2022

kpff

SE 2050 Embodied Carbon ACTION PLAN

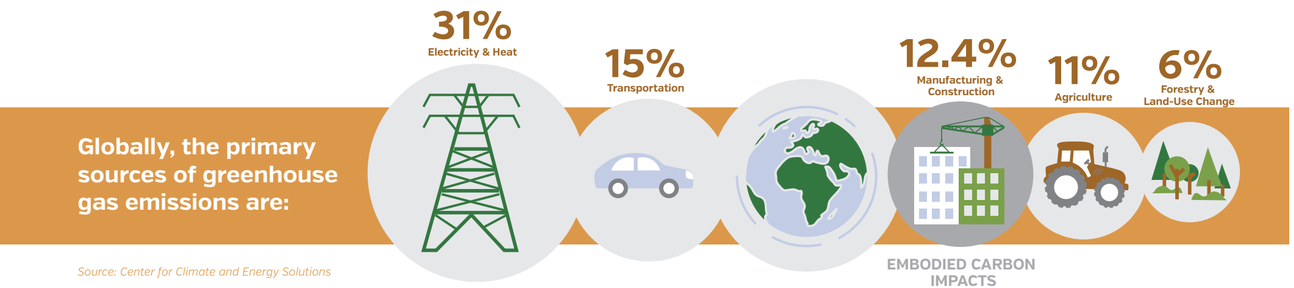
01

Introduction

KPFF recognizes and supports the SE 2050 Challenge vision statement that “all structural engineers shall understand, reduce, and ultimately eliminate embodied carbon in their projects by 2050.” As the SEI Board of Governors stated in their endorsement of the SE 2050 Challenge, we also “recognize the need for coordinated action across our profession to achieve the globally stated goal of net zero carbon by 2050.”

We joined the SE 2050 Commitment in 2021 and we have developed this updated Embodied Carbon Action Plan (ECAP) to show what we have been doing during the past year and what our plans are for this next year.

BLUE HIBISCUS



Source: Center for Climate and Energy Solutions

The vision of SE 2050 directly aligns with the core values that have guided our organization successfully over the last 60 years. These values are relationships, trust, passion, excellence, and stability. The vision of the future contained within the SE 2050 program is one of *relationships*, to our community locally and globally. It is a vision of providing *stability* and maintaining *trust* with future generations, recognizing that we play an essential role in reducing the embodied carbon (EC) that will impact future generations for the next 28 years and beyond. It exemplifies the *passion* we have as engineers to meet the challenges of today with new ideas and solutions. It requires the leadership and *excellence* to find and implement new carbon strategies that are truly effective and impactful.

Project Highlight >>

Catalyst

Spokane, WA

KPFF provided structural engineering services for a new 5-story, 160,000 sf mass timber office/classroom building with a partial daylit basement. The lateral system for the building is the first of its kind utilizing CLT shear walls and Buckling-Restrained Braces (BRB) as ductile holddown elements. The Catalyst building, certified by the International Living Future Institute (ILFI), is one of the first zero-energy, and zero-carbon buildings in North America.

02

Embodied Carbon Champions

KPFF has two designated Embodied Carbon Champions for our firm: Shana Kelley of the Seattle office and Molly Seto of the San Francisco office. Shana and Molly work together alongside a team of engineers throughout our offices to establish and develop the firm-wide KPFF Embodied Carbon program.

SHANA KELLEY

Shana Kelley is the Director of Sustainable Design in KPFF's Seattle Structural Group, where she works to coordinate KPFF's in-house life cycle assessment (LCA) program. She serves as the chair of ACI 318 Concrete Building Code Sustainability Subcommittee for ACI 318-25 code cycle and helps lead the local Carbon Leadership Forum Seattle group.

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MOLLY SETO

Molly Seto is an Associate in KPFF's San Francisco Structural Group. She leads internal sustainable initiatives within the KPFF San Francisco office, including developing an embodied carbon tracking system for our projects and external educational presentations on sustainability. The KPFF San Francisco office is active in the local Carbon Leadership Forums and the Structural Engineering Association of Northern California Sustainability Subcommittee.

molly.seto@kpff.com

Project Highlight >>

LEED PLATINUM

Mary D. Nichols Campus

Riverside, CA

KPFF was proud to provide structural and civil engineering services for California Air Resources Board's (CARB's) new Southern California HQ. With the design of the new CARB headquarters and vehicle emissions testing facility, the Department of General Services and CARB have set a new standard for energy reductions. Not only is it the largest and most advanced vehicle emissions testing and research facility in the world, it was also designed and built to be the largest true net-zero energy facility of its type, producing more energy than it uses. The structure utilized specified concrete cement replacement, high recycled steel content, and was designed to obtain a USRC resiliency rating.

03

Reduction Strategy

Much of our efforts this year have been tied to our exploration of structural carbon reduction strategies on a variety of projects. A key element has been better understanding both the large and small variables in our designs that impact embodied carbon. Regardless of whether or not a project is pursuing specific environmental goals, we can influence carbon reduction through a number of strategies.

Structural System Selection

Many projects begin with specific environmental goals or considerations, addressing the embodied carbon impacts of different structural systems in requests for proposals and project interviews. These owners and architects expect embodied carbon discussions when we are exploring structural systems.

To guide teams in these early stages and have ready, relevant answers, we have focused on getting a comprehensive understanding of the impacts of structural system selection. We have done this by creating our own in-house database of structural system life cycle assessments. Even on projects without named sustainability goals, this database can help guide conversations when making structural systems choices.

PORTLAND INTERNATIONAL AIRPORT

J. CRAIG VENTER

JAVA GARAGE

Retrofits / Adaptive Reuse

A key reduction strategy that we are really excited about is adaptive reuse and retrofitting existing structures to create new spaces. Retrofitting existing structures uses the carbon we have already spent and can significantly increase the building's useful life. Retrofits have always been a part of our practice, but we're improving our ability to help clients quantify the environmental costs of retrofitting versus building new.

Project Highlight >>

100 Stockton Project

San Francisco, CA

In our recently completed 100 Stockton project, we breathed new life into an 8-story brutalist concrete building. Creative solutions, including modifying and repairing existing post-tensioned girders, using carbon fiber wrapping to improve performance of existing columns, and designing a new seismic core system that weaves through the existing structure, allowed us to save much of the original building. To determine which retrofit strategies were most effective at reducing carbon, KPFF conducted an embodied carbon study on the structure, comparing the as-built retrofit to a new building.

Material Reuse

Even when reusing an entire structure is not an option, there are still opportunities to incorporate elements from demolished projects in our new construction.
A great example of this is the Federal Center South project in Seattle, where we used 200,000 board feet of wood framing from an existing structure demolished on-site. This is roughly equivalent to the yield of 4 acres of Washington forest. This work required extensive cataloging of the existing framing, unique and flexible detailing, and structural testing to fully capture the capacity of the existing wood.

This past year we have explored new ways of detailing our current systems to consider end-of-life reuse. In collaboration with ZGF Architects, we are exploring CLT system design, using our experience lab testing composite CLT systems to help explore how these systems are disassembled.

200,000 BOARD FEET OF WOOD FRAMING USED FROM AN EXISTING STRUCTURE DEMOLISHED ON-SITE

System Efficiency

KPFF has always focused on increasing structural efficiency while still accounting for capacity and performance. Less structural material usually translates to lower costs, an important goal for many of our clients. Less structural materials also means less embodied carbon impact. We have found that considering efficiency and embodied carbon together further emphasizes the importance of creating an efficient design.

FEDERAL CENTER SOUTH

Material Specification

Once the structural system has been selected, the next opportunity to reduce embodied carbon is material selection. We have made the biggest impacts through changing how we specify high EC intensity materials like concrete and steel. Several of our offices have implemented location-specific language requiring environmental product declarations (EPDs) and/or global warming potential (GWP) reductions on certain projects. We are working to increase the projects where these specifications are incorporated.

Determining typical EC intensities of both specific materials and overall structural systems are already underway in many of our offices. Offices are gathering location-specific information, which we are populating into a firm-wide database of life cycle assessment and embodied carbon information. This is done in conjunction with our database reporting for SE 2050. We also have a global KPFF group within the online EC3 software that allows us to share models amongst all KPFF engineers using EC3.

04

Education Plan

KPFF has created a Structural Sustainability group made up of sustainability champions identified from each office. Last year, the group met for the inaugural two-day KPFF Sustainability Summit, where we each share lessons learned and how our local markets are tackling sustainability in design. We concluded the summit with informational sessions on embodied carbon. Each sustainability champion then shares the knowledge they have gained with their local office. The KPFF Structural Sustainability group will hold these Sustainability Summits annually.

In addition to the internal Sustainability Summits, KPFF provides avenues to share lessons and expertise within the firm between our regular meetings. We have created a firm-wide portal for structural sustainability on our Microsoft Teams hub that is accessible by all KPFF employees as a means to broadcast sustainability messages. We have many employees who actively give and attend presentations by the Carbon Leadership Forum, ASCE, and local Structural Engineering Association chapters and material suppliers. The message board allows us to advertise these presentations firm-wide.
A resources section includes documents from SE 2050 as well as copies of internal presentations and resources. The Question and Message Board page allows structural engineers to share resources and get advice from engineers throughout the firm.

05

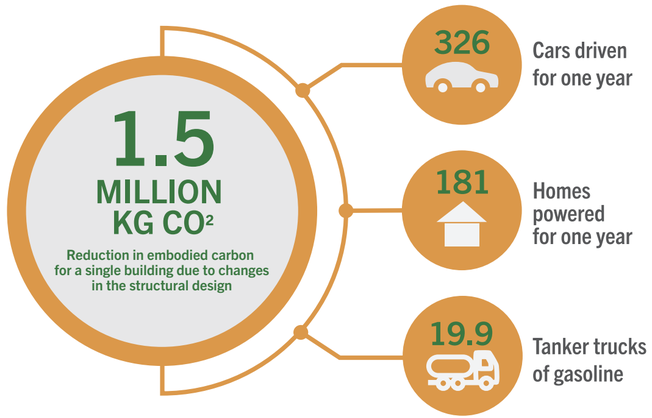
Knowledge Sharing

Our approach to advocacy for embodied carbon reduction over the last year focused on sharing our experiences, advocating on our local projects, and advocating in the wider industry.

As we have been developing our knowledge base for embodied carbon in structures, we have found ways to share the lessons in local and national organizations. As noted in the elective section, we participate in and present on embodied carbon topics related to structures in these organizations. We will continue to work on engaging and contributing in the coming year.

For our local projects, we proactively discuss pathways to embodied carbon reduction with architects, owners, jurisdictions, and contractors. One of the biggest roadblocks to embodied carbon reduction is reticence to change construction methods. By sharing evidence of projects successfully implementing low-carbon strategies and selectively test-running new materials or systems, we continue to move the needle forward.

As structural engineers, we have many opportunities to engage with contractors and suppliers on a wide range of materials for structural systems. We will continue to develop a better understanding of how the manufacturing processes for these materials contribute to EC while finding opportunities to advocate for new and effective solutions.



06

Reporting Plan

KPFF's approach to measuring, tracking, and reporting embodied carbon is very much on a project-by-project basis. As the approach and resources highly depend on project goals and location, we utilize a host of different strategies and best match them to each specific project.

When calculating the embodied carbon of structural materials, we try to utilize the most realistic EC intensities for materials used on our projects, both for baseline and proposed models. For example, many of the markets that we work in do have extensive EPDs available for local concrete; however, some do not. We have found that the availability of EPDs for many structural materials is increasing for both local and regional materials. As EPDs continue to be uploaded to the Building Transparency tool, we will be able to filter industry and product EPDs there as well.

The software we use for life cycle assessments and for evaluating EC impacts on projects depends on the project's specific sustainability goals and certifications. Embodied carbon tracking software programs that have been commonly used on our projects include Tally, Athena, and EC3. Use of the beta TallyCAT tool is also being explored to better integrate Autodesk applications and EC3 on our projects.

The life stages included in the life cycle assessments we have done in the past depend on the purpose for performing the LCA. Where a choice between products for specific materials is being considered, we will sometimes look only at the cradle to gate embodied carbon using EPDs. However, when looking at overall structural systems, we include more stages. Both LEED and ILFI certifications have different requirements for the life stages to include, so those requirements often control what is included. When producing reports outlining our findings, we always include a summary of what life stages are included.

When embodied carbon is being studied early on in a project, the material quantities may only be estimated from previous similar projects. For projects that are further along in design, many of our current structural projects are modeled in Revit, and we have found that this is one of the most accurate ways to extract material quantities. Timing of extraction of material quantities will vary depending of project goals.

Clifford Allenby Building

Sacramento, CA

07

Electives

The following are the SE 2050 Electives we are committing to achieving during the next year.

Reduction (1 required, 4 recommended)

- ✓ Participate in a LEED, ILFI Zero Carbon, or similar design charrette and speak to potential design considerations impacting embodied carbon (REQUIRED)
- ✓ Update your specifications and incorporate embodied carbon performance. Inlcude embodied carbon in your submittal review requirements
- ✓ Collaborate with your concrete supplier to reduce embodied carbon in a mix design
- ✓ Work with a contractor during material procurement to meet an embodied carbon performance criteria on at least (1) project
- ✓ Have an Environmental Product Declaration (EPD) created on a project
- ✓ Incorporate biogenic materials on at least one project annually

Education (2 required, 4 recommended)

- ✓ Distribute ECAP within your firm upon publishing (REQUIRED)
- ✓ Make (1) webinar focused on embodied carbon available to employees (REQUIRED)
- ✓ Have one representative of your firm (any employee) attend quarterly external education programs (e.g., webinar, workshop) provided by SE 2050, Carbon Leadership Forum (CLF), or other embodied carbon resources
- ✓ Share the SE 2050 library of resources with technical staff
- ✓ Minimum (1) employee attends a presentation or demo of an LCA-base tool used to calculate embodied carbon, such as Tally, Athena IEB, or One Click LCA

Advocacy (2 required, 4 recommended)

- ✓ Describe the value of SE 2050 to clients. How can your design teams collaborate to reduce embodied carbon? Please attach any associated marketing materials (REQUIRED)

Many of our clients have focused their sustainability efforts on reducing operation carbon. By identifying structural engineering partners that are knowledgeable in embodied carbon, the SE 2050 program provides a framework for our clients to start discussing EC.

Embodied carbon reduction strategies are not one-size-fits-all. KPFF tailors the reduction strategies we use on each specific project according to its needs. Whatever strategies we use, design teams work with owners to determine the sustainability critical success factors at project start, working as a cohesive team to achieve stated goals. These goals are tracked and evaluated regularly throughout the design process to ensure all targets are being met.

- ✓ Declare your firm as a member of the SE 2050 commitment with boilerplate proposal language (REQUIRED)
- ✓ Share your commitment to SE 2050 on your company website

When we first joined the SE 2050 commitment, a blog post describing the program and our work in adopting the commitment was posted on our website here: https://www.kpff.com/blog/news/post/kpff-is-a-signatory-of-se-2050. As we further develop and grow with the commitment, we will continue to post progress updates on our website.

- ✓ Give an external presentation on embodied carbon that demonstrates a project success or lessons learned

The following presentations were given during the last year, we will continue to look for opportunities during the next year to present our lessons learned on embodied carbon.

Net Zero C CLF Hub: *Shana Kelley has given talks on applying embodied carbon requirements in specifications and strategies of reducing embodied carbon in steel design.*

Net Zero Conference: *In August 2021 Shana Kelley joined Miller Hull in a presentation titled Drawdown Decade: Climate Action Commitments in the Building Industry, where Shana talked about KPFF's journey to becoming SE 2050 commitment adopters.*

- ✓ Share education opportunities with clients
- ✓ Start an embodied carbon community of practice or mentorship program in your office

KPFF holds an annual Sustainability Summit where the sustainability champion from each office shares how each of our local markets are tackling sustainability in design. Each sustainability champion then reports back lessons learned from the summit to their specific office.

Some of our offices have internal "Green Teams" that engage in embodied carbon education and work on office-specific sustainability goals. For example, the San Francisco KPFF Green Team meets bi-weekly to engage younger staff and introduce them to sustainability in design.

Electives

Reporting (1 required, 2 recommended)

- ✓ Submit a minimum of (2) projects per U.S. office with structural engineering services to the SE 2050 Database. You are not required to submit more than (5) total projects across your firm (REQUIRED)
- ✓ Report a greater percentage of projects than you did the previous year

  In April we submitted project LCA data to the SE 2050 database from multiple KPFF offices. We plan to continue to gather data from across our offices and increase the number of projects included every year.
- ✓ For a project submitted to the database, ask the Architect or Owner if the project has a carbon budget or if there are established project-sustainability goals at the project kickoff meeting

  Many of our projects have eco-charrette meetings at the beginning of design to address sustainability issues. Embodied carbon and LCA often come up as topics during these meetings. Many of the projects we plan to submit to the SE 2050 Database next year will have embodied carbon reduction goals that were discussed at early meetings.
- ✓ Propose other actions that promote the reporting of embodied carbon data and describe their value

  Internal training for embodied carbon measurement: We have given presentations to several KPFF offices regarding the measurement of embodied carbon of both specific materials and of a whole building. Following our goal from last year, this year we have made new resources and webinars available to all interested employees firm-wide through our KPFF MS Teams Structural Sustainability page. We will continue to provide resources and presentations for the measurement of embodied carbon so more reporting takes place.

Project Highlight >>

LEED PLATINUM

Chatham University, Eden Hall Campus

Richland, PA

The 388-acre Eden Hall Campus is home to the new Falk School of Sustainability and the Environment, the first ground-up campus in the nation to integrate sustainable development, learning, and living. Supporting the sustainability goals of the project, many innovative solutions were developed, including:

- Concrete mix designs with 50% cement replacement
- E-use and conversion of the existing dairy barn structure into a cafe and library
- The use of locally sourced building products
- Integrated radiant tubing into the structural slabs

08

Lessons Learned

STAY FLEXIBLE

With the rapid expansion of embodied carbon knowledge and practice across our offices, we have plenty of lessons learned during 2021. Below are a few examples:

Keeping it Local

Embodied carbon reduction strategies need to vary depending on the location of the project. The knowledge base and information available regarding the embodied carbon of structural materials widely varies across the nation. This applies to information about local building materials (EPDs) as well as contractor knowledge. Each project's embodied carbon goals need to recognize this variability and be customized for the project location.

For example, many of our offices require reporting and reductions for embodied carbon in concrete submittals. Where EPDs are readily available, the specifications can be written to require a calculation of the reduction from a regional baseline. Where EPDs are not readily available, limitations on high embodied carbon constituents can be specified instead.

Being Flexible

We have learned to stay flexible when selecting embodied carbon reduction strategies. On multiple projects, specified materials became unavailable due to supply issues (for example, Type IL cement was unavailable from one of the main concrete suppliers in the Seattle area for a number of months due to shipping issues and a fly ash shortage in the San Francisco Bay Area). In these cases, we have to adjust and evaluate the impacts of the changes. In many cases we've been able to find alternate EC reduction pathways, such as the use of lower-carbon reinforcing steel or the use of alternative supplementary cementitious materials, to still maintain the reduction goals of the project.

Database Reporting

This year we coordinated the database input between offices, formatting the data from each office in a format that would be easy to input data into the SE 2050 database. Some projects completed in the past year were not included in our database submittal because we did not have all the information for all the required fields. Now that we understand the SE 2050 database format, we can better plan for data gathering, although we remain concerned that the required fields may continue to change over time.

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Spokane
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