2025
Embodied Carbon Action Plan

UC Berkeley Beach Volleyball Facility
Berkeley, CA

Introduction

In 2019, representative from SEI, CLF, AIA, and the USGBC began to formulate a program to tackle embodied carbon.

In 2020, the SEI Board of Governors established SE 2050 as a formal SEI program aimed at inspiring structural engineers, architects, developers and building owners to eliminate embodied carbon from buildings.

The SE 2050 challenge targets the buildings structural systems which can represent more than half of the embodied carbon in a building project. Embodied carbon emissions represent emissions released in the extraction, production, transport and manufacturing of building materials over the course of a building's lifespan.

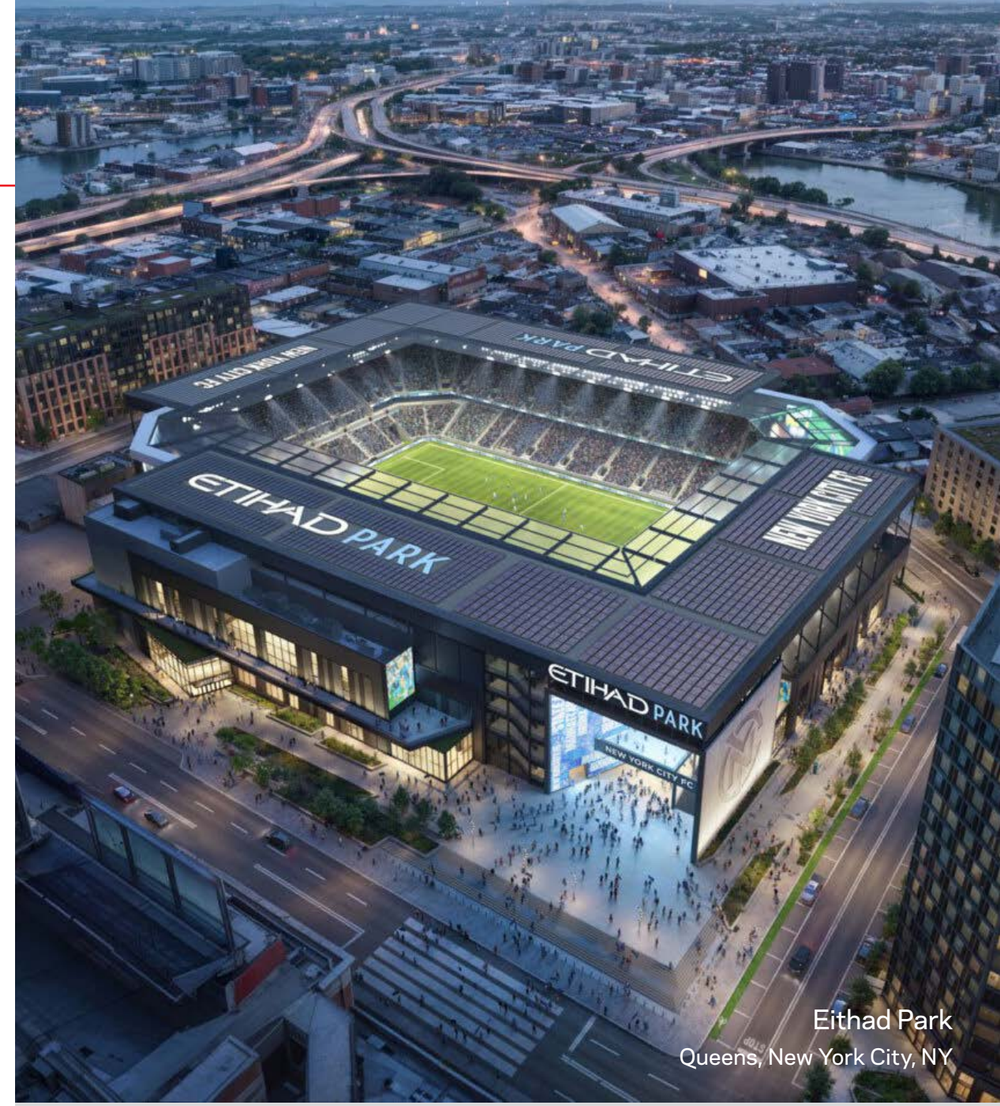
As a leader in sustainable design, it is in HOK's ethos to join the commitment and pledge to reduce embodied carbon in our building projects. HOK has been a signatory firm since SE 2050's inception and has been developing yearly Embodied Carbon Actions Plans to show progress, prepare for the following year and share the lessons learned along the way.

Executive Summary

HOK has been a signatory firm of SE 2050 since 2020 and has successfully fulfilled the yearly requirements of the commitment. Pursuant to the firm's commitment to reduce embodied carbon, HOK's Executive Board enacted the HOK Whole Building Life Cycle Assessment (WBLCA) Policy mandating performance of an LCA for all new-build projects. The LCA data informs how HOK-designed buildings are performing and guides the selection of optimal structural systems and project specifications that drive the market to reduce embodied carbon in our design.

The ultimate goal of the commitment is to reach net zero embodied carbon by 2050. Currently, there are no industry-accepted benchmark values of carbon intensities that reductions can be measured against. Thus, HOK has made a concerted effort to conduct LCAs on several projects in order to develop a firmwide benchmark. Beginning in 2024, HOK has set a target of 7% annual reduction in carbon intensity, working towards 50% reduction by 2030 and 100% reduction by 2050.

For 2025, one of HOK's major goals is to educate staff on the approachable and realistic reduction strategies that can be implemented on projects. Specifically, how the material specifications and design optimization can drive reductions. We will continue to advocate for early engagement of structural engineers, which enables us to participate in the earliest, most impactful design decisions. The early engagement offers engineers an opportunity to advocate for lower-carbon design choices in material selection and layout.



Eithad Park
Queens, New York City, NY

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Education

For structural engineers to prioritize reduction of embodied carbon, we will need to adjust our typical practice. This shift in priorities will require a continuing education program to ensure that HOK continues to move in the right direction. HOK's internal education program highlights the urgency of embodied carbon emission reductions and provides guidance on how to achieve them on projects.

Reducing embodied carbon in building structures is a multidisciplinary problem that is best solved through collaboration with all members of the project team.

HOK's education program also targets the architectural and other engineering discipline groups within the firm.

Education Pillar Requirements

- The HOK structural group will continue to give firmwide presentations including at least two encompassing an introduction to embodied carbon, HOK's progress on SE 2050's commitment, structural engineering strategies to reduce carbon intensities, and general industry-wide updates.

  Thus far, these presentations have been given to separate HOK groups across all offices and time zones. These groups include HOK's core board, market-specific interdisciplinary groups, disciplines (such as structural engineering), project architect and project manager groups, and 10 individual regional offices.

- We gave 7 training and presentations in 2024, which met our goal of at least 5 that was set in 2023. For 2025, we plan on giving at least 7 training/presentations.

- New employees will be referred to the to Boston Society for Architecture's Embodied Carbon 101 video series. https://www.architects.org/embodied-carbon-101-video-archive

LESSONS LEARNED

Education is ever-evolving. Over the past two years, HOK has given several internal presentations to educate staff, both new and old, on the benefits of quantifying embodied carbon on all projects to assist in meeting the Intergovernmental Panel on Climate Change (IPCC) recommended emissions envelope. We continue to educate project managers and project architects regarding the Executive Committee's directive of a firmwide LCA Policy requiring an LCA on all whole new building projects.

We face the hurdle of individuals supporting sustainability if it demands no sacrifice (whether of design feature, typical construction method, etc.), and having them understand that radical change in results can only be accomplished with radical change in design.

We continue to educate ourselves about new material technologies that reduce embodied carbon. As the market continues to develop new technologies, we at HOK keep our staff updated on new technologies via our internal HUB Knowledge groups. We use the HUB as a place to track new technologies as they move from early stages of development to market-ready products, maintaining an evolving repository of technologies for implementation.

NASCC: The Steel Conference 2024

During the March 2024 conference, HOK led two sessions specifically on steel and sustainability, targeted for the architects and engineers in the audience. The presentation topics were:

- "Innovative Design: A toolkit for reducing embodied carbon in steel structures" : Learn about useful rules of thumb which help set up your projects for a successful reduction in embodied carbon emissions. Explore readily available tools that can be used in real scenarios to help you keep track of the project embodied carbon during all design phases. (Amir Aghajani)

- "Optimizing Steel Design: An Integrated Approach for Lowering Embodied Carbon" : During the early stages of design, parametric modeling and optimization processes become extremely helpful tools to quickly analyze structural solutions that are optimized based on project specific needs. This presentation will showcase how embodied carbon reduction can become part of the optimization process for steel structures. Project case studies will include vibration sensitive floor design and long span structures. (Francesca Meola, Claire Moore)

Recommended Electives

Train all of your firm's structural engineers on the core concepts and skills required to measure, reduce, and report embodied carbon

HOK has given at least 2 trainings teaching structural engineers how to conduct LCAs and understand the results. We have developed an internal "How-To Guide" document as well as video recording as a reference for anyone in the company. These provides background information on the purpose of LCAs. The "How-To Guide" is ever evolving and is slated to be updated as needed, and at a minimum, yearly.

Engage with a CLF Regional Hub

- Currently, there are HOK staff from the New York, Houston, and San Francisco offices who participate in the CLF Community and are members of regional hubs.
- Jaclyn Lee is actively engaged/aware of external education programs provided by the SE community through NCSEA, SEAOC, SE 2050, CLF and others.
- Minimum 1 employee attends a presentation or demo of an LCA-based tool used to calculate embodied carbon such as Tally, Athena IEB or One-Click LCA.
- OneClick LCA is the primary tool that HOK uses to calculate embodied carbon. We attended a demonstration on their Net Zero Tool and Carbon Strategy Tool. Included in HOK's license are two tailored onboarding sessions that we will take advantage of biannually.

Reporting

HOK has established a firmwide policy to perform a structural LCA on all new construction building projects that are over 5,000 square feet. All LCAs are performed using OneClick, and the results are uploaded to a firmwide project database.

Material quantities are extracted from project Revit models through a hybrid method that uses the OneClick Revit plug-in and Revit schedules. When choosing baseline materials, Environmental Product Declarations (EPDs) that reflect regional industry-wide data are preferred. If regional data is not available, EPDs that represent national industry-wide data are used.

Reporting Pillar Requirements

Since 2021, HOK has submitted 41 projects to SE 2050. These projects are spread across 13 different states and represent nine different Primary Building Use Types. HOK will submit at least 5 projects to the SE 2050 database annually.

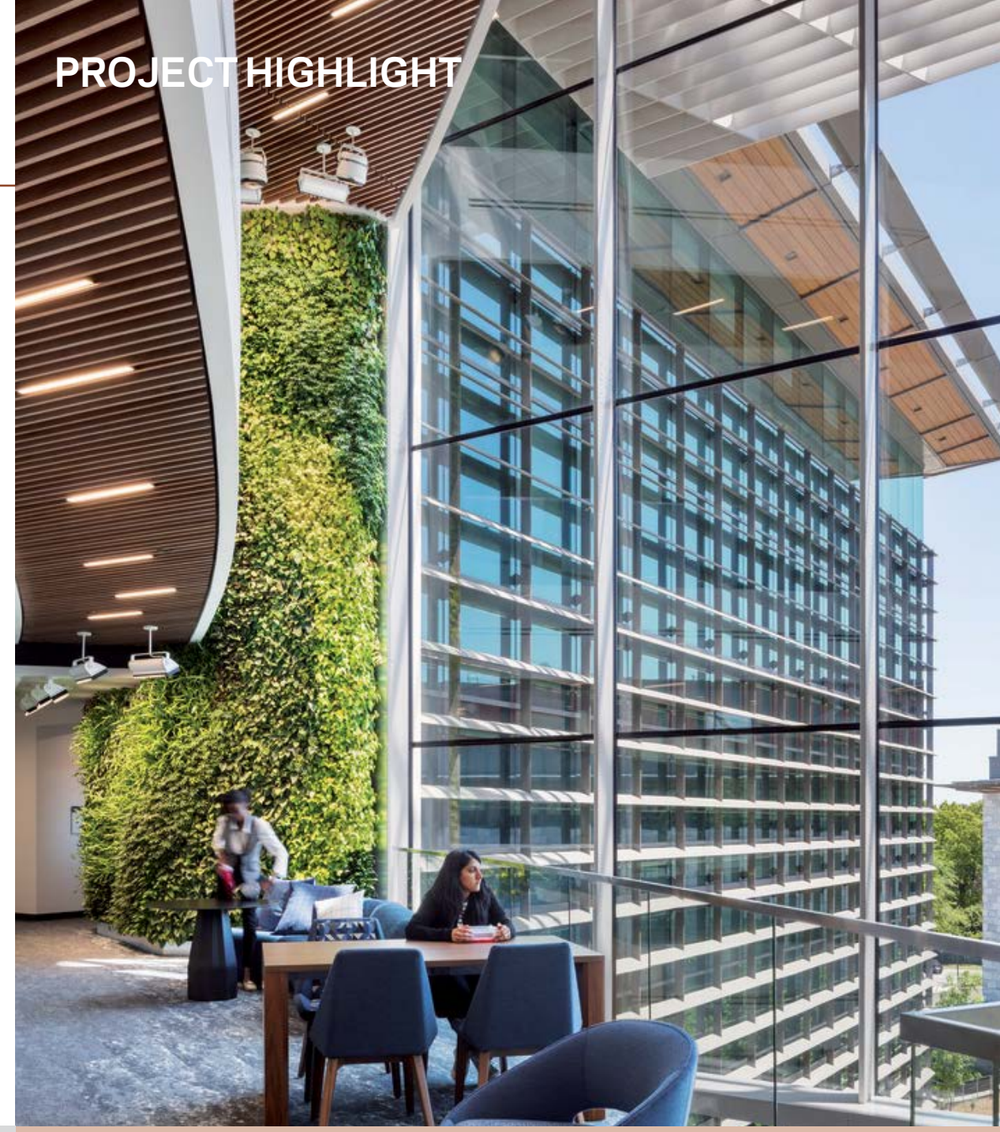
HOK has been compiling data from all firmwide projects for which an LCA was conducted. The project information and emissions data has been used to create a dashboard presenting information, including visuals, in an easily accessible format for designers to view. The dashboard has been made available firmwide through HOK HUB, the intranet platform for firmwide communication and knowledge sharing. As the background data for the dashboard grows, it will help identify and communicate any significant trends and variables influencing project emissions. The goal is to set benchmarks and also help project managers understand and apply the information to set reduction targets on future projects from those benchmark values.

LESSONS LEARNED

Since joining the SE 2050 challenge and enacting HOK's LCA Policy, we have nearly 80 projects with GWP intensity data. We continue to educate project managers about the policy and importance of conducting an LCA on all eligible projects. As a next step, we are now working towards conducting multiple LCAs at different design phases on projects to implement and track reduction targets.

At HOK we log project information into an internal databases which is separate from how we log projects into SE 2050's database. We are still working on a method to merge the information so that project teams do not have to input it in multiple locations. In addition, since HOK is a multidisciplinary firm and has signed up for multiple industry environmental challenges/commitments, we are trying to streamline our reporting efforts; similar to CLF's ECHO project.

PROJECT HIGHLIGHT



Emory University HSRBII

LEED Gold Awarded

Atlanta, GA

This 350,000 sq-ft. 8-story preeminent biomedical research building on Emory University's campus was, despite waiting until the project was in construction to enact low carbon measures, still able to make embodied carbon reductions through the concrete mixes. Ideally, a baseline LCA is conducted early in the design phase to make the most impact without compromising intended design or schedule. However, for this project, the design team worked closely with the contractor and client to run comparative LCA's for 8 different concrete mixes of varying fly-ash replacement during construction. The final mix designs were a combination of what worked for the construction schedule and met the design team's ultimate sustainability goals.

Recommended Electives

For multi-office firms, describe how each office is measuring and reporting embodied carbon. For single-office firms, describe how different project teams or managers are measuring and reporting embodied carbon.

HOK implements a firmwide policy to perform, at minimum, a single iteration structural system LCA on new construction building projects over 5,000 square feet. Resulting data informs design teams of their projects' embodied carbon across a portfolio of various project types and aids in developing appropriate project-specific reduction targets.

As a firm, we are working to achieve consistency with material mapping of industry-wide EPDs so that we can accurately compare results to appropriately set embodied carbon intensity benchmarks.

Compare the embodied carbon emissions from multiple projects across your firm. Analyze and document what data or pieces of information are most important and communicate the findings to your firm.

HOK has compiled data for all firmwide projects for which an LCA was conducted. The project and emissions data have been used to create a dashboard presenting information, including visuals, in an easily accessible format for designers to view trends and make appropriate design decisions to reduce embodied carbon.

Although we have nearly 80 projects in our database, the data is still insufficient for statistical analysis of design decision impacts. However, we have been able to use the data to set a firmwide embodied carbon intensity benchmark from which we can make reductions.

SE 2050 has a recognition program aimed to recognizing exemplary firms that have gone above and beyond in terms of developing and implementing strategies to limit their carbon emissions. This program's four categories are; Best in Education, Best in Reporting, Best in Reduction and Best in Advocacy.

Signatory firms can nominate other firms or self-nominate, and then the winner is determined by public voting.

For 2024, HOK won Best in Reporting. HOK was the only firm publicly nominated by another firm, who was impressed by HOK's commitment to doing a LCA on all major projects. For 2025, HOK will continue to report LCAs on all projects and submit data to not only SE 2050, but also other industry-recognized databases for benchmarking.

We developed a dashboard that provides basic visual aids to indicate where projects are located, what emissions are for certain market sectors, etc. We are continuing to gather more data to parse more granular conclusions and make sophisticated visual aids.

Reduction Strategies

Identifying strategies that can effectively and efficiently reduce the embodied carbon content of building structures is critical in our efforts to mitigate climate change. Many of these strategies can (and should) be implemented today, while others can be considered more towards the future.

HOK is exploring all avenues to reduce embodied carbon on projects. We have incorporated embodied carbon criteria into our engineering decision making and low embodied carbon material specifications into all our projects. We are also actively engaging with clients and architects early on in projects to highlight our reduction strategy and how we plan to hit a reduction target.

Reduction Strategies Pillar Requirements

Having found an internal embodied carbon benchmark of 295 kg CO2e/m2, HOK is now measuring all future reductions from this embodied carbon benchmark. Our goal is to reach a 50% reduction by 2030 by means of a 7% annual reduction starting in 2024.

Targeted reduction percentage is currently based on the project's expected construction start date.

Our strategy to achieve this is to split embodied carbon reductions into two categories and focus on each separately: material specification reductions and design reductions. The first involves specification of lower embodied carbon structural materials and the second involves engineering design decisions that reduce embodied carbon.

In the coming year, HOK will focus on finalizing our low embodied material specifications for masonry and timber, improve the process of cataloging and tracking design decisions, and form material working groups to evaluate emerging technologies.

LESSONS LEARNED

One issue HOK identified last year was that low embodied structural steel specifications are more complicated due to some intricacies of the steel supply chain. That has been a focus for our efforts this past year. We've since internally rolled out a more robust and reliable "good, better, best" framework for structural steel products and have put it into use on two projects so far.

Another goal from the past year was to develop HOK's design expertise around Mass Timber structures. We've currently completed design and are moving into construction for HOK's first two Mass Timber structures. Within the structural team, we've used those projects to develop in house modeling procedures for two-way CLT panels and design protocols for point-supported CLT panels. On the Architectural side, we identified that one of the main pain points for designers has been that they have a difficult time visualizing what using "mass timber" means for their building design. We started to build out an internal parametric design tool for our Designers to use in the Concept Design to get reliable structural sizing for one-way mass timber systems. That work will be completed and beta tested this coming year.

PROJECT HIGHLIGHT

Silicon Valley Corporate Headquarters

Sunnyvale, CA

HOK piloted our revised framework for low embodied carbon material specifications on a large project in Silicon Valley. Due to the high water table, the basement required a mat slab ranging from 4'-0" to 5'-0" thick which accounted for a large portion of the structure's total embodied carbon. As a part of HOK's strategy to achieve a 25% reduction across the entire building, we specified mix designs with a 25% reduction from a 2018 SEAONC concrete design mix survey.

Without additional prompting, the concrete supplier for the project—Central Concrete—provided multiple foundation mixes with a global warming potential below 170 kg CO2/m3. These provided concrete mix designs had 70% cement replacement and a GWP intensity less than half of the specified value. As a result, the project achieved a 38% reduction in total building embodied carbon.

Whole-building Life Cycle Assessment, ISO 14040 & ISO 14044 (TRACI 2.1.) Download Results Summary

	Result category	Global warming kg CO2e	Ozone Depletion kg CFC11e	Acidification kg SO2e	Eutrophication kg Ne	Formation of tropospheric ozone kg O3e	Depletion of nonrenewable energy MJ	Biogenic carbon storage kg CO2e bio
A1-A3	Construction Materials	29,204,263.16 | -43 %	0.78 | -72 %	136,239.73 | -31 %	41,174.79 | -73 %	2,449,549.98 | -15 %	149,979,062.61 | -26 %	
A4	Transport to the building site	2,896,028.53 | -7.8 %	0.66 | -8 %	5,010.82 | -11 %	2,014.24 | -8 %	71,724.33 | -15 %	44,646,800.76 | -8.9 %	
B3	Repair							
B4-B5	Material replacement and refurbishment	950,966.33 | 0 %	0.01 | 0 %	4,373.73 | 0 %	325.99 | 0 %	107,157.33 | 0 %	13,789,541.84 | 0 %	
C1-C4	End of life	1,293,786.04 | +380 %	0.3 | +340 %	4,983.89 | +260 %	1,252.3 | +560 %	122,099.27 | +600 %	20,180,955.9 | +130 %	
	Total	**34,345,044.05**	**1.75**	**150,608.18**	**44,767.31**	**2,750,530.91**	**227,596,371.12**	**0**
	Comparing total results with: 4 - Designchanges_Baseline_CD_CLF							
	4 - Designchanges_Baseline_CD_CLF Total	55,297,420.89	3.58	210,135.77	156,999.21	3,140,209.76	272,659,330.02	0
	3 - AsDesigned_CD compared with 4 - Designchanges_Baseline_CD_CLF	-38 %	-51 %	-28 %	-71 %	-12 %	-16 %	0 %
	Results per denominator							
	Gross Internal Floor Area (ASHRAE) 911270.0 sq ft	37.69	0	0.17	0.05	3.02	249.87	0

Please note. The following LCA or EPD standards are all fully compliant with the requirements of ISO 14044: ISO 14025, ISO 21930, EN15804. Assessment period fixed to 60 years.

Recommended Electives

Calculate your firm average benchmark for embodied carbon

HOK 's embodied carbon benchmark for structure only (sub and superstructure) is 295 kgCO2e/m2. This was determined from 50 projects of a varying of structural systems, project locations, and market sectors.

HOK is still tracking future updates to this benchmark and will work towards future revisions. The two priorities identified are:

1) Breaking out building use specific benchmarks: Similar to how AIA treats pEUI, we acknowledge that different building uses have inherently higher or lower embodied carbon intensities. We currently do not have statistically significant data for all building uses.

2) Incorporating exterior enclosure data: Reliable information on exterior enclosure embodied carbon accounting can be very time consuming and currently covered only via LEED requirements. We have not yet identified a process for incorporating embodied carbon reduction strategies into exterior façade systems. These are tasks our Façades Engineering group will be focusing on in the future

Collaborate with your concrete supplier to reduce embodied carbon in a mix design below an acceptable baseline (e.g. NRMCA regional baseline values). Discuss what you found and what it means in your market

For a project in New York, we are working the contractor and concrete supplier to get the project's mix designs to include a particular cement replacement. This cement replacement has been successfully used on other projects however, the contractor is not familiar with it. We are in the process of educating the project team with the product to be used in the mix. The product can replace up to 50% of cement in concrete.

Update your specifications to incorporate embodied carbon performance. Include embodied carbon in your submittal review requirements

HOK has incorporated embodied carbon limits into our template contract documents that are adjusted on a project by project basis. Note that this language is split across our specifications and general notes. Our experience is that incorporating embodied carbon language solely into project specifications makes them more likely to be overlooked. Thus we note the limits in our General Notes.

Under the submittal requirements subsection of our specifications, we list requirements for material tracking for and information needed to run WBLCA's like EPD requirements and a bill of materials. In the products subsection, we reference the maximum embodied carbon criteria on our general notes and provide alternate compliance paths. We also recognize that the reality of material procurement is different for each major structural material. HOK has developed guidelines and a strategy to specify low embodied carbon materials for cast-in-place concrete and structural steel. We are actively working on an hybrid approach towards reinforced masonry with a trial run this year. We are also in the process of developing specifications for the various mass timber products.

Propose other embodied carbon reduction strategies and describe their value.

A large part of HOK's efforts to successfully lower the embodied carbon of our buildings is through specifying low embodied carbon materials on our projects. To support that effort, it's important to have a reliable framework for all major structural materials.

Through previous lessons learned, a reliable structural steel framework has less room for customization and is tied to the supply chains in place for structural steel manufacturing. We have also learned that the supply chain is very different for various steel projects—beam vs. coil vs. bar—and they must be addressed separately. Most notably, we also do not agree with the Carbon Leadership Forum recommendations for baseline materials across the suite of structural steel products. See below for an excerpt of internal HOK baseline values and our simplified "Good, Better, Best" framework for a fabricated beam product:

Fabricated Hot Rolled Structural Steel

	GWP ($kgCO_2e/kg$)	Notes	Resources
HOK Internal Baseline	1.55	Intent is to more accurately reflect a baseline steel building at HOK. Acknowledges that not all of our buildings use fully domestically produced steel. Based on an assumed 30% import rate based on projects typical at HOK. Intent is to eventually have region-specific baselines if they significantly different.	https://worldsteel.org/wp-content/uploads/2021-LCA-Study-Report.pdf
Good	1.22	Intent is to specify domestically produced steel. Align with latest AISC Industry Wide EPD. Currently using 2021, AISC working on an updated EPD with reduced values. Will update as new EPD comes out. Project teams to review design for atypical sizes and adjust percent compliance in specification section under 051200 under Part 2 to account for tonnage of these sections.	https://carbonleadershipforum.org/clf-material-baselines-2023/
Better	1.15	Excludes Nucor Berkeley's mill. Nucor Berkeley is combined plate and beam mill and only rolls limited beam sizes. Nucor working on updated facility specific EPD's. Will update as new Nucor Facility Specific EPD's come out.	
Best	0.85	Excludes Steel Dynamics Columbia mill in additional to Nucor Berkeley.	

We've built our internal standards for various steel products, are refining and looking to regionalize in the coming year. Moving forward, with strategies in place for cast in place concrete and the various steel products, HOK will be pivoting our focus to Masonry specifications and how we can address each constituent part while maintaining flexibility when Masonry is used as part of the Architectural design.

Advocacy

Advocacy and thought leadership of embodied carbon reduction is an integral part of influencing change within the industry-at-large. It is important that we share our knowledge of the efforts, successes and lessons learned to clients, the design community and public.

HOK's strategy to advocacy and thought leadership has been to share our findings with local project teams and clients, agencies such as GSA, public forums through Carbon Leadership Forum and SE 2050, and provide public feedback to proposed policies, codes and green building rating systems.

Advocacy Pillar Requirements

- HOK has met the initial requirement of publicly announcing our commitment to SE2050 since we joined in 2020.
- HOK gave a presentation on embodied carbon at the 2024 NASCC Steel Conference and was invited back again to speak in 2025.

  We have submitted abstracts to speak at NCSEA Summit, California Green Building Conference, and as a panel member at the SEI Structures Congress and Greenbuild International Conference and Expo.
- HOK has worked with material production companies to better understand the supply chain and its affects on reducing embodied carbon emissions.

LESSONS LEARNED

HOK recognizes the importance of industry awareness in driving change. We have benefited from giving internal and external presentations as well as attending external presentations because we learn something new every time. Whether sharing a new product, lessons learned, or simply updates, we must continually advocate the importance of measuring and reducing embodied carbon in the building industry. Furthermore, we are committed to aggressive change, and understand that buildings that open in 2030 are often on the drawing board today, so we must target reductions well beyond our LEED credit thresholds and set precedents for the industry.

PROJECT HIGHLIGHT

Frank E. Moss Courthouse
Salt Lake City, UT

We often hear that renovating and using what is already built is the least carbon intensive way to build "new" buildings. However, it's not clear how much embodied carbon is actually being saved. The Moss Courthouse LCA analysis project estimated emissions reductions for a renovation/retrofit building compared to a new building of similar size and function. The results of the study were intended to assist General Services Administration (GSA) in setting performance targets on their future design and construction projects and assist in achieving climate action goals.

HOK analyzed the carbon emissions of the structure, enclosure and interiors of two different buildings; the renovation of the historic Frank E. Moss Courthouse and the baseline case, a hypothetical newly constructed building. For the Moss Renovation, only new elements associated with the renovation were included in the analysis; demolished and existing elements were not. Renovation of the existing historical structure resulted in 59% less embodied carbon than equivalent new construction.

This is equivalent to the carbon sequestered in one year's time by 7,830 acres of US Forest or the size of 5,921 football fields.

Baseline
New Replacement Building (NRB)

Frank E. Moss Courthouse
Seismic Upgrade &Renovation

Recommended Electives

Give an external presentation on embodied carbon that demonstrates a project success

- HOK has given presentations at the 2024 NASCC Steel conference and will be presenting in 2025 as well.
- We have been invited to be part of a panel in proposed presentations at SEI Structures Congress and Greenbuild International Conference & Expo, and have put in abstract proposals at the SEAOC Convention

Propose alternative methods for advocacy and describe their value

- HOK provided data to CLF for both their California-specific study and their benchmark v 2.0 study. The California-specific study has since been released to the public and the benchmark v 2.0 dataset is scheduled to be released in 2025. HOK continues to contribute data to industry organizations, like California Air Resource Board (CARB), to help make sense of buildings' emissions and benchmark data.

AIA 2030™

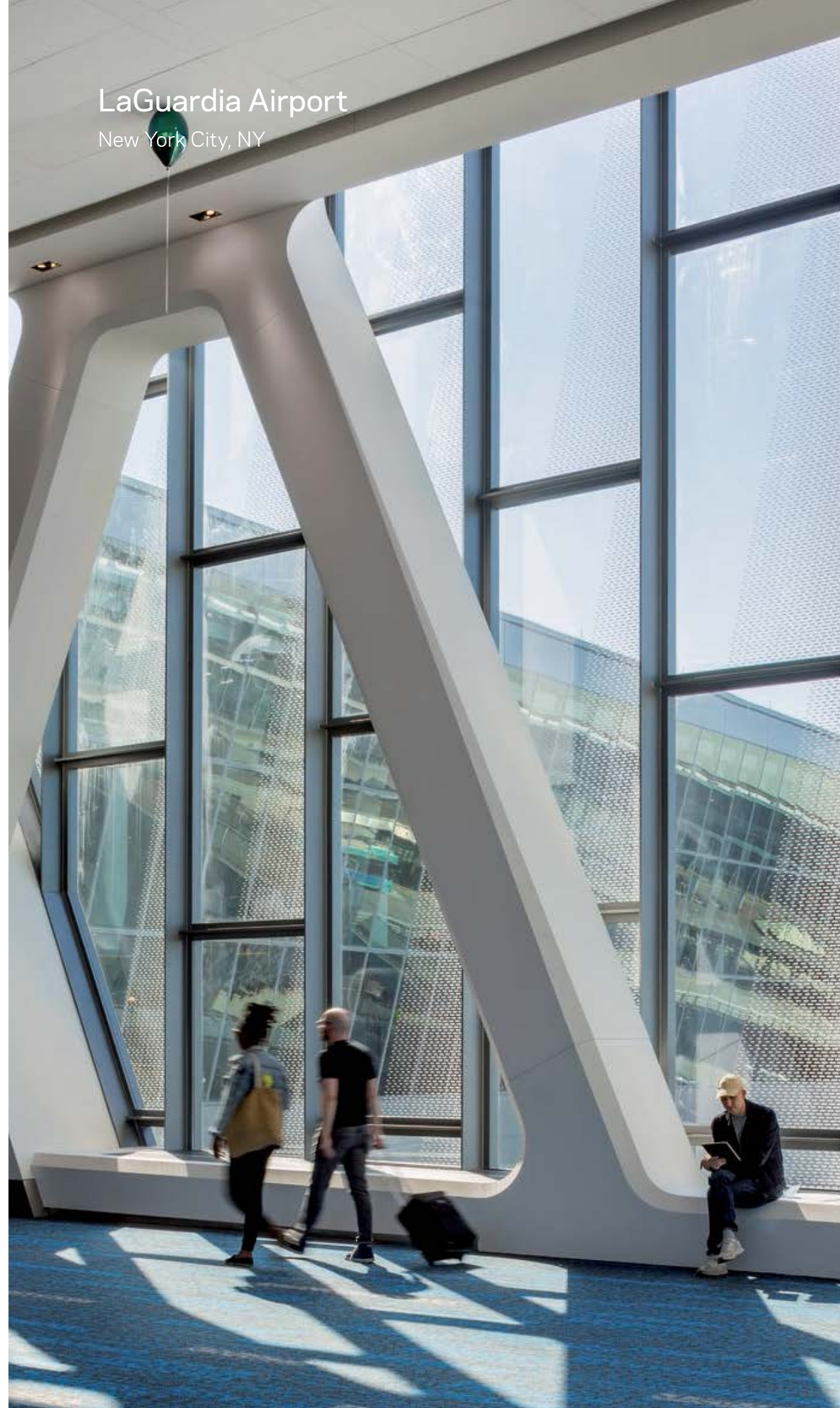
MEP 2040 Committing to Zero

SE2050 COMMITTING TO ZERO

American Society of Landscape Architects

SCIENCE BASED TARGETS
DRIVING AMBITIOUS CORPORATE CLIMATE ACTION

HOK's approach to reducing carbon is holistic; we are a signatory firm to major industry challenges that are tackling both operational and embodied carbon emissions. AIA 2030, which has primarily focused on operational carbon, now is tracking embodied carbon and we are contributing data. The American Society of Landscape Architects and Science Based Targets are operational carbon focused. MEP 2040 is a commitment that addresses both operational and embodied carbon of systems, and of course SE 2050 which is embodied carbon of structures.



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