson



Manuel CastellanosCantu



Zarre Baldwin

EMBODIED CARBON ACTION PLAN

APPENDICES

A. SE 2050 Commitment Letter

B. SE 2050 IMEG Staff Announcement



LETTER OF COMMITMENT TO THE SE 2050 PROGRAM

DATE: April 20, 2021

TO: Ms. Laura Champion, Director, Structural Engineering Institute

FROM: Ed Gharibans, Vice President of Structural Engineering, IMEG Corp.

SUBJECT: Letter of Commitment to the SE 2050 Program

Dear Laura:

IMEG Corp. – a Top 5 engineering firm with 1500 team members including 300 structural engineers and headquartered in Rock Island, Illinois, with offices located throughout the U.S. – is hereby signing on to the SE 2050 Commitment Program. We support the vision that all structural engineers shall understand, reduce, and work toward eliminating embodied carbon in their projects by 2050.

We sign this commitment because we are not only passionate about engineering, but we are also passionate about the planet. With that in mind, our firm has integrated environmentally friendly policies and practices into our organization and design work. As leaders of the structural engineering community, we hold ourselves responsible for sustainable design solutions that provide efficient buildings that use less energy, deplete fewer natural resources, generate less waste, provide flexible environments for occupants, and are within the client's budget.

We therefore commit IMEG Corp. to taking the following steps as part of the SE 2050 Commitment Program:

- Within six months and annually henceforth, we commit to reporting an Embodied Carbon Action Plan (ECAP) and permit the ECAP document or form be made public on the SE 2050 website.
- Within one year and annually henceforth, 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,

A handwritten signature in blue ink, appearing to read "Ed Gharibans", is positioned above the typed name.

Ed Gharibans, PE, SE
Vice President of Structural Engineering
Ed.T.Gharibans@imegcorp.com

HLH/sm
\\files\Corporate\Technical_Operations\Task_Force\Structural\Sustainability_TPSE2050



MEMO

To: All IMEG Staff
From: Heather Heidenreich, Director of Structural Engineering & Laura Hagan, Chair of Structural Sustainability Task Force
Subject: SE 2050
Date: April 21, 2021

What is the SE 2050 Commitment?

It is a voluntary commitment, taken by structural engineering firms, to support the SE 2050 Challenge working towards net zero embodied carbon structural systems by the year 2050.

Structural engineering firms are leading the challenge and have specifically tailored it around the industry.

There are three main goals of the commitment:

1. **Educate** - Inform our structural engineers on best practices in sustainable design and construction methods.
2. **Engage** - Establish an embodied carbon tracking program within the structural engineering profession.
3. **Report** - Track and report current embodied carbon data and develop reduction targets.

Many of you are probably thinking that all sounds great but have reservations around the time commitment, what this means to our clients and more. We understand and we are not here to change things overnight. This is about being informed and learning how decisions impact embodied carbon.

Let's walk through what the SE 2050 Commitment entails. There are three areas of focus within the program.

1. **Plan** - We are committed to establishing an Embodied Carbon Action Plan (ECAP) to provide staff with education in embodied carbon and life cycle analyses (LCAs) within 6 months. Through this plan, we will develop processes, provide many educational opportunities, prepare shareable documents, etc. to help assist our staff's learning.
2. **Implement** - We will engage in sustainable goals on projects and specify low carbon impact materials where possible. Throughout our participation in SE 2050, IMEG's role is to support the client's needs at whatever level they determine, from the uber-level of sustainability to the low end. We will also be working toward assessing our projects using LCA methods.



@All-IMEG
April 20, 2021
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3. **Share** - We will need to share embodied carbon data on some of our projects and help the commission develop reduction targets for the industry. All data will be encrypted, not available to the public, and aggregated so no one specific project can be identified. The point of the database is to collect data to set benchmarks and establish industry targets.

We are excited to be making this first step in being more mindful and understanding of embodied carbon and its impact on the environment.