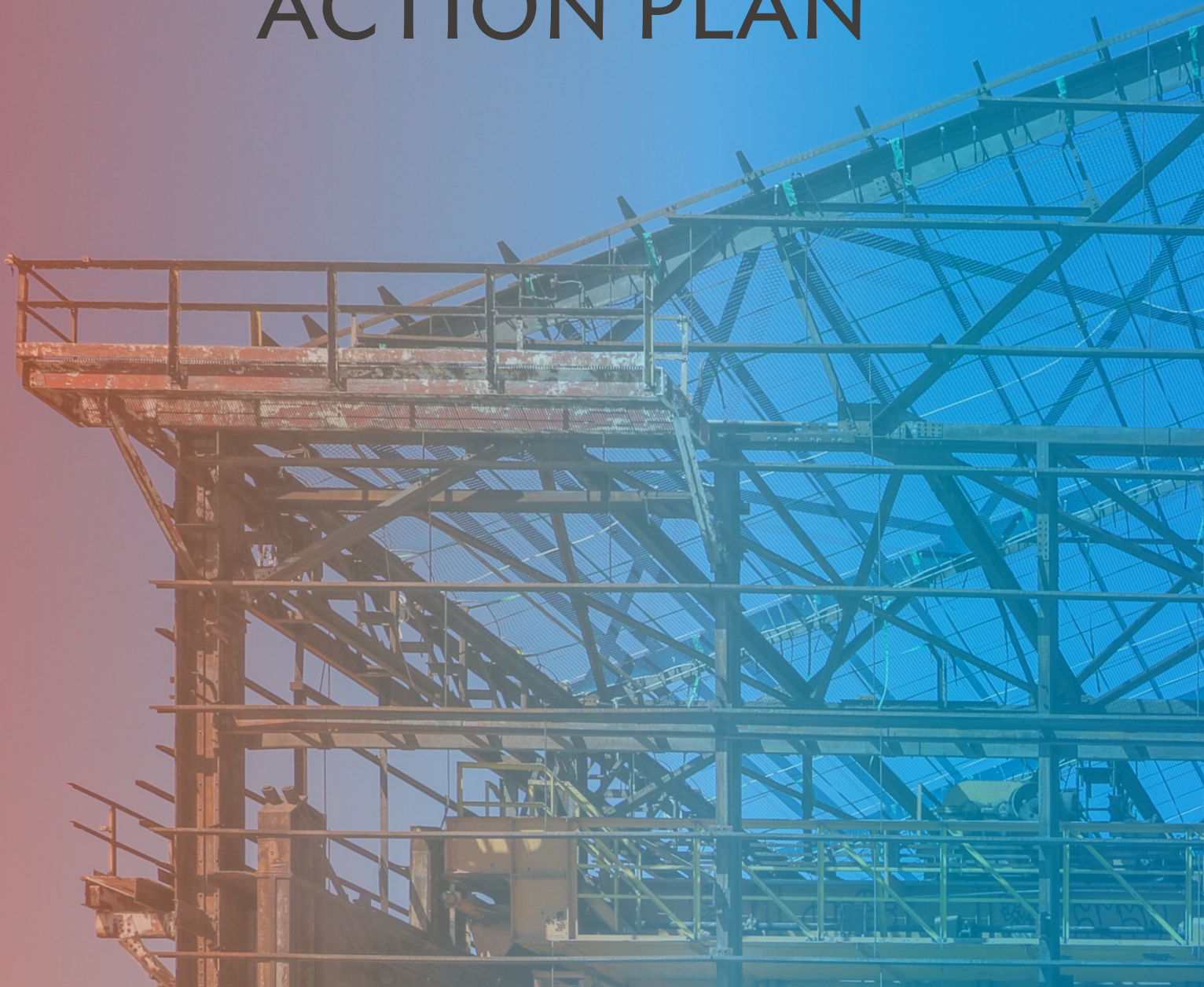


# BALA

SE 2050

## EMBODIED CARBON ACTION PLAN





# CONTENTS

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Bala Consulting Engineers is pleased to submit the following Embodied Carbon Action Plan outlining our commitment towards reducing the embodied carbon of our structural designs to net zero by 2050.

- |   |              |   |                 |
|---|--------------|---|-----------------|
| 1 | Introduction | 4 | Reduction       |
| 2 | Education    | 5 | Reporting       |
| 3 | Advocacy     | 6 | Lessons Learned |



# INTRODUCTION

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Structural engineering is the backbone of every building and on the front lines of design and construction in every project. With concrete and steel, comprising a significant portion of a building's total emissions, Structural Engineering plays a paramount role in addressing embodied carbon within the built environment. Bala is dedicated to transforming structural design and advancing towards a more sustainable future. Substantive embodied carbon reductions in the design and construction of structural systems will require a collaborative effort amongst engineers, manufacturers, contractors, and designers; and we are excited to be a part of advancing this multi-industry effort.

## About Bala

Bala Consulting Engineers is a multi-discipline engineering and design organization comprising over 200 engineers, designers, and support personnel. Bala unifies structural engineering with our other engineering disciplines, enabling us to provide a wide range of services spanning all project phases and various industries including: corporate office buildings, healthcare facilities, municipal buildings, residential structures, religious institutions, parking structures, educational facilities, warehouse facilities, pharmaceutical manufacturing and laboratories.

***We believe sustainable design is essential design. As engineers we take our role seriously in influencing a more sustainable standard of structural design for the built environment.***

## Our Embodied Carbon Champions



**DYLAN J. LEE**  
**STRUCTURAL PROJECT ENGINEER**

As a key member of our structural engineering team, Dylan enthusiastically leads our internal research, documentation and advocacy on reducing embodied carbon in structural designs. He has developed our internal Embodied Carbon Calculator tool which will be used alongside EC3 to track and report embodied carbon in our designs.



**ELIZABETH K. LARSEN, M.S.**  
**SR. SUSTAINABILITY ENGINEER**

Elizabeth shapes Bala's services in the sustainability consultancy market and supports projects across our portfolio by providing design best practices and research. She will drive the implementation of embodied carbon education and advocacy as well as overseeing reduction strategies and reporting for SE 2050.



**DAN GOFF, PE**  
**STRUCTURES PROJECT MANAGER**

Dan is a sustainable design committee member for the Structural Engineers Association Metropolitan-Washington Chapter. As a project manager, Dan strives to incorporate sustainable practices into each design.



**STEVEN M. ANASTASIO, PE, SE, LEED AP**  
**DIRECTOR OF STRUCTURES**

As our Director and Growth Leader, Steven is committed to growing relationships and strengthening our operations as we strive to eliminate embodied carbon in our projects. He will drive client advocacy, education, and our project implementation to accelerate reduction of embodied carbon.



# EDUCATION

## Education Plan

At Bala, we believe that education and knowledge sharing is a lifelong pursuit. This comes in various forms – ranging from formal mentorship programs and enterprise-wide Knowledge Center presentations to team bonding and internal Lunch & Learns.

**We are promoting firm-wide education and understanding on embodied carbon through the following actions:**

GOAL	PROGRESS	DESCRIPTION
In August 2021, we hosted an enterprise-wide Knowledge Center presentation on the SE 2050 Commitment and announced our involvement internally. From there, our goal is to expand our knowledge of sustainable practices and implement tools that help new hires and interns in our mission.	Ongoing	The structures group does lunch and learns, both internally and externally that involve sustainable design. This includes attending meetings from various groups (DVASE, CLF Leadership Forum, SEAMW, and more) as well as implementing studies for best practices. Some studies include: the carbon offset from using normal weight concrete and lightweight concrete based on the footprint and height of the building and Mass Timber optimization tool using Dynamo.
Upon completion of this ECAP, we will publish our plan on our internal Share-Point page for all staff to reference.	Complete	Every year when the ECAP is published, we share the document on our internal Sustainability SharePoint site in addition to our external website.
Get awarded a Life Cycle Analysis project where the focus is on sustainable design	Ongoing	We are currently working on confidential projects that involves full building Life Cycle Analyses that span across the continental United States.
Currently, our Embodied Carbon Champions attend Carbon Leadership Forum education sessions. We will broaden this to all Structural Engineers in our firm.	Ongoing	Will implement a minimum of one sustainability-focused seminar every quarter as well as spreading this information to the rest of the group the following week during a lunch and learn. We also attended Towards Zero Carbon SEI conference in Boston to discuss the best practices for carbon accounting as well as share insight across the industry. This is an on-going task that we will continue to build upon.
We currently participate in the Carbon Leadership Forum Philadelphia hub and plan to expand that participation to DC as well.	Complete	Expanded to the DC market via SEAMW and their Sustainable Design Committee. As we continue to expand across the East Coast and fill more offices, we will pursue sustainable design committees local to the region.
We will develop internal tools and studies for best sustainable practices. This includes a tool for conceptual design as well as an in-house LCA tool that allows us to backcheck online LCA software such as One-Click	Ongoing	Over the past year we have been using One-Click LCA tool for our carbon accounting. To back check the imports via Revit, we developed an internal spreadsheet that allows for manual material takeoffs and GWP values based on the 2023 CLF Baseline document. In addition to this, interns that are interested in sustainable practice have an allowance for research topics that will help identify best sustainable practices; whether that is a design tool (like the Mass Timber Optimization tool) or a one-pager on sustainable topics (Normal weight versus lightweight concrete overall impacts).

### New Goals

1. Continue to add to our DC office to officially make it a “structural office”. This will give more flexibility in projects we decide to do LCA analyses as well as increase our requirements for the SE2050 database from 2 projects to 4 next year.
2. Implement performance based specifications that specify low carbon concrete and a GWP percentage reduction based on the 2023 CLF Baseline values for concrete and steel construction.
3. Secure a mass timber project that includes a life cycle assessment (LCA) of the structure.



# ADVOCACY

A critical component to the success of the SE 2050 commitment is buy-in from clients and other design professionals. As part of our advocacy efforts, we plan to start every project off with a discussion about embodied carbon, educate clients on the importance of and strategies to achieve sustainable design, participate in local structural engineering working groups, and promote this work via email, social media, and through proposals.

**Our initiatives regarding external knowledge sharing and advocacy are below:**

GOAL	PROGRESS	DESCRIPTION
Since committing to the SE 2050 Challenge, we have joined a local Structural Engineering consortium dedicated to discussing embodied carbon.	Complete	We actively participate in various Structural Engineering organizations. We previously had the opportunity to participate in these groups on embodied carbon. We hope to continue to have these opportunities in 2025. Outside of structural specific groups, we also participate in the Carbon Leadership Forum's Philly Hub, local USGBC chapters, DVASE, and SEAMW in DC.
On all projects moving forward, we plan to start conversations about embodied carbon early and bring it up often. We shall talk to architects, owners, general contractors, manufacturers, and other stakeholders about our commitment to this challenge.	Ongoing	Embodied Carbon in proposal but have not received any traction in implementing this in our design projects up to date. However, we have been awarded a LCA project for a confidential client that we are currently working on.
We added language to our Structural proposals to highlight our commitment to the SE 2050 Challenge	Complete	We include, in every proposal, language about our commitment to the SE 2050 Challenge and our focus on embodied carbon in our project portfolio. Next step is to be awarded an LCA project that coincides with our design schedule.
All Structural Engineers' email signatures will include our commitment to SE 2050.	Complete	We have added an image in our email signatures to state we are involved in the SE 2050 Commitment.
We plan to host a client roundtable in 2024 focused on embodied carbon and other key issues facing the Structural Engineering and built environment industry.	Complete	We had a client roundtable for implementation of Mass Timber in warehouse design with Norwood Construction and Wolff Architects. We also gave presentations about Mass Timber design to various architectural firms in the DC area. We also have on-going "Carbon and Coffee" conversations with clients.
Our commitment to the SE 2050 Challenge is already highlighted on our Sustainability and Structures webpages.	Complete	Every year we update our internal SharePoint as well as external web-pages to show we are committed to the SE2050 challenge.
Annually, we will report our progress toward our SE 2050 goals on LinkedIn and other social media platforms.	Ongoing	We will post the results of the embodied carbon footprint in April after the completion of the embodied carbon analysis. These results will be posted on our company's Linked-In Page.
In addition to publishing annual progress, we will highlight projects that focus on embodied carbon on LinkedIn and other social media platforms.	Ongoing	We highlighted our involvement in the confidential LCA project as well as provided a structure brochure for our SE2050 commitment.

## New Goals

1. Continue doing our Carbon and Coffee talks with clients and expand this into the Philadelphia region. This is a good way to casually bring up the conversation and talk next steps for how we can implement strategies discussed into projects.
2. Highlight sustainable research topics on our external website that we will be conducting in summer 2025

# REPORTING

Bala plans to implement accurate 3D modeling strategies that will allow ease of model transfer into an LCA tool such as One-Click. In addition to the accurate modeling, BALA will request contractors to receive material takeoffs (ideally) and products EPDs (realistically) for all structural materials used on a project. For all projects in the CA phase, submittals will be the main component for retrieving the material quantities of structural materials. For all projects that are still in the design phases, BALA will rely on accurate modeling and One-Click EPD database to complete the LCA of a building. This would be for phases A1-A5 regardless of the phase of design the building is in. An internal spreadsheet was also developed to be more confident with our LCA that was conducted via One-Click.

GOAL	PROGRESS	DESCRIPTION
We will utilize EPDs and the EC3 tool to estimate the embodied carbon emissions of each project. Our scope will include stages A1-A5, unless otherwise requested by a client.	Ongoing	Continue to push for design projects to have a sustainable portion to them such as a LCA. For the confidential project, we established a baseline via the 2023 CLF baseline and compared that to the 100% CD design using reductions specified on the specifications.
We will contact and suggest that concrete suppliers to provide product-specific data, rather than relying on region-specific data when possible.	Ongoing	Directly talk to and coordinate with manufactures on mix designs as well as requesting EPDs.
At project kickoff meetings, we will start the conversation on embodied carbon and optimization, inform client manufacturers about providing EPDs, and ask the architect and/or owner if a carbon budget has been set up for the project.	Ongoing	Developed Dynamo script to assist with this conversation on Mass Timber design in the conceptual phase. This allows for the conversation to be had and gives a visual to what it would take to make the structure work as well as give the architect a rendering of what we are anticipating Mass Timber is selected.
At a minimum, we will report 4 projects for the SE 2050 Database (2 per office) from our 2023 portfolio.	Ongoing	Bala conducted 2 LCA projects this year to the SE2050 database. These do not include the confidential project we are currently working on. Next year we will do a minimum of 4 projects into the SE2050 database as we are expanding structure professionals into the DC office.

## New Goals

1. Submit a minimum of (4) projects to the SE 2050 Database for global warming potential intensity.
2. Promote the reporting of embodied carbon data on projects and describe their value using internal tools developed to make it easier for clients to understand the intent of the design.



In line with our reduction strategies, we have also developed a project implementation guide that identifies specific points of advocacy, measurement, tracking and reporting of embodied carbon through the project process, across all stages from pre-design to project completion. *Our project implementation guide is illustrated on the following page.*



# Project Implementation

## Engineering Design Process

### Pre-Design & Project Kickoff

- Discuss embodied carbon with the project owner and design team upfront. Highlight the need for a goal and collaborative design thinking.
- Benchmark and set a goal for total Global Warming Potential (GWP) using OneClick Carbon Designer 3D based on project location, size, building classification, and industry standards.

### Schematic Design

- Analyze structural system options with high-level tools such as OneClick Carbon Designer 3D, an internal LCA spreadsheet or our in-house Dynamo script.
- Spark optimization conversations with the project owner about best possible construction methods, materials, component weights, and material costs.
- Discuss the scope of embodied carbon reduction with the client. We will recommend AI-A3 at a minimum. (MEP team working adjacently on Modules A&B)

### Design Development

- Complete an embodied carbon model by the end of DDs with either the EC3 Tool, OneClick LCA, or internal LCA spreadsheet.
- Draft specifications to ensure low-GWP materials are used and EPDs are requested.
- Owners can opt out of the environmental specifications if they want, however, they must opt out, rather than just allowing them to opt in.
- Utilize the EC3 Tool to gather industry EPDs to inform material and manufacturer decisions in the final version of the specifications.

### Construction Documents

- Complete and share at the end of CDs a final designed embodied carbon model using the EC3 Tool, OneClick LCA, or an internal LCA spreadsheet.
- Include language in our specifications to ensure local, low-GWP materials are used and EPDs and material takeoffs are requested.
- Material quantities will come from Revit. We will also supply any additional time allowance in order to factor in miscellaneous metals and connections into our calculations.

### Contract Administration

- As part of the submittal process, we will review and approve the provided EPDs and material takeoffs for our final embodied carbon model.
- Update models with appropriate takeoffs and EPDs as supplied by manufacturers and/or GC. When completed, share with the project owner, the final results of the embodied carbon modeling and reduction strategies.

### Deconstruction & End of Life

- Continue to promote our Deconstructability AIA presentation and blog for wider spread education on the topic.
- Consider analyzing Modules C/D especially for Adaptive Reuse projects.

# REDUCTION

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As Structural Engineers, we have a unique opportunity to make a direct and lasting impact on the future of our planet. It is estimated that embodied carbon will be responsible for almost half of new construction emissions between now and 2050. Through implementing strategies focused on reducing these emissions, we can help to significantly mitigate the climate crisis. **Our reduction strategies are as follows:**

## Short Term Goals (<1 year)

- >> Transition to performance-based specifications that will reference 2023 CLF baseline values.
- >> Update our specifications to request material takeoffs and EPD's in the submittal review process.
- >> Implement low carbon specifications on a minimum of (2) structural projects.
- >> Establish a baseline for our own internal reference based on all projects submitted to SE2050.

## Long Term Goals (>5 years)

- >> Implement and prove a 15% reduction in our structural design based on optimization and specifications.
- >> Have an EPD created for a project.
- >> Incorporate sustainably harvested biogenic materials in at least one project.
- >> Be awarded a Mass Timber project that includes a full building Life Cycle Analysis.



# REDUCTION

GOAL	PROGRESS	DESCRIPTION
Identify areas of the design where we are comfortable optimizing to 100% that will not impact the structural integrity of the building.	Complete	Low impact designs include: slab on grade, concrete perimeter frost walls, non-load bearing foundations, use of fiber reinforced concrete, and floor fire rating assemblies.
Once our baseline is set, we will work to identify a reduction target for future years.	Ongoing	With 7+ projects uploaded to the SE2050 database as well as the confidential projects we are working on, we now have enough data to create an internal baseline. This is a 2025 goal.
A key goal is to educate owners using case studies and by providing low-carbon alternatives.	Ongoing	Interns that are interested in sustainable design will work with structural engineers to identify key areas of research similar to what we did in the past with normal versus lightweight concrete.
Going forward, all concrete specifications will request Environmental Product Declarations (EPDs) as a submittal for review.	Ongoing	This will be implemented into our specifications along with performance based specifications to reduce from the 2023 CLF baseline values.
We plan to conduct outreach regarding local concrete suppliers and collaborate on a low-carbon mix design.	Complete	We have met with various concrete suppliers via different sustainable organizations (DVASE, CLF Leadership Forum, etc.) to get their input on this topic. This is achieved through coordination and specifications.
We will pull together carbon reduction case studies regarding our previously completed adaptive reuse projects.	Ongoing	This will go along with our internal baseline. With the help of sustainably motivated interns, we will review past projects to see areas where we could have optimized the design for a reduction in carbon across the project. As a learning tool, they will do their own LCA with the help of One-Click and/or our internal spreadsheet to see the possible reduction with performance based specifications and optimizing low-impact structural members.
<b>New Goals</b> <ol style="list-style-type: none"> <li>1. Identify an internal baseline for our projects using previously submitted data to SE2050. This will be broken up into different building sectors (i.e. residential, commercial, healthcare, warehouses, etc.). From there, we can start to show the reduction in carbon across our projects for all different building sectors.</li> <li>2. Update to performance-based specifications that reference the 2023 CLF baseline values and specify a percentage reduction from these baseline values. We will use region specific values that correlate to where the project is being constructed.</li> </ol>		



# LESSONS LEARNED

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Through our research, case studies, attendance at conferences, and project work, we've learned a lot. Some of our key takeaways are as follows:

- Optimal ratio of volume-to-square footage of mass timber elements for the project to be economically feasible is 0.85. Anything over this value will not be economically feasible and therefore more than likely not be accepted as an alternative. This limits the design professionals to use a maximum of 5-ply CLT panels to make this work. Glue laminated beams and columns can be used as support for larger bay sizes.
- Optimization is another key to reducing the carbon impacts of a building. We need to assess the risks of each structural element and optimize the design to where it is structurally acceptable to do so. Slab on grade and perimeter frost walls are areas we have identified to help reduce the quantity of concrete on a project.
- Concrete remains the target, specifically the mix design. Through performance-based specifications and coordination with the manufacturers, a reduction of global warming potential is possible; however, as design professionals we must be flexible in how this low carbon concrete is achieved. Manufacturers will have to rely on locally sourced materials to do this work economically and sustainably.
- Other means of fire protection for the floor assembly must be observed rather than increasing the concrete thickness of the topping slab on the metal deck. All fire rating assemblies must be brought to the table to see which would make the least impact for both global warming potential as well as cost.





We are creating lasting change  
by joining together. We are  
committed to achieving net zero  
embodied carbon structures by  
2050.

A photograph of a modern building with a green and blue facade and large glass windows, situated on a grassy hill at dusk. The building has a complex, angular design with a mix of green and blue panels and large glass sections. A set of stairs leads up to the entrance. The sky is a mix of orange and blue, suggesting sunset or sunrise.

BALA