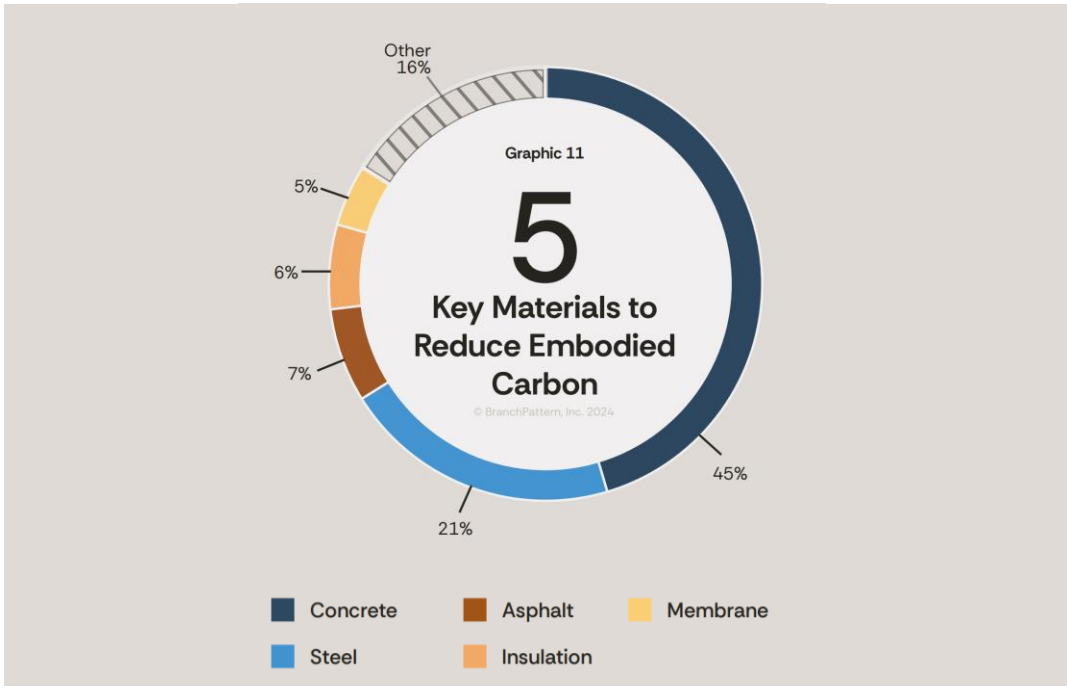
Low Carbon Materials List

In BranchPattern's *Embodied Carbon Benchmark Study v2*, it was estimated that **84% of embodied carbon in North American industrial warehouses can be attributed to concrete, steel, asphalt, insulation, and roofing membrane materials**. By focusing on low carbon alternatives to high-impact materials, the embodied carbon of industrial warehouses can be reduced significantly. Embodied carbon is reported in $kgCO_2e$ under Global Warming Potential (GWP) in Environmental Product Declarations (EPDs). Reported GWP is compared to industry benchmarks in this document to inform low carbon material procurement.



Embodied Carbon in U.S. Industrial Real Estate, Version 2

Material reuse provides the highest reduction in A1-A3 embodied carbon emissions for all materials. Early coordination between owners, design teams, contractors, and sustainability consultants can yield dramatic material savings.

Material Options by GWP Reduction from Baseline

Concrete Pavement	GWP Reduction
North American Average 4000psi 0%-19% SCMs	383.6 $kgCO_2e/yd^3$
Martin Marietta Quivas Plant CD4525 (20% Fly Ash)*	***-33%***
Smyrna Smith Street Plant GR60S4P5NA (40% Slag)*	***-42%***

Asphalt Pavement	GWP Reduction
North American Average Hot Mix Asphalt	53.7 $kgCO_2e/ton$
Holcim Bladensburg Plant H186B09R2B57 (WMA)*	***-21%***
Knife River Sundial Plant OR53D30000 (30% RAP)*	***-30%***

Steel Columns and Beams (HSS)	GWP Reduction
North American Average Fabricated HSS	1,990 $kgCO_2e/ton$
Bull Moose EAF Fabricated HSS	***-31%***
Nucor EAF Fabricated HSS	***-41%***

Steel Roof Deck	GWP Reduction
Industry Average Steel Deck	2,330 $kgCO_2e/ton$
Nucor EAF Steel Roof and Floor Deck	***-26%***
New Millenium EAF Steel Roof and Floor Deck	***-30%***

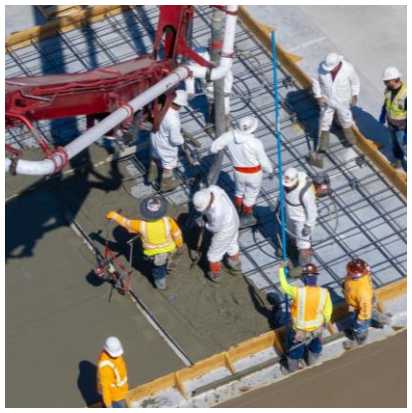
Steel Joists and Girders	GWP Reduction
Industry Average Open Web Steel Joists	1,430 $kgCO_2e/ton$
New Millenium EAF Steel Joist Products	***-26%***
Nucor EAF Steel Joists	***-41%***

Insulation (Board)	GWP Reduction
North American Average EPS	2.53 $kgCO_2e/m^2$ @ RSI-1
Hunter Panels Polyiso Roof Board	***-14%***
Atlas Roofing GPS with BASF Neopor	***-31%***

Roofing Membrane (TPO)	GWP Reduction
Industry Average TPO 60mil	4.95 $kgCO_2e/m^2$
Seaman FiberTite 60mil	***-14%***
Johns Manville TPO 60mil	***-16%***

**GWP values demonstrate outcomes associated with specific strategies. Engage with suppliers to identify project-specific pathways to reduction.*

Emerging Low Carbon Building Materials



Pouring of LC3 Concrete (Photo from NRMCC)

Limestone Calcinated Clay Cement (LC3)

LC3 is an emerging alternative to traditional concrete. In a 2025 National Ready Mixed Concrete Company (NRMCC) structural performance test, LC3 mixes were used in the tilt-up panel, slab on grade, and sitework construction. It was estimated that LC3 mixes resulted in a 17%-27% reduction in embodied carbon compared to a typical mix, while maintaining structural capability.

Additional information can be found at Low Carbon Concrete Field Trial

Low Carbon Cement Pour for Data Center Construction (Photo from STACK)

Low Carbon Cement Manufacturing

Innovative manufacturing processes can lead to reductions in A1-A3 emissions for concrete. Companies like Sublime Systems, Biomason, and Prometheus Materials use renewable energy systems and electrochemical processes for sustainable manufacturing of low carbon raw material inputs This results in low carbon alternatives to Ordinary Portland Cement (OPC), ready to use in any mix design.

Interior of Metal Frame Storage Facility (Photo from MBMA)

Portal Frame and Metal Panelized Construction

Metal buildings replace traditional constructions using prefabricated framing, cladding, and roofing. Unlike insulated metal panels, built-up metal buildings are assembled on site, starting at a metal interior layer then working outwards. The layered enclosure allows for easier disassembly, reuse, and recycling, as well as excellent durability, indoor air quality, moisture control.

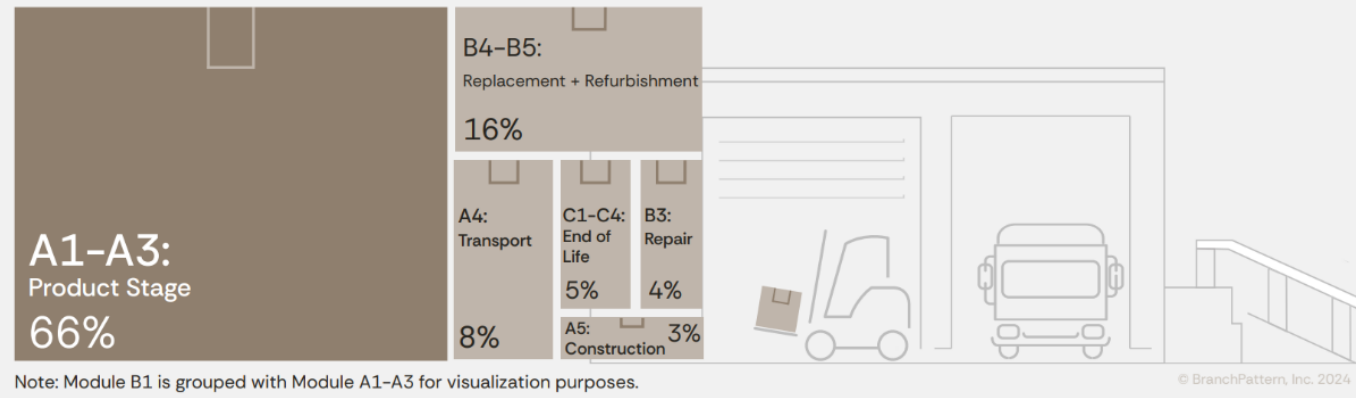
Additional information can be found at BranchPattern Perspectives

TimberBatt Wood Fiber Batt Insulation Install (Photo from TimberHP)

Bio-Based Materials

Manufactured wood, straw, wool, and mycelium-based insulation panels are alternatives to traditional insulation. Companies like TimberHP, Verdant Panel, ROCKWOOL, and Mycocycle provide low carbon alternatives to traditional insulation. Timber can also serve as a low carbon alternative for structure and enclosure systems. When sustainably harvested, mass timber can support local economic development, act as a carbon sink, and encourage forest management.

Beyond A1-A3 Carbon Emissions



Embodied Carbon can also be reduced through procuring locally-sourced materials to reduce travel distance to site (A4), extending service life of materials to reduce replacement rates (B4-B5), and end-of-life waste management (C1-C4). Incorporating Design for Disassembly principles extends these benefits through future material reuse in support of a circular economy, reducing waste and embodied carbon emissions over building life cycles.

Embodied Carbon in U.S. Industrial Real Estate, Version 2

Beyond Carbon

The environmental impact of construction materials goes beyond GHG emissions. Using sustainable materials can improve air quality, human health, and productivity. Material choices can also help create and protect habitat. Some links between materials, health, and habitat are summarized here.

In-Land Fauna Preservation

A reduced embodied carbon will help reduce the effects on the threatened and endangered species. Selection of fauna-friendly materials (pervious paving, biophilic materials such as Mass Timber construction and bio-based products). Reduced fauna migration, starvation, and loss of habitat, and improve the ecosystems, thanks to the reduction of raw material extraction and energy-intensive processes.

Marine Preservation

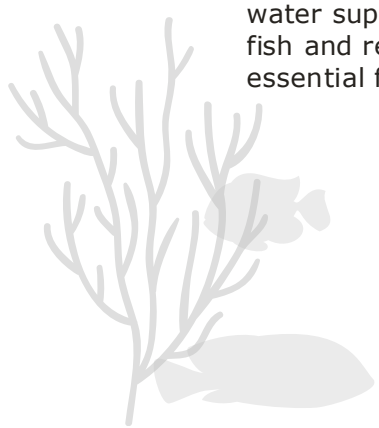
Marine preservation is directly associated with the reduction on Acidification and Eutrophication of water.

Steel fibers have high Eutrophication levels, which over nutrients water supplies, killing fish and reducing essential fish habitats.

38-40%

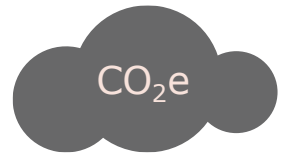
Environmental Impact Reduction with SCM Mixes

20-30% SCM mixes can reduce these environmental impacts by 38-40%, making fish habitats healthier and more sustainable.



Forest Preservation

-1MT



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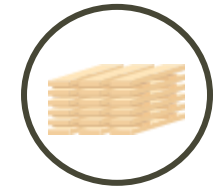
Carbon sequestered by 1.2 acres of US forest for one year



Mass Timber should be sourced from a Sustainably Managed Forest so that forests resources are protected, and the biodiversity, vitality, productivity and health of the forests are supported.

People Health and Comfort

Ozone depletion not only impacts the Planet's life at a larger scale, but also affects air and radiation filtration. A lower GWP or Embodied Carbon is often associated with lower Ozone Depletion.

Lower Ozone depletion helps stop the rising temperature of the planet and mitigate the changes of climatic catastrophes. It also reduces the impact on comfort, energy required for cooling or heating and improves people's health and comfort.

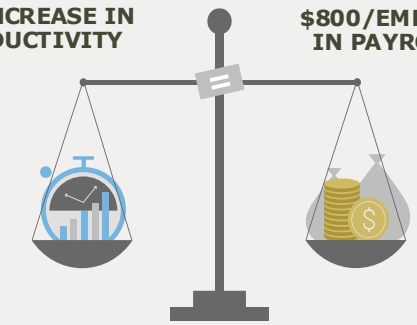
Air Pollution

The formation of tropospheric ozone is associated to the ground-level ozone, nitrogen (NOx) and volatile organic compounds (VOC). Having a lower GWP or embodied carbon affect directly the reduction of these chemicals and gases.

Improving air quality results in improved productivity by 5% and improved voluntary worker retention

1% INCREASE IN PRODUCTIVITY

$800/EMPLOYEE/YR. IN PAYROLL COSTS



Appendix

Category	EPD Description	EPD Number	Data Validity	A1-A3 GWP
Concrete Pavement	North American Average 4000psi 0%-19% SCMs	EPD10294	2029 – 2026	383.6 $kgCO_2e/yd^3$
	Martin Marietta Denver Plant CD4525 (20% Fly Ash)*	5c5d9a508e202b7442b8c298	2021 – 2026	258.4 $kgCO_2e/yd^3$
	Smyrna Smith Street Plant GR60S4P5NA (40% Slag)*	0fbdabc9-e652-4ad3-99f1-66c913a19328,1	2024 – 2029	224.4 $kgCO_2e/yd^3$
Asphalt Pavement	North American Average Hot Mix Asphalt	NAPA SIP-109	2024	53.7 $kgCO_2e$/ton
	Holcim Bladensburg Plant H186B09R2B57 (WMA)*	633a707fa2466359afaf2142	2022 – 2027	42.3 $kgCO_2e$/ton
	Knife River Sundial Plant OR53D30000 (30% RAP)*	6692679f1040414eaa25a6e8	2024 – 2029	37.7 $kgCO_2e$/ton
Steel Columns and Beams (HSS)	North American Average Fabricated HSS	4789556099.103.1	2022 – 2027	1,990 $kgCO_2e$/ton
	Bull Moose EAF Fabricated HSS	SCS-EPD-10294	2024 – 2029	1,380 $kgCO_2e$/ton
	Nucor EAF Fabricated HSS	SCS-EPD-10312	2024 – 2029	1,170 $kgCO_2e$/ton
Steel Roof Deck	Industry Average Steel Deck	4789985146.101.1	2022 – 2027	2,330 $kgCO_2e$/ton
	Nucor EAF Steel Roof and Floor Deck	SCS-EPD-09143	2023 – 2028	1,720 $kgCO_2e$/ton
	New Millenium EAF Steel Roof and Floor Deck	EPD 504	2023 – 2028	1,640 $kgCO_2e$/ton
Steel Joists and Girders	Industry Average Open Web Steel Joists	4789985166.101.1	2022 – 2027	1,430 $kgCO_2e$/ton
	New Millenium EAF Steel Joist Products	EPD 505	2023 – 2028	1,060 $kgCO_2e$/ton
	Nucor EAF Steel Joists	EPD 394	2022 – 2027	839 $kgCO_2e$/ton
Insulation (Board)	North American Average EPS	4790678084.101.1	2023 – 2028	2.53 $kgCO_2e/m^2$ @ RSI-1
	Hunter Panels Polyiso Roof Board	EPD 271	2021 – 2026	2.17 $kgCO_2e/m^2$ @ RSI-1
	Atlas Roofing GPS with BASF Neopor	EPD10299	2019 – 2024	1.74 $kgCO_2e/m^2$ @ RSI-1
Roofing Membrane (TPO)	Industry Average TPO 60mil	ASTM-EPD 446	2023 – 2028	4.95 $kgCO_2e/m^2$
	Seaman FiberTite 60mil	EPD 822	2024 – 2029	4.27 $kgCO_2e/^2$
	Johns Manville TPO 60mil	4791137694.101.1	2025 – 2030	4.14 $kgCO_2e/m^2$

Additional Resources

BranchPattern Embodied Carbon Benchmark Study v2

2025 CLF North American Baseline Report

Low Carbon Concrete Guide