

Embodied Carbon Action Plan



STRUCTURAL
ENGINEERING
INSTITUTE



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EMBODIED CARBON ACTION PLAN



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Left: Repurposing and vertically expanding the structure at 633 Folsom significantly reduced the embodied carbon that would be required with a new building.

Our Commitment

EMBODIED CARBON ACTION PLAN

Tipping Structural Engineers joined the SE 2050 movement in 2021 with our formal commitment to a path of substantive reductions of embodied carbon in structural systems.

The SE 2050 Program aligns with Tipping's sustainable design goals and our ongoing efforts to reduce the short- and long-term impact of building construction on the environment. Tipping is part of the growing cadre of firms who are working to combat climate change through education, embodied carbon reduction, and advocacy.

Tipping consistently considers sustainable design solutions when approaching various problems. We take a holistic view at the early stages of structural design and we effectively collaborate with other disciplines to reduce the environmental impact of our projects. We strive to reduce the carbon impact of our structures by:

- ✓ designing efficient structural systems with minimal structural material quantities;
- ✓ designing cost-effective structural systems appropriate for minimizing life-cycle costs;
- ✓ detailing for longevity and adaptability;
- ✓ utilizing locally sourced materials whenever possible;
- ✓ proactively coordinating with the architect and mechanical engineer on key sustainability considerations
- ✓ protecting the building by designing for enhanced seismic performance;
- ✓ specifying low-cement concrete and high-recycled-content steel that can meaningfully reduce the greenhouse gas impacts of construction;
- ✓ avoiding construction waste and reducing costs; and
- ✓ providing expertise in the design of lightweight and longspan structures.



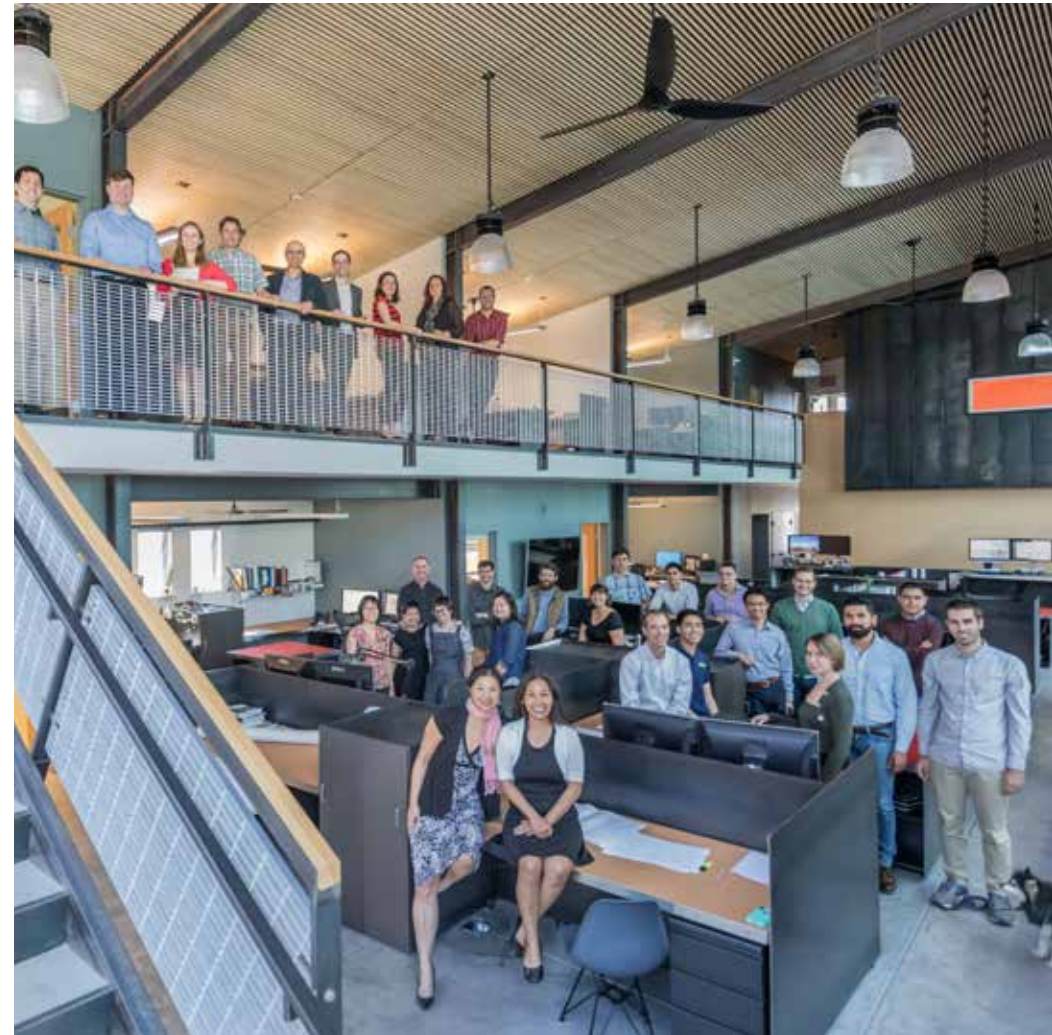
Our Commitment

EMBODIED CARBON ACTION PLAN

Tipping has made concerted efforts to research and analyze alternative, resource-efficient materials. These have included:

- ✓ low-cement concrete;
- ✓ mass timber;
- ✓ resource-efficient wood framing;
- ✓ optimized reinforcement grades whenever possible (using higher strength reinforcement);
- ✓ unconventional and naturally sourced materials:
 - ✓ straw bale;
 - ✓ rammed earth;
 - ✓ bamboo; and
- ✓ lightweight tensile membranes (architectural fabrics & films)

Tipping will continue making progress on projects with measured reductions, advocacy, sharing of our knowledge and sharing data to accelerate widespread adoption of reduced embodied carbon design strategies for the broader industry.



Our Commitment

EMBODIED CARBON ACTION PLAN

Tipping joined the SE 2050 movement to be a part of the community of designers actively reducing carbon in our built environment. Our ECAP is refining Tipping's approach to reducing embodied carbon by providing actionable goals to inform decisions being made by our internal teams, and to support conversations with our collaborators and our clients.

Our firm had ambitious goals in our first year of participation in SE 2050 some of which were realized and some of which are ongoing. We have learned a lot from being a part of SE 2050 including the sharing of best practices to reduce embodied carbon, investigating carbon accounting tools, developing our own tools for carbon accounting, promoting our commitment to SE 2050 and continuing to collaborate for more efficient project designs that reduce embodied carbon. For our renewed commitment in 2023, we continue to develop in-house resources and tools for carbon reduction.

We have internal presentations to share notable prior Tipping projects so new staff members can gain institutional and technical knowledge about important design approaches. One of the projects presented this year was the Omega Center for Sustainable Living that was Tipping's first Living Building project (completed in 2009) and included the structural design requirements of low carbon concrete, biological wastewater treatment, PV supports, and design for minimal thermal bridging in a cold climate.

In 2023, we are planning to initiate more carbon accounting across project teams using tools we have internally developed to establish firm-specific averages of embodied carbon for various project types. We will provide more embodied carbon reduction education, carbon accounting instructions and custom tools and templates to help more staff participate in carbon accounting. We will compare our averages to industry benchmarks. With our averages established, we will then set measurable targets for embodied carbon reduction on all of our future projects and monitor our progress in reaching our reduction targets.



Above: Completed in 2009, the Omega Center for Sustainable Living LEED Platinum and certified Living Building

Education

EMBODIED CARBON ACTION PLAN

Tipping has a long standing tradition as an organization that is committed to continual learning and nurturing the educational development of our staff. We view our commitment to the SE 2050 movement as an inspiring opportunity to expand the knowledge base of our employees and clients into an area of our practice that is essential for combating climate change.

SE 2050 TIPPING TEAM CARBON

The educational members of Tipping's SE 2050 internal task group have made several advancements in sharing sustainability knowledge with the broader firm. We have accomplished this by creating a SE 2050 Slack channel, with Slack being our office's primary form of internal communication, which currently hosts the following resources:

- ✓ links to the SE 2050 website, published papers, articles, and internal and external presentations;
- ✓ tips for adopting sustainability language into project specifications;
- ✓ carbon accounting tools and methods for tracking embodied carbon on projects; and
- ✓ research into material and technology advancements regarding sustainable design.

This channel will continue to be a resource for members of our office as more information becomes available. It is intended to be an on-going, direct source for communication as sustainability related questions arise in the office.

TIPPING TEAM CARBON

SE 2050 LEADERSHIP



CARBON TRACKING & REPORTING



EDUCATION INITIATIVES



SE2050 Leadership:
Bruce Danziger, SE;
Ian Kelso, SE; Gina Carlson, SE

Carbon Tracking and Reporting:
Itria Licitra, CE; Jenna Williams, CE; Isaac Williams, CE

Education Initiatives:
Ashley Waite, CE; Joy Wei, SE

Education

EMBODIED CARBON ACTION PLAN

In 2023, the primary goal is to expand our sharing of carbon reduction strategy content to the office to ensure that sustainability is at the forefront of design. A newsletter will be issued quarterly to the firm that will include, but is not limited to, the following:

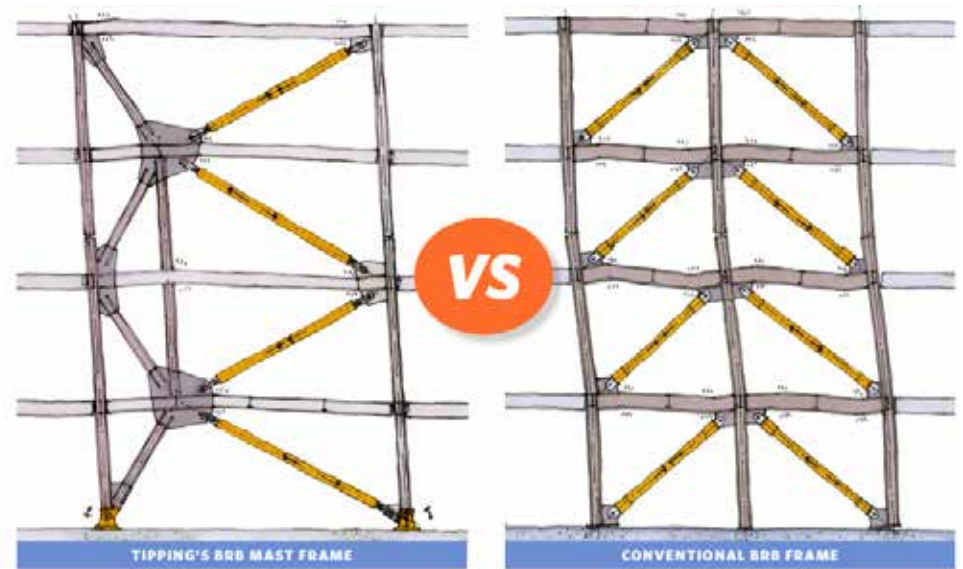
- ✓ upcoming Carbon Leadership Forum (CLF) events;
- ✓ links to relevant sustainable design articles and/or videos;
- ✓ updates on Tipping's carbon accounting measures; and
- ✓ quick facts related to various sustainable resources.

In addition to the quarterly newsletter, the internal task group will host two presentations each year that focus on educating the office about sustainable practices and/or carbon reduction.

EDUCATION INITIATIVES

Beyond the Team Carbon internal task group, Tipping is actively encouraging employees to seek further education about embodied carbon reduction practices. We provide opportunities for staff to attend external webinars and conferences that focus on sustainability and embodied carbon reduction through the use of Tipping's yearly employee professional development allowance.

Tipping will not only educate our employees; we will create robust external practices focused around educating our clients about our SE 2050 initiatives and goals. Early in the project phases, we engage in open discussions regarding embodied carbon reduction methods and how we might incorporate these practices into our clients' buildings.



Above: With two recent projects, we found that the BRBM frame was able to cut the number of required frames almost in half and the number of required BRBs by approximately 70%. For example, in one project the 7 conventional BRB frames were reduced down to 4 BRBM frames and the number of required BRBs were reduced from 56 to 16.

Education

EMBODIED CARBON ACTION PLAN

TIPPING'S WEBSITE

Tipping is delighted to be involved in the SE 2050 movement. We have highlighted our participation on our company website to spread awareness of this initiative to the general public. Our dedicated sustainability page features:

- ✓ a summary of our commitment to SE 2050;
- ✓ actionable tasks that have been completed as part of our involvement in SE 2050; and
- ✓ a link to our Embodied Carbon Action Plan (ECAP) that is to be updated annually.

As we continue to expand on our educational initiatives, the website will be updated to externally share our progress.

COMPLETED EDUCATION ELECTIVES

Tipping is actively pursuing the completion of several electives. Below is a summary of a few of the many completed electives in 2022:

- ✓ distribute ECAP within our firm;
- ✓ webinar focused on embodied carbon made available to employees;
- ✓ shared the SE 2050 library or resources with technical staff;
- ✓ nominated an employee to participate in a CLF Community Hub;
- ✓ provided narrative outlining plans for at least (2) firm-wide presentations per year on the topic of embodied carbon; and
- ✓ initiated an embodied carbon interest group within our firm that meets regularly and helps guide our process of embodied carbon reduction.

We will continue to play an active role in spreading awareness of SE 2050 to the broader office and we will promote embodied carbon education in 2023.



Left: Rammed-earth columns are used to meet the design goals of the architect and the client.

Carbon Tracking and Reporting

EMBODIED CARBON ACTION PLAN

Tipping has an established practice model to produce efficient, innovative designs and smart solutions that reduce both cost and embodied energy. We are continuously evaluating carbon accounting methodologies and tools that integrate carbon reduction opportunities into our existing practice methods. We believe that rapid and accurate material quantity and carbon estimates during the initial phases of design provide one of the most effective opportunities for carbon reduction.

EARLY DESIGN STAGE TRACKING

We have combined our current quantity estimating methods with rapid carbon accounting tools and a pre-vetted “carbon library” of our most commonly used structural materials to facilitate rapid approximations of embodied carbon during early design. Our goal for 2023 is to apply this rapid carbon estimating process to many of our new projects in order to begin calibrating our own internal “carbon baselines” and to more effectively identify carbon reduction strategies.

Early Design Stage Action Items:

- ✓ ongoing training of junior staff in accurate early phase quantity estimating;
- ✓ annual review of our in-house “carbon library” of common structural materials to update EPD data and improve initial phase (A1-A3) carbon data;
- ✓ integration of carbon estimating functionality into current weigh-up design templates; and
- ✓ issue carbon estimating templates to all design teams to facilitate early accounting of more projects to ultimately create internal “carbon baselines”.

LATER DESIGN STAGE TRACKING AND VALIDATION

While a nimble carbon estimating process during early design maximizes opportunities for impactful reductions, a more detailed process must also be deployed later in the design to confirm initial estimates and validate the efficacy of reduction strategies and design decisions. To this end, Tipping is continuing to develop our capacity to pair BIM modeling developed LCA software. This is currently being done most often using Revit and Tally, but our processes continue to evolve.

Later Design Stage Action Items:

- ✓ expand training of staff in the use of Tally to support structural LCA using Revit model inputs;
- ✓ evaluate and update default modeling standards to better integrate with efficient and accurate LCA processes;
- ✓ complete detailed LCAs based on final construction documents for at least three projects for which early phase carbon estimating was performed in order to assess and validate preliminary methods; and
- ✓ upload complete carbon accounting for at least six projects to the SE 2050 database.

Carbon Tracking and Reporting

EMBODIED CARBON ACTION PLAN

COMPLETED TRACKING AND REPORTING ELECTIVES

Tipping is actively pursuing the completion of several electives. Below is a summary of completed electives in 2022:

- ✓ we created a carbon reporting plan defining how we measure, track, and report carbon data;
- ✓ we created an in-house “carbon library” of most commonly used materials and their carbon content, linked to EPD data;
- ✓ we created in-house tools for rapid accounting of early stage carbon using both Excel and in-house custom calculation software; and
- ✓ we submitted 2 projects to the SE 2050 database, one based on rapid early phase accounting and one based on a full LCA.

Right: Green concrete specified on the SFPUC Headquarters decreased the project's carbon footprint by 7.4 million pounds of CO₂ emissions.



Embodied Carbon Reduction

EMBODIED CARBON ACTION PLAN

Embodied carbon reduction of structural materials is the ultimate goal of the SE 2050 program. We use external resources, such as SE2050 and CLF, as well as our own internal carbon tracking data to identify and set strategies. We demonstrate leadership by applying and further developing best practices through design and collaboration with the design community.

EMBODIED CARBON REDUCTION STRATEGIES INITIATIVES

Our goals for the second year continue to be focused on education, gathering more embodied carbon project data, further developing carbon reduction tactics on our projects and establishing carbon reduction targets across our portfolio of projects. We will continue to learn from and share with the SE 2050 community to advance best practices for carbon reduction.

Strategic Action Items:

- ✓ establish a “carbon baseline” for our various project types in order to set an ambitious EC reduction goal for the following year (year three);
- ✓ continue to promote the use of mass timber (MT), and supplementary cementitious materials (SCM) on our projects;
- ✓ further develop and disseminate best practices for embodied carbon accounting and reduction for lightweight tensile membrane structures;
- ✓ incorporate additional language in our specifications targeting carbon reduction; and
- ✓ communicate the embodied carbon impacts of different design options to clients with creative data visualization.

The David Brower Center's high sustainable goals achieved LEED Platinum and was recognized as an AIA/COTE Top 10 Green Projects.

COMPLETED EMBODIED CARBON REDUCTION STRATEGIES ELECTIVES

Tipping strives to reduce the carbon footprint of our projects aligning with the goals of the reduction strategy electives. Below are some of the carbon reduction electives we addressed in 2022:

- ✓ specifying green concrete mixes that include supplementary cementitious materials and using higher strength reinforcement to reduce the embodied carbon of reinforced concrete;
- ✓ using mass timber on projects; and
- ✓ initiating projects with embodied carbon reduction studies to evaluate options and sharing the schemes and outcomes with the design team.



Advocacy

EMBODIED CARBON ACTION PLAN

We are promoting our commitment to SE 2050 and our efforts to reduce embodied carbon. We share our experience and knowledge within our firm, within the design community, and beyond. Positive change will come with industry-wide adoption, recognizing that our collective impact reaches beyond any individual firm.

ADVOCACY INITIATIVES

In 2023, our advocacy goals continue to focus on sharing carbon reduction strategies with the industry and promoting our efforts to reduce embodied carbon.

Advocacy action items:

- ✓ give external presentations on embodied carbon reduction;
- ✓ encourage industry and policy change by promoting and using low-carbon and carbon sequestering materials;
- ✓ continue to support our Tipping Team Carbon office leadership efforts for embodied carbon reduction and sustainability mentorship in our office;
- ✓ plan for more effective early conversations with owners, architects, and contractors to advocate for more sustainable design;
- ✓ teach innovative and sustainable design to the next generation of design professionals at institutions of higher education and industry events;
- ✓ present best practices for embodied carbon accounting and reduction for lightweight tensile membrane structures to international professional organizations including Tensinet and IASS; and
- ✓ forge new relationships and strengthen existing relationships with like-minded design professionals, builders, and clients.



Above: Principal Leo Panian presented the benefits of green concrete to a multi-disciplinary audience at the 2020 Design Colloquium.

Advocacy

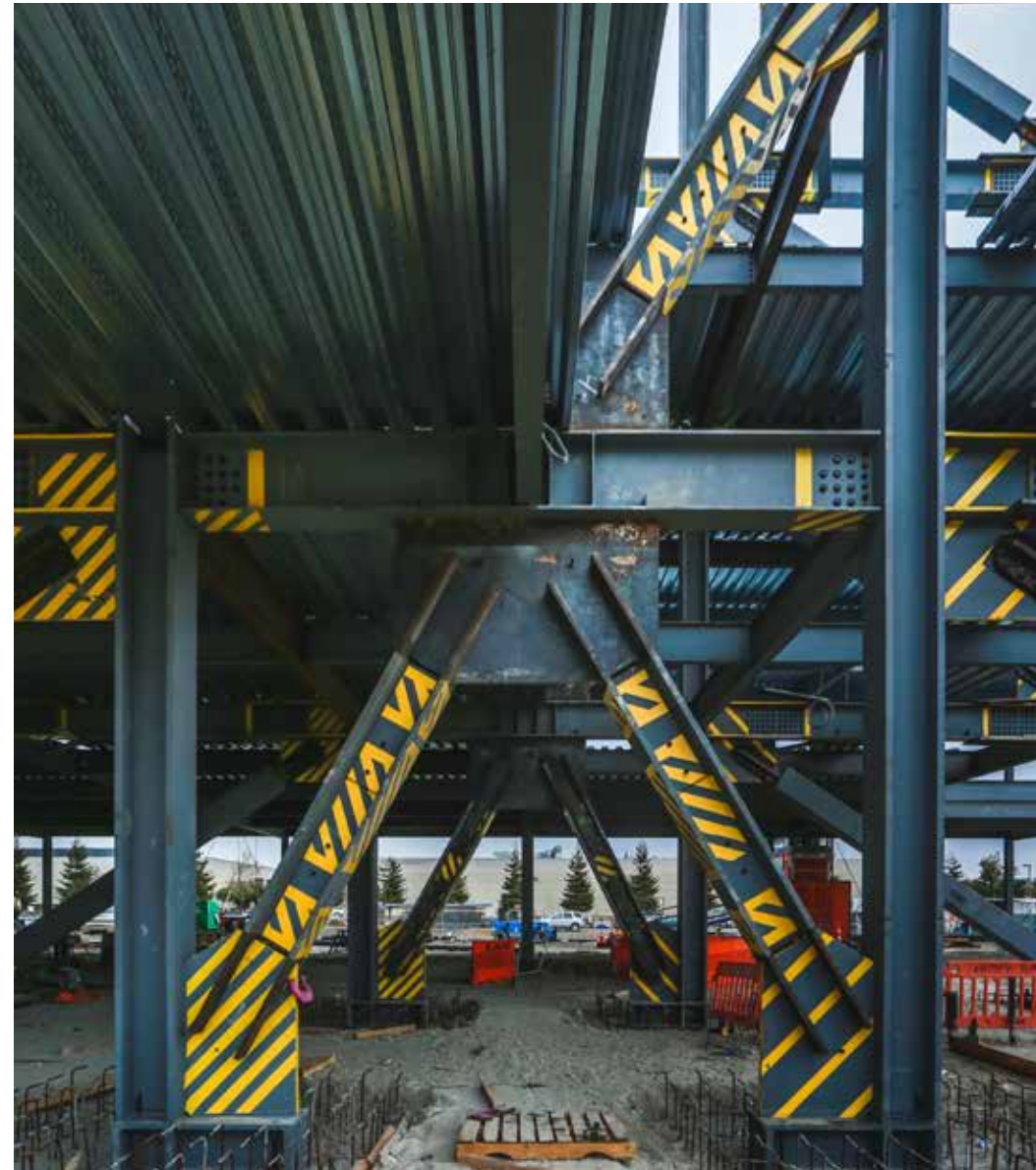
EMBODIED CARBON ACTION PLAN

COMPLETED EMBODIED CARBON REDUCTION STRATEGIES ELECTIVES

Tipping advocates for reducing the carbon footprint of our projects. Below are some of the completed advocacy electives from 2022:

- ✓ shared our commitment to SE 2050 on our company website;
- ✓ included proposal language that declares our firm as a member of the SE 2050 commitment;
- ✓ delivered presentations for architects including strategies for implementing mass timber design that focus on efficiency and constructability;
- ✓ taught innovative and sustainable design to the next generation of design professionals at institutions of higher education and industry events;
- ✓ collaborated with an international team of experts to develop and disseminate best practices for embodied carbon accounting and reduction for lightweight tensile membrane structures;
- ✓ promoted SE 2050 in our external-facing communications; and
- ✓ developed our embodied carbon community of practice and mentorship in our office.

Right: At 1951 Harbor Bay Parkway, BRB mast frames use significantly less material than a conventional structural steel system, while also providing enhanced redundancy, improved damage protection, and increased reliability.





TIPPING

STRUCTURAL ENGINEERS

FOUNDED IN 1983 BY STEVEN B. TIPPING

STAFF OF 39

56 EXCELLENCE IN ENGINEERING AWARDS

1 LIVING BUILDINGS

23 LEED PLATINUM, 15 LEED GOLD BUILDINGS

8 NET-ZERO-ENERGY BUILDINGS

9 AIA COTE TOP TEN GREEN PROJECTS