Date: December 1, 2025

To: Senator Tou Xiong, Chair, Senate State and Local Government
Senator Andrew R. Lang, Ranking Member, State and Local Government
Representative Ginny Klevorn, Co-Chair, State Government Finance and Policy
Representative Jim Nash, Co-Chair, State Government Finance and Policy
Senator D. Scott Dibble, Chair, Transportation
Senator John R. Jasinski, Ranking Member, Transportation
Representative Erin Koegel, Co-Chair, Transportation Finance and Policy
Representative Jon Koznick, Co-Chair, Transportation Finance and Policy
Senator Nick A. Frentz, Chair, Energy, Utilities, Environment, and Climate
Senator Andrew Mathews, Ranking Member, Energy, Utilities, Environment, and Climate
Representative Patty Acomb, Co-Chair, Energy Finance and Policy
Representative Chris Swedzinski, Co-Chair, Energy Finance and Policy

From: Commissioner Tamar Gronvall, Administration
Tamar Gronvall Digitally signed by Tamar Gronvall Date: 2025.12.01 20:42:20 -06'00'
Commissioner Nancy Daubenberger, Transportation
Nancy Daubenberger Digitally signed by Nancy Daubenberger Date: 2025.12.01 20:08:40 -06'00'

RE: Environmental Standards Procurement Task Force Report

Pursuant to Minnesota Statutes 16B.312, enclosed is the report summarizing the findings and recommendations of the Environmental Standards Procurement Task Force.

Cc: Legislative Reference Library

DEPARTMENT OF ADMINISTRATION

Environmental Standards Procurement Task Force Legislative Report

December 1, 2025

A report prepared for the
Minnesota Legislature by
The University of Minnesota's
Center for Sustainable Building Research,
Minnesota Department of Administration,
Minnesota Department of Transportation, and the
Environmental Standards Procurement Task Force

Funding

Per the requirements outlined in Minnesota Statute 3.197, the cost to prepare this report was $98,388.

This report summarizes the findings and recommendations of the Environmental Standards Procurement Task Force, also known as the 'Buy Clean Task Force' or 'Task Force', mandated by Minnesota Statute 16B.312 Subd. 5(g).

Contributors

About the Center for Sustainable Building Research (CSBR)
The Center for Sustainable Building Research is a research center in the College of Design at the University of Minnesota. Building on past success and looking into the future, the work of the center is focused in six areas, each directly linked to each other and to the built environment: (1) energy and climate change; (2) the water cycle; (3) sustainable materials for a healthy built environment; (4) measuring regenerative design; (5) equitable designs to provide sustainability for all; and (6) creating regenerative and resilient communities. It is impossible to solve any of these problems in isolation from each other and transforming the building industry and built environment will strike at their root causes.

Authors
The Center for Sustainable Building Research (CSBR) at the University of Minnesota managed the research, analyzed feasibility and summarized recommendations on policy and next steps. Researchers from the CSBR that participated in the research and report:

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The report was based primarily on the research and data collected by CSBR.

Acknowledgements
We would like to thank the leaders, members, and stakeholders of the State of Minnesota Environmental Standards Procurement Task Force also known as the Buy Clean Task Force (see Appendix B for a list of contributing organizations and individuals) for their ongoing involvement and participation, with special thanks to Task Force co-chairs Betsy Hayes (Minnesota Department of Administration) and Curt Turgeon (MnDOT) and their staff. Special acknowledgement goes to Emil Bautista, PhD, PE at MnDOT for his contributions to the Asphalt section of this report (section 2B).

Conflicts of Interest
The Center for Sustainable Building Research (CSBR) is funded by federal, state, university and non-profit grants to support project-based research for the center. The center does not accept any sponsorships from manufacturers, trade associations, or special interests.

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Executive Summary

The Environmental Standards Procurement Task Force, mandated by Minnesota Statute 16B.312 Subd. 5(g) in 2023, is tasked with examining potential impacts of a program that will require submission of Environmental Product Declarations (EPDs) to demonstrate compliance with global warming potential (GWP) limits on certain construction materials used on state projects. EPDs are third-party verified documents that quantify environmental impact data of a product, written in conformance with international standards, and based on an in-depth life cycle assessment (LCA).

This report summarizes recommendations for implementation of Minnesota's Buy Clean program, which have been developed by the Task Force based on research, industry engagement, and material-specific subject matter expertise. This program is intended to assist with procurement of lower carbon materials/products within the same material category, after a decision on material type has already been made by the project team (i.e. for comparison of "like-for-like" materials and not for comparison between different overall material systems such as steel versus concrete superstructure). This program focuses on EPDs to document environmental impacts of products through the initial product life cycle stages (A1-A3), while a more comprehensive carbon approach might consider the entire life cycle of a product, integrating EPDs into life cycle assessments and incorporating operational carbon to inform key project decisions at earlier stages of design, in addition to material procurement and construction phases[1]. Requiring EPDs as a part of a Buy Clean program will ensure material transparency and drive the GWP data eco-stream evolution that will be vital to accurately reporting and significantly reducing emissions on our state's infrastructure projects. To support this goal, Minnesota's Buy Clean Task Force has examined and provided recommendations for a path forward for the following materials: concrete, asphalt, structural steel, carbon steel reinforcing bar (rebar), and other materials such as lumber and mass timber, glass, insulation, aluminum, and more.

[1] Graves et al. 2024. Embodied Carbon Policy Development in the Upper Midwest. www.aceee.org/sites/default/files/proceedings/ssb24/assets/attachments/20240722160831719_7f65b1ac-a5c1-41df-b86b-b0a5d40a2e87.pdf

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Recommendations

The following section presents a summary of recommendations for Minnesota's Buy Clean Program developed by the Task Force based on research, industry insights, stakeholder engagement, and material-specific subject matter expertise.

Limit Setting

While specific GWP limits and time frames will vary based on the material/product and market progression in each industry, the general approach will involve setting an initial maximum GWP limit, reevaluating roughly every 2 to 3 years, and adjusting limits accordingly depending on the market shift. Figure 0-1 illustrates this limit-setting approach. To ensure that initial GWP limit values established are achievable, policy-wide and material-wide thresholds will generally be set at industry-wide benchmarks, with the option for agencies to set more stringent limits for project-specific and category-specific materials/products in their bid specifications.

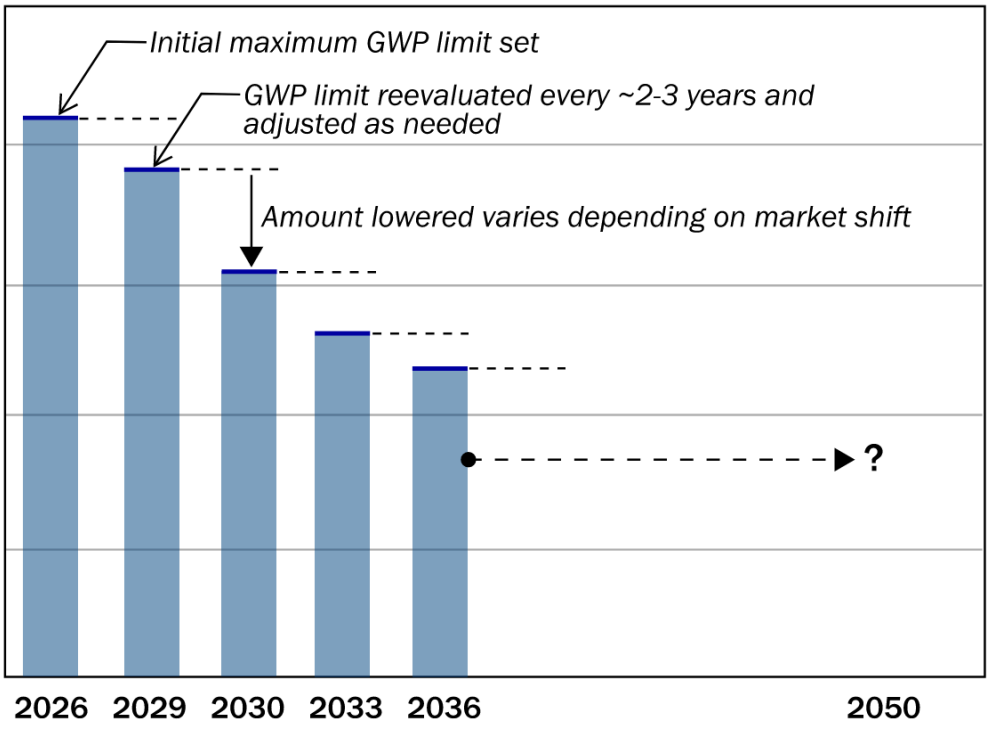

Figure 01: GWP Limit Setting Timeline. Image based on CLF (2020) with modifications by CSBR.

Material-Specific Recommendations

Recommended GWP limit tables and EPD requirements specific for each material - concrete, asphalt, and steel (structural steel and rebar) - can be found in the following report subsections listed below. While Minnesota legislation specifies that GWP limits are set for specific materials *no later than* a certain date, the Task Force has prepared recommendations that may justify implementing requirements sooner for certain materials based on industry developments, benchmarking data, and market trends. Additional details about the methodologies utilized for GWP benchmarking and setting

limits for each material can be found in report subsections immediately preceding the material-specific recommendations linked below, and are for the most part based on industry benchmarking data and analysis. Certain materials/products listed in the GWP limit tables do not have adequate data to be able to set a limit at this time and are noted as “TBD” (to be determined) in the GWP limit column. In order to gather sufficient quality data to be able to set GWP limits at a future date and encourage material transparency, it is recommended that EPDs are required for all materials/products listed in the following GWP limit tables, regardless of whether a GWP limit is in place.

Material-Specific Recommendations - GWP limit tables and EPD requirements:

2A(R). Concrete Recommendations
2B(R). Asphalt Recommendations
2C(R). Steel Recommendations

In addition to the materials/products included in the above categories, the Task Force examined additional materials that might be considered to add to the program now or in the future. In order to prioritize materials and identify when/how they might be integrated into program requirements, the Task Force developed a 3-tiered categorization system. This prioritization schema and recommendations for other materials are presented in section 2D(R). Other Materials Recommendations.

The Task Force proposes that the requirements presented in the Material-Specific Recommendations summarized in this section of the report and sections 2A(R), 2B(R), 2C(R), and 2D(R), **be enacted for all eligible state funded projects with a letting date on or after July 15, 2026.** This would require project teams to submit EPDs for the eligible materials presented in the tables of the aforementioned material recommendations sections of this report, and meet GWP limits for certain materials/products, where limits are provided. Task Force recommendations will be updated annually and summarized in legislative reports through December 2028, and will include modifications to reflect industry standards and market shifts, which may or may not result in adjustments to certain material requirements. It is important to note that the legislation states that “the commissioner may adjust any of the [GWP limit] values downward to reflect industry improvements” if the industry average has declined, but does not appear to allow increasing GWP limit values once they have been established.

Implementation Recommendations

To maximize program compliance and optimize efficiency in program implementation, this section summarizes recommendations for program mechanics and operations.

The material requirements will be integrated into the bidding process for eligible vertical and horizontal construction projects, by including specification language outlining the requirements as a part of the project design/bidding documents. Training and education sessions will be essential to inform project teams and contractors of the specific program requirements, including how and when EPD data must be submitted, prior to procurement of eligible materials. Project teams will submit required project data and EPDs via an online form which will be integrated into a database maintained by the state; however, since the online EPD submittal process and database are still under development, in the interim, EPDs may be collected from contractors/suppliers via a dedicated state agency email account or other electronic transmittal/file-sharing methods.

Of the existing material databases explored, Building Transparency's EC3 online platform[2] seems to be the most viable option at this point in time, at least with respect to tracking and reporting buildings projects. Historically the tool has focused on vertical construction projects, but recent updates have provided additional functionality to accommodate reporting and tracking of horizontal construction projects. Additional effort would be needed to ensure asphalt and concrete pavement categorization and data filter options within EC3 align with Minnesota functional mix categories, as well as additional measures to ensure data accuracy and validity. MnDOT is collaborating with other DOTs and industry to explore data management solutions that interface with EC3, such as BuiltCold, and other custom-built solutions, with the end goal of integrating streamlined EPD data transfer. To simplify data collection and create a unified approach, an ideal database solution is one that can effectively manage EPD data across a variety of project types (vertical and horizontal construction). Due to the differences in project procurement processes, material/technical properties, and resource limitations, there may initially be the need for separate data collection methods for buildings versus transportation projects, until data integration is practical and achievable. Additional database research, planning, and development is currently ongoing and will be further developed in the next phase of program implementation.

Waivers/exceptions to the material requirements will require project teams to submit a waiver request form demonstrating what efforts were undertaken to attempt meeting the requirements and must indicate the specific justifiable circumstances that might warrant a waiver. Waiver requests will be assessed by the state on a case-by-case basis.

Justifiable circumstances that might warrant a waiver include:

1. Technically Infeasible
2. Significant Increase in Project Cost
3. Significant Delay
4. Results in Sole-Source of Material
5. Emergency or Director's Order

As required by the Buy Clean legislation, a grant program has been established "to offset the cost of obtaining environmental product declarations or otherwise collect environmental product declaration data from manufacturers based in Minnesota". The first round of grant awards has been allocated, and additional rounds of grant awards are planned to allocate remaining funds. It is recommended that grant funding be prioritized and maintained to provide adequate support for Minnesota's construction industry to meet the market demands for material transparency and lower carbon construction materials.

As the Task Force transitions from the initial program creation phase to a technical advisory phase, material recommendations and program mechanics strategies will be refined and updated in annual legislative reports moving forward in 2026, 2027, and 2028, with the goal of continuing to make meaningful impacts in carbon reduction and efficiency in infrastructure construction.

[2] The EC3 Tool | Building Transparency www.buildingtransparency.org/tools/ec3

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Introduction

The Minnesota Buy Clean Buy Fair Act, a procurement policy aimed at reducing environmental impacts of construction materials used on state-funded projects, was enacted in 2023 under Minnesota Statute 16B.312 - Construction Materials; Environmental Analysis (see Appendix A for the full text included in the statute). Preceding Minnesota Statute 16B.312, a 2022 legislative report was published, entitled "Construction Materials: Environmental Impact Study[3]" by CSBR and CLF, which examined the feasibility, economic costs, and environmental benefits of requiring Environmental Product Declarations (EPDs), which are third-party verified documents that report the environmental impacts of products, for procurement of certain construction materials, and the research and recommendations of the 2022 report laid the groundwork for current and future procurement policy development.

The 2023 Buy Clean legislation created the Environmental Standards Procurement Task Force (also called the Buy Clean Task Force) hereinto referred to as the 'Task Force', which was established on October 1, 2023 by commissioners of the Departments of Administration and Transportation, with facilitation and research support provided by the Center for Sustainable Building Research. The Task Force is responsible for examining requirements of a program that will require Environmental Product Declarations (EPDs) to demonstrate compliance with future Global Warming Potential (GWP) limits that will be established for concrete, rebar, structural steel, asphalt, and other construction materials purchased by the state for eligible projects.

The Task Force is composed of a wide breadth of industry representatives and organizations (see Appendix B for a list of current members and stakeholders), which is required by legislation to meet at least four times annually (and may convene additional meetings at the call of the chair). Task Force findings shall be summarized in a report submitted to the chairs and ranking minority members of the senate and house of representatives committees with primary jurisdiction over state government, transportation, and energy no later than December 1, 2025, and annually thereafter, until the Task Force expires on January 1, 2029. See Appendix C for the Task Force Timeline.

[3] mn.gov/admin/assets/2022%20Legislative%20Report_EIS_Construction%20Materials_tcm36-621215.pdf

Scope of the Report

The State of Minnesota Commissioner of Administration contracted with the Center for Sustainable Building Research (CSBR) at the University of Minnesota to provide the report outlined in the legislation passed in the 2023 session: The Task Force shall make recommendations to the commissioners of administration and transportation for integration into a report to the Legislature by December 1, 2025 and annually thereafter until the Task Force expires in January of 2029.

This report provides an overview of the research conducted by the Task Force, including low environmental impact material policies, focusing on the use of environmental product declarations (EPDs), and presents the key issues, recommendations, and next steps to implement Minnesota's Buy Clean policy. This report is divided into three sections:

1. Summary of Federal and Other Programs - This section provides a review and summary of other construction material procurement policies in the US and abroad.

2. Focus Materials - State of the market, decision points and stakeholder perspectives, material-specific technical considerations, and recommendations are presented for each of the focus material categories:
    A. Concrete
    B. Asphalt
    C. Steel (including Structural Steel & Carbon Steel Rebar)
    D. Other Materials

3. Program Mechanics - This section provides implementation recommendations, to optimize program performance, compliance and integration into existing procurement and bidding processes.

Key Terminology

The following key terms and definitions are based on several of which are included in Minnesota legislative language to date or have been established by the Task Force for the purposes of this work.

Carbon steel means steel in which the main alloying element is carbon and whose properties are chiefly dependent on the percentage of carbon present (16B.312.1).

Electric arc furnace means a furnace that produces molten alloy metal and heats the charge materials with electric arcs from carbon electrodes (16B.312.1).

Eligible project means (16B.312.1):

1) new construction of a state building larger than 50,000 gross square feet of occupied or conditioned space;
2) renovation of more than 50,000 gross square feet of occupied or conditioned space in a state building whose renovation cost exceeds 50 percent of the building's assessed value; or
3) new construction or reconstruction of two or more lane-miles of a trunk highway.

Environmental Product Declaration (EPD) means a supply chain specific type III environmental product declaration that (16B.312.1):

1) contains a material production life cycle assessment of the environmental impacts of manufacturing a specific product by a specific firm, including the impacts of extracting and producing the raw materials and components that compose the product;
2) is verified by a third party; and
3) meets the ISO 14025 standard developed and maintained by the International Organization for Standardization (ISO).

Global Warming Potential (GWP) has the meaning given in section 216H.10, subdivision 6: *"Global warming potential" or "GWP" means a quantitative measure of the potential of an emission of a greenhouse gas to contribute to global warming over a 100-year period expressed in terms of the equivalent emission of carbon dioxide needed to produce the same 100-year warming effect, as reported in Fourth Assessment Report: Climate Change 2007, Intergovernmental Panel on Climate Change.* (216H.01, referenced in 16B.312.1)

Greenhouse gas has the meaning given to "statewide greenhouse gas emissions" in section 216H.01, subdivision 2: *"Statewide greenhouse gas emissions" include emissions of carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride emitted by anthropogenic sources within the state and from the generation of electricity imported from outside the state and*

consumed in Minnesota. Carbon dioxide that is injected into geological formations to prevent its release to the atmosphere in compliance with applicable laws, and carbon dioxide associated with the combustion of fuels other than coal, petroleum, and natural gas are not counted as contributing to statewide greenhouse gas emissions. (216H.01, referenced in 16B.312.1)

Integrated steel production means the production of iron and subsequently steel primarily from iron ore or iron ore pellets (16B.312.1).

Material production life cycle means an analysis that includes the environmental impacts of all stages of a specific product's production, from mining and processing the product's raw materials to the process of manufacturing the product (16B.312.1).

Product Category Rule (PCR) is a set of standards specific to a certain material/product that defines the rules and requirements for creating life cycle assessments (LCAs), and it is a critical component of EPD development. PCRs ensure that LCAs and EPDs for the same type of product are developed using the same methodology, data requirements, and reporting standards.

Rebar means a steel reinforcing bar or rod encased in concrete (16B.312.1).

Secondary steel production means the production of steel from primarily ferrous scrap and other metallic inputs that are melted and refined in an electric arc furnace (16B.312.1).

State building means a building owned by the state of Minnesota or a Minnesota state agency (16B.312.1).

Structural steel means steel that is used in structural applications in accordance with industry standard definitions (16B.312.1).

Supply chain specific means an environmental product declaration that includes specific data for the production processes of the materials and components composing a product that contribute at least 80 percent of the product's material production life cycle global warming potential, as defined in ISO standard 21930 (16B.312.1). Note that PCRs for some materials provide additional guidance on inclusion of supply chain–specific information. Inclusion of supply chain–specific (i.e. primary) upstream data for processes with large impacts is recommended, and may be required in PCRs for certain materials, in lieu of secondary data.

Environmental Product Declarations

Environmental Product Declarations (EPDs) are third-party verified documents that quantify environmental impact data of a product, written in conformance with international standards, and based on an in-depth life cycle assessment (LCA).

In order to understand the feasibility and intricacies of requiring EPDs to demonstrate product compliance as a part of a Buy Clean policy, it is helpful to understand the basic principles and rules that govern the process to develop EPDs, including what and how EPD data are reported.

There are several general types of EPDs that are publicly available:

1. Industrywide EPDs: These EPDs are intended to represent the whole industry for the product described in the EPD. Typically, the document holder will be a trade group rather than an individual company.
2. Companywide EPDs (i.e., multiple-facility): These EPDs typically represent a single entity but the data will represent multiple facility locations. GWP may be reported as a multifacility average or reported separately for each facility location.
3. Facility-specific EPDs: These EPDs represent a single entity and single facility.
4. Product-specific EPDs: These EPDs represent a single product.

Depending on the underlying material PCR and/or the scope of the EPD, different life-cycle stages of a product can be included:

1. **Cradle-to-gate** EPD involves only the manufacturing process and harvesting of a material. It has the minimum amount of data for life cycle assessment.
2. **Cradle-to-grave** EPD includes the whole life cycle of a product, specifically covering its maintenance and the end of life. If you wish to create an EPD for your product or utilize your manufacturer's EPD, this is the option you should select.
3. **Cradle-to-gate with options** includes the minimum requirements that are present in the cradle-to-gate option with a few additional information modules from cradle-to-grave EPD variation.

Figure 0-1 shows the life cycle stages of a building product typically included in an EPD.

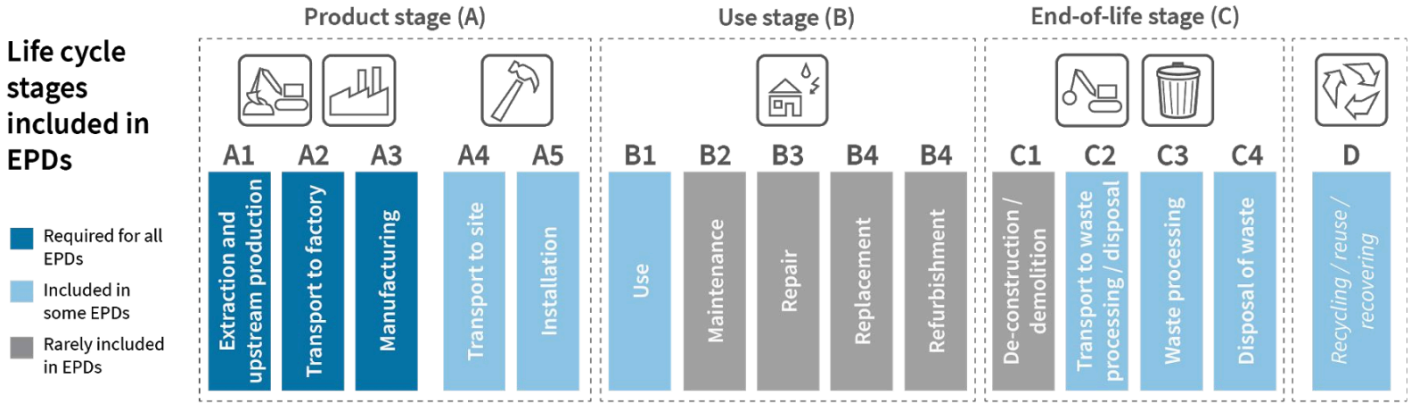

Figure 0-1: Life cycle stages of a building product typically included in an EPD, based on EN 15978:2011 and ISO 21930:2017 (EPD Standards). Image source: Carbon Leadership Forum - Embodied Carbon Policy Toolkit - Guidance on Embodied Carbon Disclosure, 2020.

EPD Standards

The International Standards Organization (ISO) has published several standards that govern how LCAs are performed and more specifically, how EPDs are developed, some of which are listed below:

- ISO 14025: *Environmental Labels and Declarations — Type III Environmental Declarations — Principles and Procedures*
- ISO 14027: *Environmental Labels and Declarations — Development of Product Category Rules*
- ISO 14040: *Environmental Management - Life Cycle Assessment — Principles and framework*
- ISO 14044: *Environmental management - Life Cycle Assessment - Requirements and Guidelines*
- ISO 21930: *Sustainability in Buildings and Civil Engineering Works — Core Rules for Environmental Product Declarations of Construction Products and Services*

ISO 14025: *Environmental Labels and Declarations — Type III Environmental Declarations — Principles and Procedures* provides the framework for EPDs and includes standards to measure and report quantified product information based on life cycle impacts. One key component of ISO 14025's framework in relation to Buy Clean policies is the explicit goal of comparability: Type III declarations "are intended to allow a purchaser or user to compare the environmental performance of products on a life cycle basis". EPD comparisons may be appropriate "between products fulfilling the same function," meaning that appropriate comparison at the EPD level is generally within (and not across) product categories, and when holding durability and performance constant.

ISO 21930:2017 provides the principles, specifications and requirements to develop an environmental product declaration (EPD) for construction products and services, construction elements and integrated technical systems used in any type of construction works and complements ISO 14025 by providing specific requirements for the EPD of construction products and services. ISO 21930 informs more regional Product Category Rules (PCRs), such as EN15804+A2 in Europe and TRACI 2.1 (as well as EN15804+A2) in the US. In July 2019 a major amendment to the EN15804+A2 standard (19 environmental impacts +17 reporting categories) standard was approved, which came with a variety of updates but most notably changed the format of data requirements in EPDs.

Product Category Rules (PCRs), also governed by ISO standards, dictate methodological decisions that are tailored to the material supply chain of a specific product category (e.g., ready mix concrete, asphalt mixtures, fenestration assemblies, etc.). A PCR dictates which life cycle stages and scopes must be included in the LCA, which background data sources are acceptable or mandatory, and other modeling choices such as allocation method and impact assessment method. PCRs are developed and maintained with support from industry experts and multi-stakeholder committees, and are reviewed and updated to improve data quality and standardization within and across product categories.

While several environmental impacts are measured and quantified in LCAs (e.g. ozone depletion, acidification, etc.), global warming potential (GWP) is commonly used as a proxy for estimation and comparison between products and systems, and is measured in kilograms of CO_2 equivalent.

It is important to note that comparisons between EPDs should only be made if their impacts were calculated using the same LCA methodologies, life cycle modules, LCI data sources, core PCRs, and GWP reference values (i.e. 100-year time horizon GWP values based on a specific Intergovernmental Panel on Climate Change IPCC assessment report such as AR4, AR5, or AR6).

Legislative Topics Covered in this Report

For full legislative text included in Minnesota Statute 16B.312 CONSTRUCTION MATERIALS; ENVIRONMENTAL ANALYSIS, see Appendix A.

The following requirements, as outlined in Minnesota Statute 16B.312, Subdivision 5 (b) and (c), are addressed in this report in the sections listed:

(b) The Task Force must examine, at a minimum, the following:

(1) which construction materials should be subject to the program requirements and which construction materials should be considered to be added, including lumber, mass timber, aluminum, glass, and insulation; ***see Section 2D(R). Other Materials Recommendations***

(2) what factors should be considered in establishing greenhouse gas emissions standards, including distinctions between eligible material production and manufacturing processes, such as integrated versus secondary steel production; ***see Section 2. Focus Materials***

(3) a schedule for the development of standards for specific materials and for incorporating the standards into the purchasing process, including distinctions between eligible material production and manufacturing processes; ***see Section 3. Program Mechanics***

(4) the development and use of financial incentives to reward vendors for developing products whose greenhouse gas emissions are below the standards; ***see Section 3. Program Mechanics***

(5) the provision of grants to defer a vendor's cost to obtain environmental product declarations; ***see Section 3. Program Mechanics***

(6) how to ensure that lowering environmental product declaration values does not negatively impact the durability or longevity of construction materials or built structures; ***see Section 2. Focus Materials***

(7) how to create and manage a database for environmental product declaration data that is consistent with data governance procedures of the state and is compatible for data sharing with other states and federal agencies; ***see Section 3. Program Mechanics - Databases & Data Management***

(8) how to account for differences among geographical regions with respect to the availability of covered materials, fuel, and other necessary resources, and the quantity of covered materials that the department uses or plans to use; ***see Section 2. Focus Materials***

(9) coordinating with the federal Buy Clean Task Force established under Executive Order 14057 and representatives of the United States Departments of Commerce, Energy, Housing and Urban Development, and Transportation; Environmental Protection Agency; General Services Administration; White House Office of Management and Budget; and the White House Domestic Climate Policy Council; ***see Section 1. Federal and Other Programs and Section 2. Focus Materials***

(10) how the issues in clauses (1) to (9) are addressed by existing programs in other states and countries; and ***see Section 1. Federal and Other Programs and Section 2. Focus Materials***

(11) any other issues the Task Force deems relevant.

(c) The Task Force shall make recommendations to the commissioners of administration and transportation regarding:

(1) how to implement requirements that maximum global warming impacts for eligible materials be integrated into the bidding process for eligible projects; ***see Section 3. Program Mechanics***

(2) incentive structures that can be included in bidding processes to encourage the use of materials whose global warming potential is below the maximum established under subdivision 2; ***see Section 3. Program Mechanics***

(3) how a successful bidder for a contract notifies the commissioner of the specific environmental product declaration for a material used on a project; ***see Section 3. Program Mechanics***

(4) a process for waiving the requirements to procure materials below the maximum global warming potential resulting from product supply problems, geographic impracticability, or financial hardship; ***see Section 3. Program Mechanics***

(5) a system for awarding grants to manufacturers of eligible materials located in Minnesota to offset the cost of obtaining environmental product declarations or otherwise collect environmental product declaration data from manufacturers based in Minnesota; ***see Section 3. Program Mechanics***

(6) whether to use an industry average or a different method to set the maximum allowable global warming potential, or whether that average could be used for some materials but not others; ***see Section 2. Focus Materials***

(7) any other items the Task Force deems necessary in order to implement this section.

Report:
Subd. 5 (g) The commissioner of administration shall summarize the findings and recommendations of the Task Force in a report submitted to the chairs and ranking minority members of the senate and house of representatives committees with primary jurisdiction over state government, transportation, and energy no later than December 1, 2025, and annually thereafter for as long as the Task Force continues its operations.

1. Federal, State, and Other Programs

This section provides an overview of construction material procurement policies that have been examined as a part of the Task Force work from 2023 to 2025. Project eligibility, material scope, program requirements, GWP benchmarking processes, GWP limit structures, and implementation timelines were among several of the variables analyzed. Figure 1-1, published in the Carbon Leadership Forum's November 2024 report entitled, "Scaling Buy Clean Policy: Strategies to Achieve Larger Embodied Carbon Reductions", summarizes the general timelines for 14 policies and programs across the U.S. Note that timelines and status of programs may have changed since this report was published.

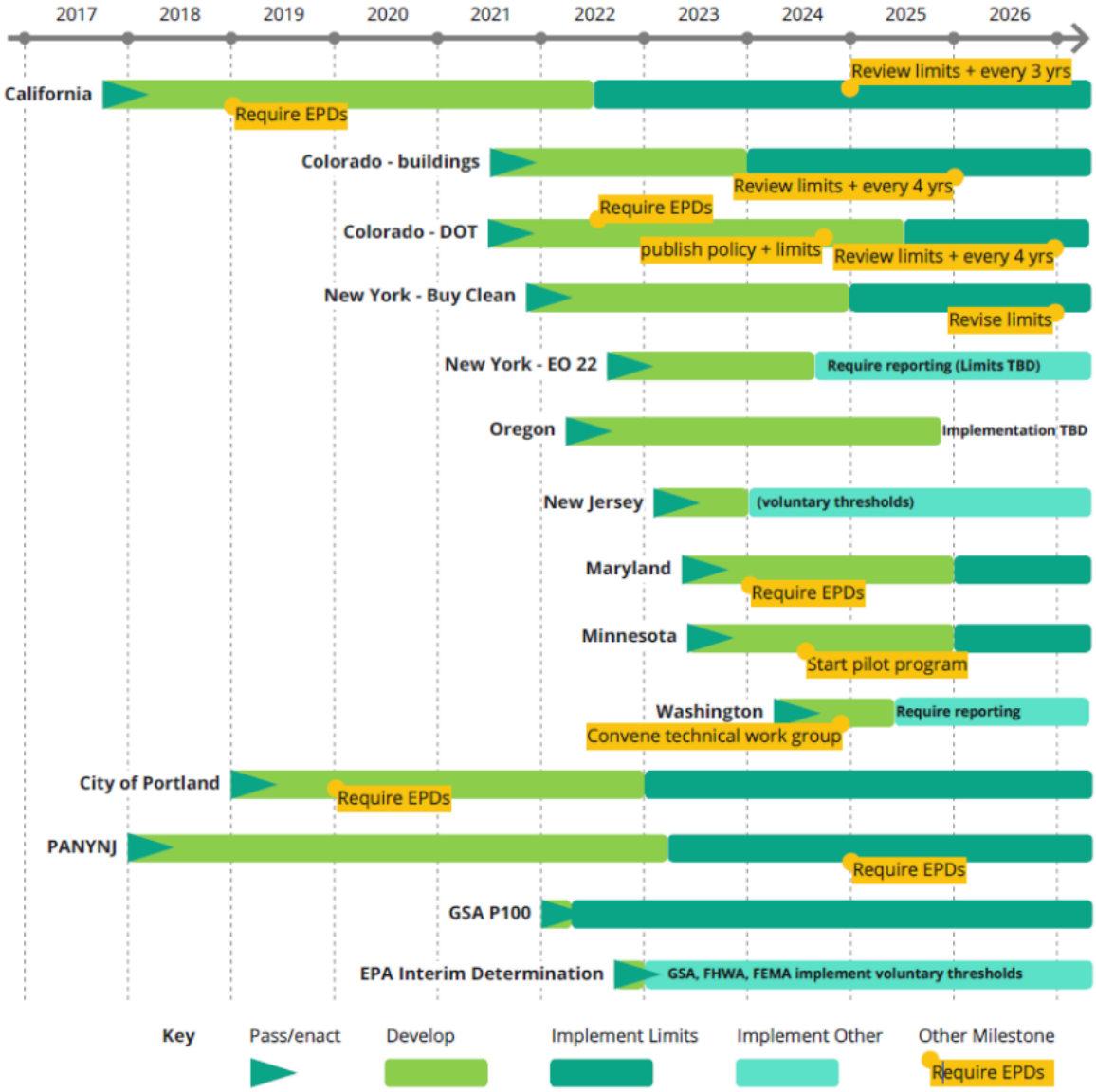

Figure 1-1: Implementation Timelines for 14 Federal, State, and Local Policies.
Source: Carbon Leadership Forum 2024 report "Scaling Buy Clean Policy".
Note: This list is not comprehensive. Timelines and status of programs may have changed since this report was published.

Federal Programs

The federal government developed several programs that addressed embodied carbon. Most of these programs are no longer active as of January 2025. In 2021, Executive Order 14057 was signed by former-president Biden, directing the federal government to create a Buy Clean policy and establish a Federal Buy Clean Task Force. Though the order was rescinded, it would lay the foundation for several state, local, and other initiatives to prioritize material transparency and the procurement of lower-carbon infrastructure materials.

In 2022, the EPA issued an Interim Determination[4], providing other agencies with actionable guidance on selecting substantially lower embodied carbon materials and products across several material categories. Also in 2022, the General Services Administration (GSA) issued the 'Low Embodied Carbon Concrete Standards' and the 'Environmentally Preferable Asphalt Standards' as a part of GSA's *P100*[5] *Facilities Standards*, which applied to all GSA projects that use at least 10 cubic yards of concrete or asphalt. Additionally, GSA IRA-funded projects had to meet GWP limits set for asphalt, concrete, cement, concrete masonry units (CMU), reinforcing steel, structural steel, glass, and cold-formed galvanized steel (stud, track, framing, etc.), though these limits are no longer active. EPA's C-MORE[6] (Construction Material Opportunities to Reduce Emissions) included programs to support reporting and reducing embodied carbon in construction materials, including a Grant Program, Labeling Program[7], as well as a Draft Approach for Developing Product-Level Embodied Greenhouse Gas Emissions Thresholds. The U.S. Department of Transportation's Federal Highway Administration (FHWA) created the Low Carbon Transportation Materials (LCTM) Program - a grant program originally allocating $2 billion from the IRA to support the use of low-carbon materials/products used in transportation projects and provide resources for agencies to implement processes to quantify and reduce emissions, develop specifications, and update procurement processes to encourage the use of low-carbon asphalt, concrete (cement), and steel. In years past, the FHWA has also run the Sustainable Pavements program, housed under the FHWA Pavements & Materials Program, which addressed embodied carbon in pavements. Table 1.1 summarizes some of the federal policies and programs that addressed embodied carbon of construction materials. **Note that some of the Federal programs mentioned in the report may or may not be active at the time this report is published.**

Table 1.1: Summary of Federal Policies and Programs Examined by the Task Force as of March 2025.
Note: some programs may or may not be currently active at the time this report is published.

Name	Date Implemented	Description
Federal Buy Clean Initiative (Federal Sustainability	December 2021. Revoked/ Archived 2025.	The Federal Sustainability Executive Order (EO 14057) of 2021 (revoked in 2025) directed the federal government to create a Buy Clean policy. This transformative policy leveraged government purchasing power to encourage the use of low-carbon materials in federally funded projects, and also supported broader climate goals, like net-zero emissions by 2050. The Federal Buy Clean Task Force

[4] EPA 2022.12.22 Interim Determination. (2022). www.epa.gov/system/files/documents/2023-01/2022.12.22%20Interim%20Determination%20on%20Low%20Carbon%20Materials%20under%20IRA%2060503%20and%2060506_508.pdf
[5] GSA P100 - 1.9.3.10.3 & 1.9.3.10.4 www.gsa.gov/system/files/P100%202024%20Final%2010012024.pdf
[6] EPA C-MORE www.epa.gov/greenerproducts/cmore
[7] EPA Labeling Program www.epa.gov/greenerproducts/labeling-materials-products

Executive Order 14057)		was formed to develop recommendations on policies and procedures to expand consideration of embodied carbon in Federal projects. This work included[8]: ● Identifying construction materials and products with the highest embodied carbon concerns - such as steel, cement/concrete, asphalt and flat glass - to prioritize for lower embodied carbon consideration in Federal procurement and federally-funded projects. ● Increasing the transparency of embodied emissions through supplier reporting of Environmental Product Declarations (EPDs), including incentives and technical assistance to help domestic manufacturers better report and reduce embodied emissions. ● Launching pilot programs to boost Federal procurement of cleaner construction materials and learn more about their performance in real-world applications.
EPA's Interim Determination	December 22, 2022	This document provided GSA, FHWA, and other agencies, with actionable guidance on how to specify construction materials/products with "substantially lower levels of embodied greenhouse gas emissions, associated with all relevant stages of production, use and disposal as compared to estimated industry averages of similar materials or products, as determined by the Administrator of the Environmental Protection Agency" in order appropriate IRA funds to eligible infrastructure and construction projects. In this determination, the EPA listed eligible materials "prioritizing materials/products that have the highest global-warming potential impact in the production stage." Purchase categories included: ● Concrete (and cement) ● Glass (including, but not limited to, flat/float glass, processed glass, and insulated glazing units) ● Asphalt mix ● Steel (including, but not limited to, hot rolled sections, plate, hollow structural sections, steel reinforcing bars/rebar, cold formed steel framing and steel joists) ● Assemblies comprised of at least 80 percent of materials that qualify under this determination, by total cost or total weight. The determination provided guidance to "estimate the GWP at the 20th and 40th percentiles and the industry average, as needed, for each material/product category using data from a verified source (e.g., an open source EPD database, industrywide EPDs or a 3rd party-verified LCA developed using the relevant PCR)."
EPA C-MORE	Umbrella of EPA efforts relaunched as C-MORE in January 2025. May no longer be active.	C-MORE (Construction Material Opportunities to Reduce Emissions) encompasses a multitude of EPA's embodied carbon initiatives, including a technical assistance program and resource library[9], construction material labeling program for identifying low embodied carbon materials and a grant program to support development of robust, high-quality EPDs (see below for more information on the labeling and grant programs).

[8] Federal Buy Clean Initiative (archived) www.sustainability.gov/archive/biden46/buyclean/index.html
[9] EPA EPD Technical Assistance Resource Library www.epa.gov/greenerproducts/epd-technical-assistance-resource-library-beta

EPA Labeling Program	Implementation approach issued August 2024. Relaunched under the C-MORE Program in January 2025. May no longer be active under the umbrella of EPA.	EPA was developing a labeling program to help identify lower-carbon construction materials and products. The program was initially focused on asphalt, concrete, glass and steel products with lower embodied GHG emissions from the production stage. The intent of the labeling program was to assist with selection of materials/products within the same material category after a decision on material type has already been made by the project team (i.e. comparison of "like-for-like" materials and not for comparison between different overall systems on a project). EPA's implementation approach[10] for the labeling program, issued on August 7, 2024, included three main phases to ensure quality and replicability across material categories: Phase I: Data Quality Improvement. Standardizing and improving the quality of data underlying and provided by EPDs. EPDs must be developed based on PCRs that meet EPA's PCR criteria[11]. Phase II: Threshold Setting. Establishing standardized methodologies and definitions for low embodied carbon, based on robust EPDs and other credible, relevant data. Phase III: Labeling Materials and Products. Labeling materials and products that meet thresholds set by EPA within a tiered rating system. Thresholds would be informed by input from industry and other stakeholders before being finalized, with top threshold tiers intended to incentivize deep reductions in embodied carbon.
EPA EPD Grant Program	Grant program announced Sept. 2023. Grant recipients announced July 2024. Renamed the "C-MORE" Grant Program at the beginning of 2025.	The main goal of this grant program was "to improve transparency and disclosure of embodied greenhouse gas (GHG) emissions data associated with construction materials and products to facilitate the steady reduction of embodied carbon in construction materials and products." On July 16, 2024, the EPA announced the selection of 38 grant recipients across the country[12], totaling nearly $160 million to help measure and reduce embodied carbon in construction materials. Ranging from $250,000 to $10 million, the grants would support businesses in developing high-quality EPDs across 14 material categories, including projects to encourage development of robust, standardized PCRs, tools and resources to optimize and incentivize EPD verification and production, and robust EPD data platforms and future integration into design and construction processes. Figure 1-2 shows the material and product categories for grant selections as of July 2024.
GSA P100 Standards	March 2022. Replaced by the PBS Core Building Standards in 2025.	GSA integrated requirements for 'Low Embodied Carbon Concrete' and 'Environmentally Preferable Asphalt' into their *Facilities Standards for the Public Buildings Service (P100)*[13], which established mandatory design standards and performance criteria for GSA-owned buildings, requiring construction contractors to provide environmental product declarations (EPDs) to demonstrate compliance for all GSA projects utilizing 10 cubic yards or more of concrete or asphalt. In addition

[10] EPA Label Program Implementation Approach www.epa.gov/system/files/documents/2024-08/lpa_final_8-6-24.pdf
[11] EPA Criteria for PCRs to Support the Label Program www.epa.gov/system/files/documents/2024-08/final-pcr-criteria_8-5-24_508.pdf
[12] EPA IRA Grant Announcement (2024) www.epa.gov/newsreleases/biden-harris-administration-announces-nearly-160-million-grants-support-clean-us
[13] GSA Facilities Standards www.gsa.gov/real-estate/design-and-construction/facilities-standards-for-the-public-buildings-service

		to providing product-specific cradle-to-gate Type III EPDs, asphalt mixes were required to employ at least 2 of the environmentally preferable manufacturing/installation techniques prescribed in 2024 P100 Section 1.9.3.10.4[14] . If not feasible to meet the EPD requirements, projects were able to submit a waiver and provide GWP estimations generated by an approved LCA tool. *P100* is no longer an active standard and was replaced by the *PBS Core Building Standards* in 2025.
GSA Low Embodied Carbon Program	2023. Archived in 2025.	GSA launched a pilot program in May 2023 to implement interim requirements of Low Embodied Carbon (LEC) construction materials on GSA projects funded by the Inflation Reduction Act of 2022. Material categories prioritized matched those identified by EPA's interim determination for their embodied carbon reduction opportunities: asphalt, concrete, steel, and glass. In December 2023, in collaboration with the FHWA, EPA, and the Federal Buy Clean Task Force, GSA published their LEC material requirements[15], which were largely unchanged since the pilot commenced in May 2023, with the exception of the definition of glass material assemblies to standardize on the insulating glass unit (IGU) to yield consistency with the “80/20” assembly rule from EPA’s Interim Determination (i.e. at least 80% of the IGU must be compliant flat glass). As of February 2025, about $2 billion of LEC materials had been utilized on projects across the nation. Figure 1-3 shows the estimated cost breakdown for these LEC materials. The LEC material requirements, mandatory for all IRA-funded material purchases in the categories of concrete, asphalt, steel, and glass, established tiered GWP thresholds for the Best 20th percentile of GWPs, Best 40th percentile, and Better than Average Limit, using industry average EPDs and product-specific EPDs publicly available in the Embodied Carbon in Construction Calculator (EC3)[16] database.
FEMA (IRA)	March 21, 2023 memorandum issued. May 20, 2023 implemented. Modified 2025.	On March 21, 2023, the Federal Emergency Management Agency (FEMA) issued a memorandum[17] announcing the implementation of IRA Section 70006(1) for several of its existing programs to assist with “costs associated with low-carbon materials” and provide “incentives that encourage low-carbon and net-zero energy projects”. These programs included FEMA Public Assistance (PA), Building Resilient Infrastructure and Communities (BRIC), Pre-disaster Mitigation, and Hazard Mitigation Grant Programs (HMGP). Programs may no longer be active in 2025. FEMA defined low-carbon materials eligible for funding by PA, HMGO, and BRIC, as “concrete, asphalt, glass, and steel which have a Global Warming Potential (GWP) lower than the estimated industry average for similar products in North America as demonstrated by their EPD”. On January 30, 2024, FEMA issued an addendum to the 2023 memorandum providing definitions for “net-zero energy projects” to facilitate implementation of IRA Section 70006(2), with guidance from

[14] GSA P100 (2024) www.gsa.gov/system/files/P100%202024%20Final%2010012024.pdf
[15]GSA IRA Low-Embodied Carbon Material Requirements www.gsa.gov/real-estate/real-estate-services/for-businesses-seeking-opportunities/bidding-on-federal-construction-projects/ira-lec-material-requirements
[16] The EC3 Tool | Building Transparency www.buildingtransparency.org/tools/ec3
[17] FEMA 2023 IRA Memo www.fema.gov/sites/default/files/documents/fema_inflation-reduction-act-implementation-memo_032023.pdf

		the U.S. Department of Energy's (DOE) after the DOE issued the draft version of a national definition for a zero-emissions building. On June 1, 2024, the DOE published the National Definition of a Zero Emissions Building (Part 1: Operational Emissions from Energy Use, Version 1), now archived.
FHWA LCTM	March 2024	This order established a policy for implementing a green purchasing program for the Federal Highway Administration (FHWA), originally allocating $2 billion from the IRA to support the use of low-carbon materials/products used in transportation projects and provide resources for agencies to implement processes to quantify and reduce emissions, develop specifications, and update procurement processes to encourage the use of low-carbon asphalt, concrete (cement), and steel. FHWA would provide either reimbursement equal to the incrementally higher cost of using eligible materials, as compared to the traditional material cost (determined by the recipient and verified by FHWA) or provide an incentive amount equal to 2% of the cost of using the eligible materials and products on the project funded under title 23, U.S.C. [§ 60506; 23 U.S.C. 179(b)(2).[18] Note: This program may not be currently active in all states. The majority of this funding was rescinded in 2025, with only about 5 states out of 39 that applied receiving some or all of their funding.
FHWA Sustainable Pavements Program	2010	In 2010, FHWA launched the Sustainable Pavements Program to promote sustainability of asphalt and concrete materials in pavement design, construction, and maintenance and to encourage the use of sustainable technologies and practices related to pavements. FHWA published a variety of resources including tech-briefs, LCA framework, and webinars to further advance sustainability in pavement systems, which were summarized in a 2015 newsletter.[19] Note: this program may not be currently active and associated resources may no longer be available.

[18] Title 23 USC 179: Low-carbon Transportation Materials Grants uscode.house.gov/view.xhtml?req=(title:23%20section:179%20edition:prelim)
[19] FHWA Sustainable Pavements Resources www.environment.fhwa.dot.gov/pubs_resources_tools/publications/newsletters/mar15nl.pdf

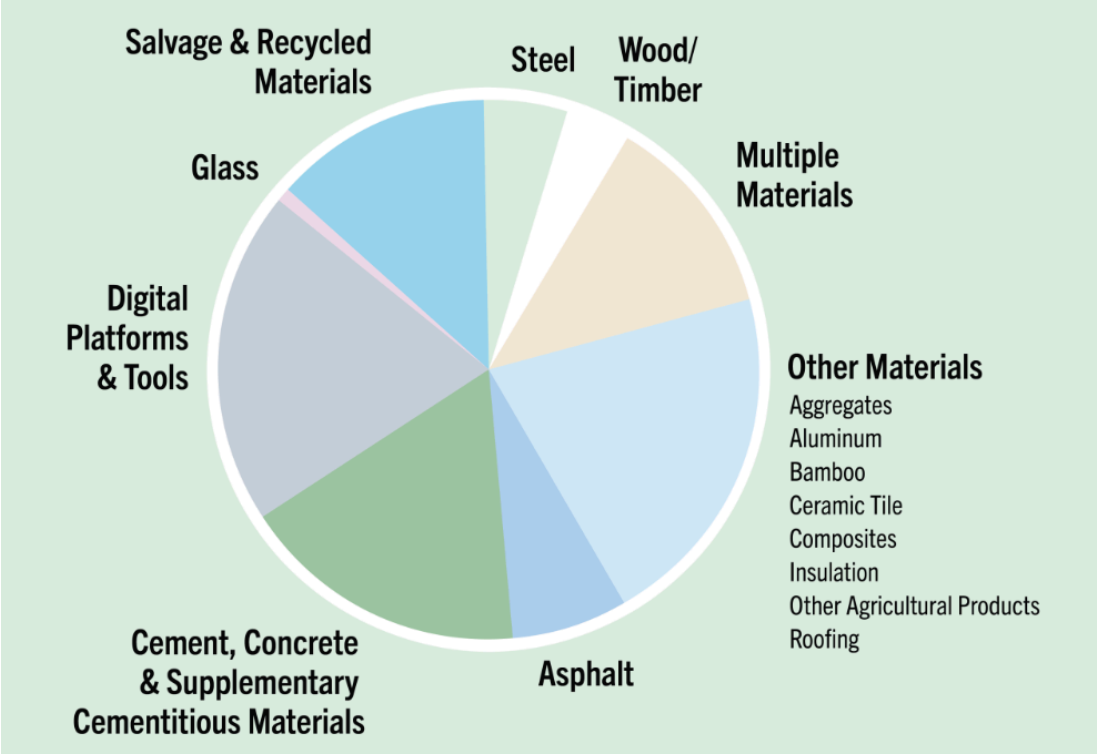

Figure 1-2: EPA Grant Program - Material & Product Categories for Grant Selections as of January 3, 2025.

Source: www.epa.gov/greenerproducts/grant-program.
Note: grant program may or may not be active at the time this report is published.

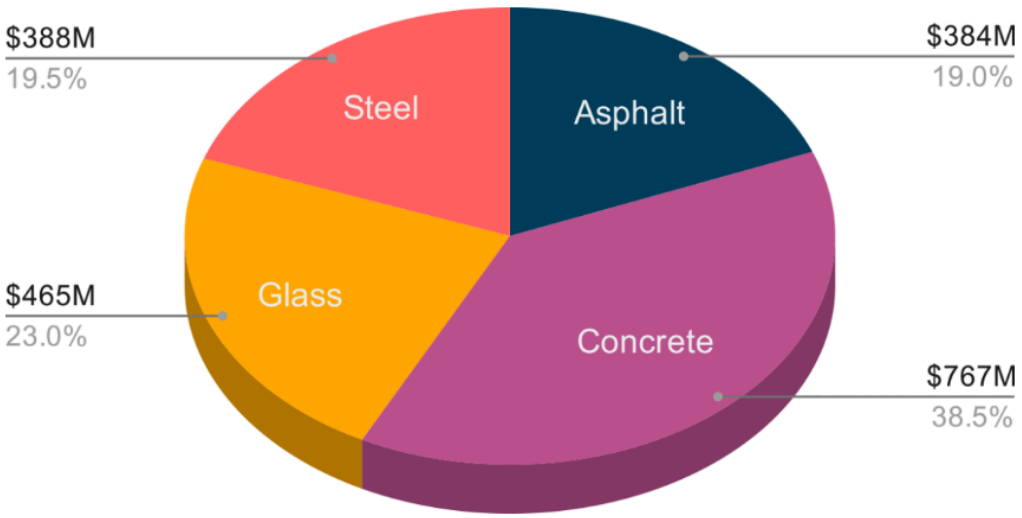

Figure 1-3: GSA Low Embodied Carbon Project Funding by Material as of January 2025.
Source: www.gsa.gov/real-estate/gsa-properties/inflation-reduction-act/lec-program-details (website no longer active).

States, Cities, & Local Policies

The Federal Sustainability Executive Order (EO 14057) issued in 2021 (later rescinded in 2025) established the Federal Buy Clean Program[20], which paved the way for further advancement of Buy Clean programs in several states and local policies across the nation. In 2023, the Biden-Harris Administration announced the launch of the 'Federal-State Buy Clean Partnership'[21], now a state-led initiative renamed the 'State Buy Clean Partnership' as of 2025, which fosters collaboration amongst 13 states (California, Colorado, Hawaii, Illinois, Maine, Maryland, Massachusetts, Michigan, New Jersey, New York, Oregon, Washington, and Minnesota) to advance procurement of cleaner construction materials in publicly-funded projects. Table 1.2 summarizes some of the state, city, and other local policies and programs that were taken into consideration as a part of the Task Force work.

Table 1.2: Summary of several state, city, and local policies and programs examined as of March 2025

Entity / Program	Date Implemented	Program Description and Project Eligibility
California Buy Clean (BCCA)	2019	The Buy Clean California Act (BCCA) requires EPDs to demonstrate compliance with GWP limits set by authorized agencies/awarding authorities for structural steel, rebar, flat glass, and mineral wool board insulation. A recent revision to the policy in 2024 (SB1207) revises the eligible material list specifying "Insulation" as opposed to "Mineral Wool Board Insulation", expanding the scope of insulation products/subcategories covered.[22] Project Eligibility: varies by authorized agency (DGS, CADOT/Caltrans, UC, DWR, CSU, etc.).
Colorado Buy Clean (OSA)	2022	The Buy Clean Colorado (BCCO) Act requires EPDs for eligible state projects utilizing asphalt, concrete, glass, post-tensioned/prestressed concrete/steel, reinforcing steel, structural steel, and wood structural elements to meet GWP limits set by the Office of State Architect (OSA) for vertical construction and by the Department of Transportation for CDOT's horizontal construction projects. Project Eligibility: Buildings ≥$500,000 project cost; Infrastructure ≥ $3,000,000 project material costs
Maryland Buy Clean (SB 424)	2023	The Buy Clean Maryland Act (SB 424 – Procurement of Construction Materials)[23] requires bidders of eligible projects to submit EPDs for cement or concrete mixtures to the Department of General Services (DGS) by December 31, 2024. On or before January 1, 2026, DGS, in consultation with the Department of Transportation, shall establish maximum GWP limits for eligible materials. Beginning July 1, 2026, state agencies will be required to specify in each solicitation for the cement or concrete mixture that would be used and prioritize proposals with the lowest carbon footprint. The legislation also includes an EPD Assistance Fund, administered by the Department of Commerce, that awards grants to producers of eligible materials.

[20] Federal Buy Clean Task Force (archived) www.sustainability.gov/archive/biden46/buyclean/index.html#abouttaskforce
[21] Federal-State Buy Clean Partnership Principles (archived) www.sustainability.gov/pdfs/federal-state-partnership-principles.pdf
[22] Buy Clean California Act www.dgs.ca.gov/pd/resources/page-content/procurement-division-resources-list-folder/buy-clean-california-act
[23] Maryland Senate Bill 424 legiscan.com/MD/bill/SB424/2023

		Project Eligibility: Capital project described in §3-602.1(c) of the State Finance and Procurement Article (which relates to high-performance buildings) that are: ● State-funded: projects ≥ 7,500 SF; ● Partially state-funded community college projects ≥ 7,500 SF and K-12 schools.
New York (Executive Order 22)	Sept. 20, 2022	Executive Order 22 – Leading by Example focuses on reporting of material quantities and EPDs, where they exist, using EC3 (or other databases). 1. Design teams shall calculate the total embodied carbon that will result from the project, including shipping, transportation, and construction equipment requirements. 2. Bidders shall be required to submit environmental product declarations when available, that include the amount of embodied carbon in given building materials. Implementation update (announced January 2025): Agencies to update their authorized contracts to require data collection beginning Oct 1, 2023. Agencies to disclose materials and embodied carbon data through annual reporting starting Aug 31, 2024.[24] Project Eligibility: NYS Agencies and Authorities Buildings >$1,000,000 with concrete>50 yd^3; asphalt mixes>16,584 lb (or 10 yd^3); rebar>20,000 lb; structural steel>5,000 lb; or glass>2,000 sf. Transportation Projects (thresholds are by material quantities only, not by project value): concrete>200 cubic yards (per mix design); asphalt>8,000 short tons (per mix design); rebar>20,000 lb; structural steel>15,000 lb; or glass>2,000 sf.
New York Buy Clean	Enacted Dec. 2021, Effective June 2022	"The NYS Buy Clean Concrete guidelines implements S542A, signed into law as State Finance Law 135-d December 2021, effective June 2022. The law calls for the Office of General Services (OGS) to establish guidelines requiring the procurement of low-embodied carbon concrete on projects deemed appropriate by the office."[25] This program focuses on concrete mixes only. Concrete GWP limits set in 2025 initially at 150% of NRMCA Eastern average and will be revised (lower) in 2027 based on NY-specific data collected. Project Eligibility: NYS Agencies State building contracts >$1,000,000 with concrete>50 yd3 NYS DOT contracts>$3,000,000 with concrete>200 yd3
New Jersey	Adopted 2022, Implemented 2024.	Assembly Bill 2234[26] provides tax credits for use of low carbon concrete and for costs of conducting environmental product declaration analyses of low carbon concrete. The New Jersey Department of Environmental Protection (DEP) will establish GWP baselines for concrete products and develop a formula to determine the amount of the tax credit (up to a maximum of 8% of the total contract) proportional to the emissions reduction achieved. Producers will be required to submit EPDs to demonstrate GWP impacts. Additionally, producers can receive tax credits for the cost of developing EPDs (up to $3,000 credit per plant for up to 8 facilities per year with a $1 million cap per producer). The total value of tax credits shall not in the aggregate exceed $10 million in any year and will be issued on a first-come, first-serve basis. Project Eligibility:

[24] NYS EO22 ogs.ny.gov/system/files/documents/2025/01/2.-eo22-embodied-carbon-guidance_summ_jan-2025.pdf
[25] NYS Buy Clean Concrete Guidelines https://ogs.ny.gov/nys-buy-clean-concrete-guidelines-0
[26] New Jersey Assembly Bill 2234 legiscan.com/NJ/text/A2234/id/2614174

		Concrete quantity delivered greater than or equal to 50 cubic yards (includes structural and non-structural masonry, and pre-cast and ready-mix concrete building products). EPD tax credit: Producers of concrete, or a producer of a major component of concrete including cement or aggregate.
Oregon (HB4139)	2022	Focuses on reducing GWP of transportation infrastructure and directs ODOT to: ● "Establish a Technical Advisory Committee (TAC) to assist with implementation ● Perform life cycle assessments; ● Develop a grant program to help offset costs of developing EPDs; ● Devise strategies to reduce GHG emissions from construction materials; and ● Report annually to the Oregon Legislature and Transportation Commission." Project Eligibility: Covered materials the department uses in the construction and maintenance activities for the state's transportation system (program requirements still under development)
Port Authority of New York and New Jersey	2020 (EPDs); 2023 (GWP limits for concrete)	In 2020, the Port Authority of New York and New Jersey announced its' Clean Construction Program[27], which requires EPD reporting for concrete, steel, and asphalt. In 2023, the Port announced that agency construction contracts must incorporate low carbon concrete specifications, which includes requirements to meet GWP limits for concrete mixes.[28] Project Eligibility: All port projects submit EPDs. All concrete mixes must meet GWP limits.
Washington State Buy Clean	2024	This law requires state agencies and higher education institutions to report on the environmental impacts of concrete, wood and steel products purchased for the construction and renovation of large, state-owned buildings. "Covered product" includes: (a) Structural concrete products, including ready mix, shotcrete, precast, and concrete masonry units; (b) Reinforcing steel products, specifically rebar and post-tensioning tendons; (c) Structural steel products, specifically hot rolled sections, hollow sections, metal deck, and plate; (d) Engineered wood products, such as cross-laminated timber, glulam beams, laminated veneer lumber, parallel strand lumber, dowel laminated timber, nail laminated timber, glulam laminated timber, prefabricated wood joists, wood structural panel, solid sawn lumber, structural composite lumber, and structural sawn lumber. Project Eligibility: 2025: buildings >100,000 GSF 2027: buildings >50,000 GSF

[27] PANYNJ Clean Construction Program www.panynj.gov/port-authority/en/about/Environmental-Initiatives/clean-construction.html
[28] PANYNJ Press Release (2023) www.panynj.gov/port-authority/en/press-room/press-release-archives/2023-press-releases/port-authority-adopts-new-industry-leading--sustainable-concrete.html

2. Focus Materials - Research & Recommendations

As outlined in the Minnesota Buy Clean legislation requirements, the following focus materials were examined by the Task Force:

A. Concrete
B. Asphalt
C. Structural Steel and Carbon Steel Reinforcing Bar (Rebar)
D. Other Materials (materials such as lumber and mass timber, glass, insulation, and aluminum)

For each focus material category, the current state of the market, industry developments, geographical considerations, and stakeholder perspectives are presented below, including what factors should be considered in establishing greenhouse gas emissions standards, a schedule for the development of standards for specific materials and for incorporating the standards into the procurement, bidding, and purchasing processes, material-specific technical considerations such as durability/longevity, and engagement/roles of contributors from raw material extraction through construction, all of which are important to examine to develop a successful implementation plan for a Buy Clean program.

2A. Concrete

Material Background

Concrete, an essential construction material used in buildings and infrastructure, is composed of a mixture of aggregates (sand, gravel, crushed stone), water, cement, and also small amounts of chemical admixtures. Figure 2A-1 shows an example of concrete ingredient composition.

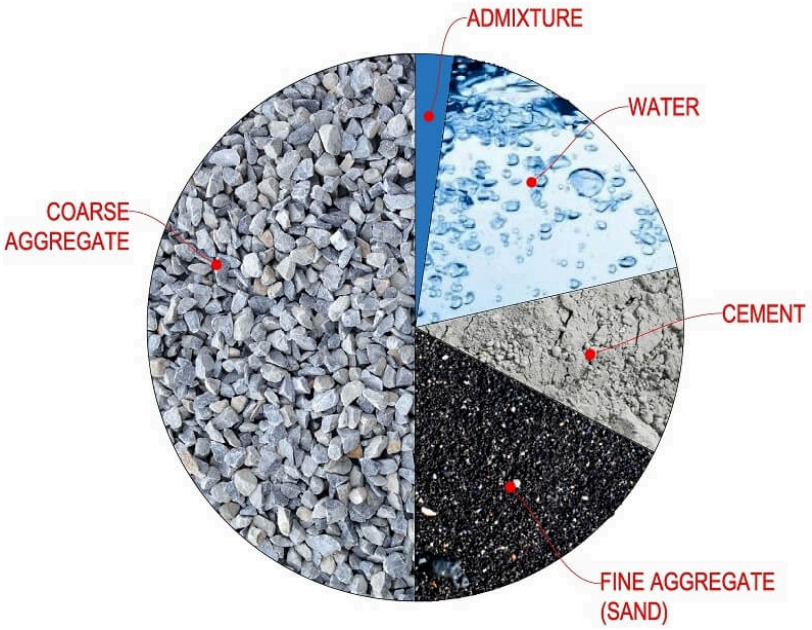

Figure 2A-1: Composition of Concrete Ingredients.
Source: worl.data.blog/2019/04/09/concrete-ingredients/

Cement is primarily composed of clinker with the addition of gypsum and other supplementary cementitious materials (SCMs). Clinker is the main strength-contributing ingredient and also the most carbon-intensive ingredient in concrete. On average, clinker makes up about 10% of the mass of a concrete mix but is responsible for over 90% of the embodied carbon of the concrete. Figure 2A-2 illustrates the percentage of mass vs the percentage of emissions of clinker, cement, and concrete.

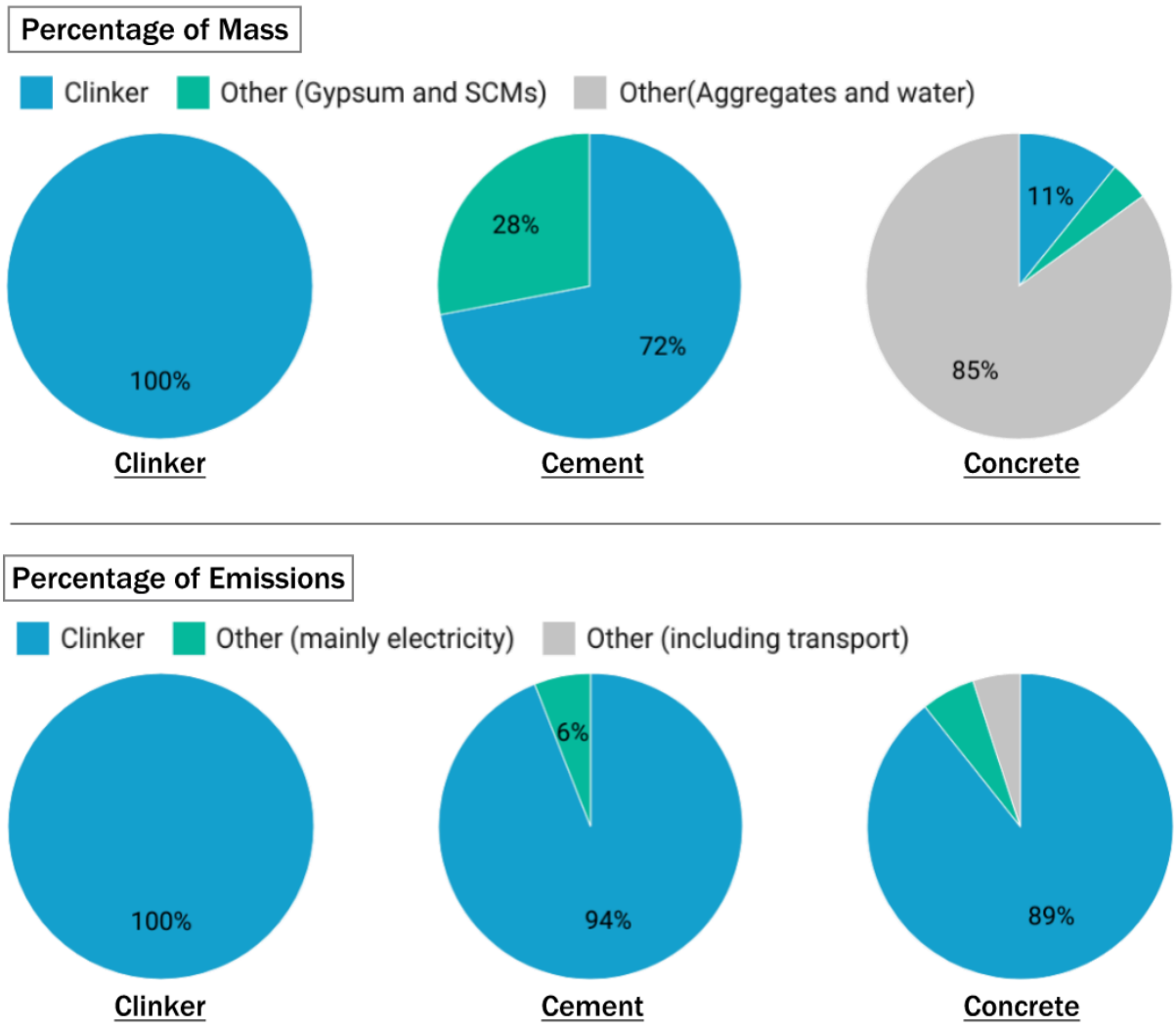

Figure 2A-2: Clinker, Cement, and Concrete Mass and Emissions.
Source: rmi.org/with-concrete-less-is-more/ based on data from Materials Economics Industrial Transformation 2050 (IEA).

There are several types of concrete materials/products commonly used for vertical and horizontal construction projects, all of which utilize concrete mix designs with varying amounts of cement/clinker depending on their end-use and performance requirements. The following concrete products were examined by the Task Force:

- **Ready Mix** - concrete to be mixed and then poured on site. This can include:
  - Cast-in-Place (CIP) concrete or Tilt-Up Concrete used for buildings projects
  - Post-tensioned concrete (commonly used for parking structures and high-rise buildings, and often utilize High Early Strength mixes)

    - Concrete pavement and abutting concrete elements for roadway applications such as curbs, sidewalks, aprons, barriers, and retaining walls

- **Precast/Prestressed** - concrete cast and cured at a manufacturing facility and then transported to the project site. This can include precast used for:
    - Structural elements (walls, beams, columns, etc.)
    - Hollowcore floor and roof systems
    - Architectural cladding and insulated precast
    - Civil & underground applications (highways, bridges, culverts, pipes, etc.)

- **Concrete Masonry Unit (CMU)** - pre-manufactured concrete block sometimes referred to as block or cinder block**.**

State of the Market

While there are a relatively large number of ready mix concrete EPDs in Minnesota, the EPD data ecosystems for prestressed/precast concrete and CMU are at earlier stages of development. As the market demands more material transparency and lower-carbon materials, and as the EPD generation process becomes more streamlined, the number of plants/facilities generating EPDs will continue to grow. The table below shows product-specific concrete EPD counts from EC3, Building Transparency's Embodied Carbon in Construction online database, for the state of Minnesota in October 2021 and September 2025.

Table 2A.1: Minnesota Product-Specific Concrete EPD Counts

Material/Product	Number of EPDs in EC3	
	October 2021	September 2025
Ready Mix Concrete	203	1618
Precast Concrete	0	6
Concrete Masonry Unit (CMU)	0	1

The number of product-specific ready mix concrete EPDs has grown substantially, while Precast Concrete and CMU material categories show less growth in EPD data generation. It is important to note that some material categories in EC3's database might have more extensive EPD data coverage than others, and that while EC3 is continuously being updated, there are other EPDs sources, including material industry/trade organizations' websites. Industry organizations representing precast concrete and CMU products, in response to the market demand for material transparency, have created several industry-wide EPDs.

The Precast/Prestressed Concrete Institute (PCI) and the Canadian Precast/Prestressed Concrete Institute (CPCI), trade organizations based in the US and Canada, have developed several industry-wide EPDs. The combined membership of these two associations/institutes includes more than 700 facilities in the US and Canada producing structural, architectural, utility and specialty precast products used on above and below grade applications. LCI data and meta-data for development of

industry-wide EPDs were provided by various member companies/manufacturers of CPCI and/or PCI to establish weighted averages for each of the following products: (a) Structural Precast Concrete, (b) Architectural & Insulated Wall Panel, and (c) Glass-Fiber Reinforced Panel, which can be found on PCI's website[29]. In May 2025, regionalized industry average EPDs were published for Architectural Precast Concrete, Insulated Precast Concrete, and Structural Precast Concrete. Figure 2A-3 below shows the PCI region boundaries. Table 2A.2 below shows the cradle to gate GWP impacts (for A1-A3 life cycle stages) per metric tonne of structural precast concrete from PCI's regionalized EPD[30].

Figure 2A-3: Precast Concrete Institute (PCI) Production Regions.
Source: www.pci.org/PCI_Docs/Design_Resources/Sustainability/2025-PCI-Structural-EPD.pdf

Table 2A.2: Cradle to Gate GWP Results for One Metric Tonne of Structural Precast Concrete [A1-A3]

FPCA	PCI Gulf South / GCPCI	PCI Central	PCI-IW	PCI Midwest	PCI Mountain	PCI West	PCINE / PCIMA	PCMA
317	273	263	248	276	297	255	240	261

Note: GWP values shown are in $kgCO_2e$ per metric tonne. Data from PCI's Structural Precast EPD. Data source: www.pci.org/PCI_Docs/Design_Resources/Sustainability/2025-PCI-Structural-EPD.pdf

[29] PCI EPDs www.pci.org/PCI/PCI/Design_Resources/Sustainability_Resources/Environmental_Product_Declarations.aspx
[30] PCI Structural Precast Industry-Average EPD www.pci.org/PCI_Docs/Design_Resources/Sustainability/2025-PCI-Structural-EPD.pdf

In 2024, the Concrete Masonry & Hardscapes Association (CMHA) published an Industry-Average EPD for concrete masonry units, which included data from 35 manufacturing facilities. CMHA's CMU EPD[31] provides environmental impact data for seven distinct classes of concrete masonry units:

- Normal weight density, CMU strength 2,000 – 3,240 psi
- Normal weight density, CMU strength 3,250 – 4,490 psi
- Normal weight density, CMU strength 4,500 psi or greater
- Medium weight density using manufactured aggregate, CMU strength 2,000 to 3,240 psi
- Medium weight density using natural aggregate, CMU strength 2,000 to 4,490 psi
- Lightweight density using manufactured aggregate, CMU strength 2,000 to 4,490 psi
- Lightweight density using natural aggregate, CMU strength 2,000 to 3,240 psi

Benchmarking

The National Ready Mixed Concrete Association (NRMCA), an industry association of ready mix concrete producers in the US, has led several efforts to support the development of ready mix concrete EPDs and embodied carbon benchmarking.

The NRMCA sponsored and published Industry-Wide (Average) EPDs in 2021[32] and 2022[33], which represent the average environmental impacts of concrete in the US based on data contributed by participating companies and plants across the country. The EPDs provide separate environmental impacts for concrete of different strength categories and fly ash or slag content, and represent average impacts for a total of 72 ready mix products (mix designs).

The NRMCA also developed, in collaboration with Athena Sustainable Materials Institute, Regional Benchmarks Reports using data collected in developing the LCAs to produce industry-wide EPDs, which include a set of regional benchmarks, at the national level as well as eight NRMCA regions, for 9 concrete mixes (6 normal-weight mixes and 3 lightweight mixes) of varying strengths and cementitious content. Figure 2A-4 shows the NRMCA regions referenced in the current Regional Benchmark Report (v3.2) and Table 2A.3 shows the national and regional GWP benchmark values for normal-weight and lightweight (LW) mixes of varying strengths.

[31] CMHA Concrete Masonry Units EPD www.masonryandhardscapes.org/wp-content/uploads/2024/11/EPD_CMHA_v5.pdf
[32] NRMCA Industry Average Ready Mix Concrete EPD v3.1 www.nrmca.org/wp-content/uploads/NRMCA_EPD10294V3.1_2020.pdf
[33] NRMCA Industry Average Ready Mix Concrete EPD v3.2 www.nrmca.org/wp-content/uploads/NRMCA_EPDV3.2_2023.pdf

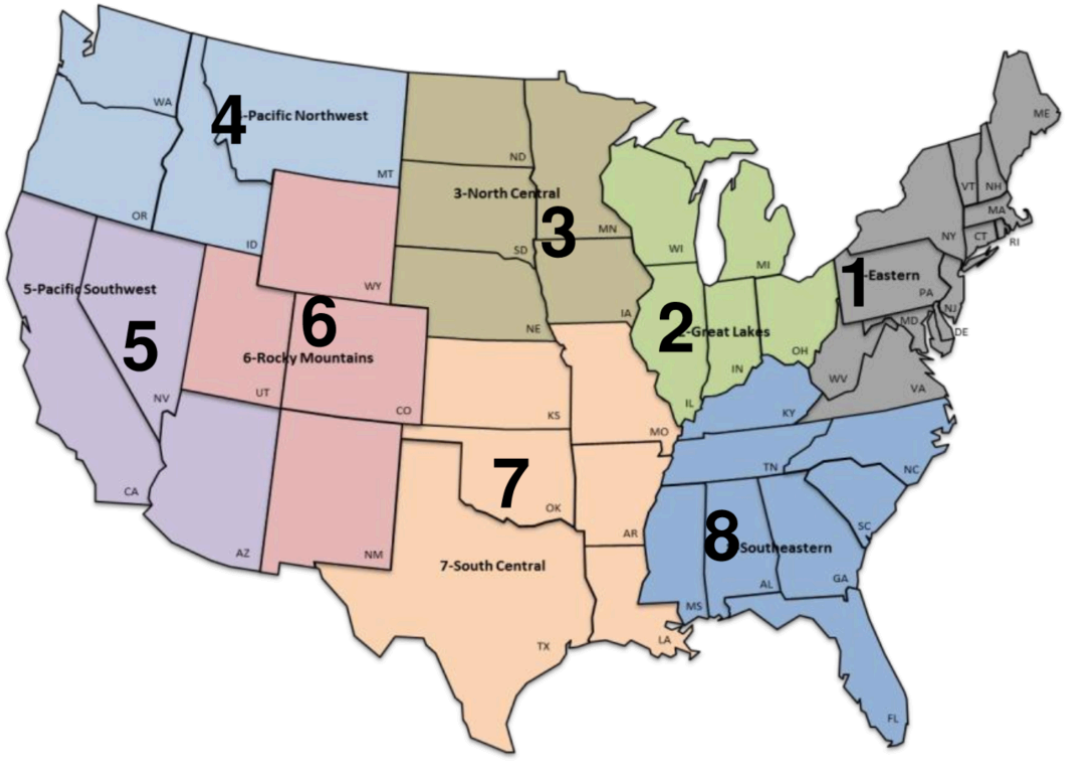

Figure 2A-4: NRMCA Regions 1 through 8 used for LCA Benchmarking.

Table 2A.3: National and Regional Concrete GWP Benchmarks from NRMCA's v3.2 LCA Report

	Concrete compressive strength at 28 days (pounds per square inch, psi)								
	2500psi	3000psi	4000psi	5000psi	6000psi	8000psi	LW3000psi	LW4000psi	LW5000psi
National	240	262	308	365	385	446	492	540	588
1. Eastern	240	264	314	378	399	472	517	573	628
2. Great Lakes Midwest	232	255	303	363	383	452	499	551	603
3. North Central	241	264	312	372	394	460	487	537	591
4. Pacific Northwest	235	261	316	386	408	487	518	575	632
5. Pacific Southwest	257	279	323	378	401	456	500	546	594
6. Rocky Mountains	232	255	301	358	379	440	484	532	580
7. South Central	226	245	286	336	356	409	468	510	555
8. Southeastern	247	268	309	360	382	435	478	521	562

Note: GWP values shown are in $kgCO_2e/m^3$. Mix strengths shown with LW indicate lightweight concrete; all others apply to normal weight concrete.

The NRMCA has also developed the NRMCA EPD Program to support concrete producers and product suppliers in obtaining certified EPDs. Through the program, NRMCA provides guidance on selecting a verified LCA consultant to develop a draft EPD, which will then be certified by a qualified independent

verifier randomly selected by NRMCA. The NRMCA is an EPD Program Operator, which means that it oversees the development, verification, and certification of concrete EPDs, which must be produced in accordance with concrete product category rules (PCRs) and third-party verified.

While EPD counts and manufacturer participation in industry-wide average EPD efforts can be a metric to estimate market readiness of a material, another indicator is the availability of resources for streamlined, on-demand EPD generation. There are a growing number of tools and resources available that are capable of calculating carbon impacts of ready mix concrete, such as Climate Earth's Ready Mix EPD Generator[34] which allows concrete suppliers to generate EPDs on-demand, in some cases in as little as 24 hours.

Additional Considerations

Mobile batch plants

The Product Category Rule (PCR) for Concrete v2.3 – 2025 Extension (NSF 1112-19 with 2024 deviation and 2025 extension) was recently updated to include proposed language developed by the Concrete PCR Committee to provide clarity on data collection requirements for mobile concrete batch plants. The proposed language would require that data be reported in EPDs under module [A3] for transportation for mobilization of the plant to the location indicated in the EPD. Previously this data was not required according to the PCR, but could be omitted if the transportation for mobilization is less than 1% of the total transportation that includes the mobilization of the plant and the mix design raw materials for the intended project. While some procurement policies are excluding mobile plants from requirements, it is recommended that EPD data is collected for mobile plants utilized in Minnesota to be able to establish appropriate benchmarks and set meaningful GWP limits in the future.

Concrete in Other Programs/Policies

Most Buy Clean policies or programs include requirements on concrete and/or cement, with the exception of the state of California, which has incorporated concrete GWP requirements into local codes. Following the GWP limit structure published in EPA's interim report (EPA 2022), GSA has established tiered limits based on EPDs found in EC3, to establish GWP values for the average, top 40%, and top 20%. A tiered limit structure allows for targeted values to set incentive thresholds to encourage program performance above and beyond a single average benchmark value. Other programs such as FEMA (IRA) and those implemented in New York State, Colorado, and Portland, Oregon have established concrete GWP limits based on NRMCA regional benchmark values. Table 2A.4 summarizes benchmarking sources and implementation timelines for concrete in other policies, as well as GWP limit values for a normal-weight 4,000 psi mix as an example for comparison purposes (GWP limits shown are in $kgCO_2e/m^3$).

[34] Climate Earth Ready Mix Concrete EPD Generator climateearth.com/solutions/readymix/

Table 2A.4: Ready Mix Concrete GWP Limits in Other Programs/Policies

Entity / Policy	Benchmark source	Timeline	GWP Limit* ($kgCO_2e/m^3$)
GSA (IRA)**	3 tiers of limits - based on EPDs uploaded to EC3 per product type, including product EPDs and industry EPDs weighted at 20x	12/12/2023 (after six-month pilot period that began 5/16/2023)	Average: 352 Top 40%: 326 Top 20%: 284
FEMA**	NRMCA USA National benchmark (v3.2)	3/21/2023	308
California (CALGreen code Title 24)	175% x NRMCA Pacific Southwest Region benchmark (2022) GWP values	Requirements went into effect July 1, 2024.	566
New York State	150% x NRMCA Eastern Region benchmark (v3.2) GWP values	1/1/2024: Require EPDs 1/1/2025: GWP Limits 1/1/2027: Revise Limits	471
Colorado (OSA)	NRMCA Rocky Mountain Region benchmark values (v3.2) for value at the high end of Colorado's strength range.	1/1/2024, 1/1/2026 (and every four years after). OSA may review the GWP limits on an annual basis with any updates complete by 02/28 of the applicable year.	301
Colorado (DOT)	Based on EPDs for CDOT materials published between Oct. 2, 2021 and Nov. 18, 2024. GWP limits are set at the 90th percentile values.	GWP Limits published Jan. 1, 2025. Required for all projects bid on July 1, 2025 or later.	Class P concrete limit = 346.2 Class D concrete limit = 365.1 Class B concrete limit = 360.0
Portland, OR	NRMCA Pacific Northwest Region benchmark (v3.2)	1/1/2020: Require EPDs 1/1/2023: GWP Limits	316
Port Authority of New York and New Jersey	Limits based on historical mix data and LCA emission factors per ingredient		267

*GWP limits shown are for 4,000psi Normal-weight Concrete for comparison purposes, unless noted otherwise. GWP limits may have changed since this report was published.

**GWP limits may no longer be active for these entities.

Minimum Material Quantity Thresholds

Some programs have set minimum material quantity thresholds, which would need to be met in addition to the overall project eligibility requirements of the program. In addition to meeting overall project eligibility based on cost or size, certain materials would need to meet or exceed minimum quantities to trigger EPD requirements. Below are a few examples of minimum concrete quantity thresholds:

- GSA (P100): ≥ 10yd^3 on any GSA project.
- New York State: Buildings: Cost≥$1mil AND Conc≥50$yd^3$; DOT: Cost≥$3mil AND Conc≥200yd^3.
- New Jersey: ≥ 50yd^3 on any state-funded project.
- Portland, OR: ≥ 50yd^3 on any City project.

In order to simplify program requirements, streamline the submittal process, and reduce administrative burden of project teams (designers, engineers, project managers, and contractors) and state agencies, it is recommended that additional minimum quantity thresholds are not added to expand the current definition of eligibility as currently established in Minnesota's statute language, which is shown below:

MN Article 12. Section 1. [16B.312]. Subd.1
"Eligible project" means
(1) new construction of a state building larger than 50,000 gross square feet of occupied or conditioned space;
(2) renovation of more than 50,000 gross square feet of occupied or conditioned space in a state building whose renovation cost exceeds 50 percent of the building's assessed value; or
(3) new construction or reconstruction of two or more lane-miles of a trunk highway.

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2A(R). Concrete Recommendations

Concrete GWP recommendations are shown in Table 2A.R below. Ready mix concrete limits are based on the National Ready Mix Concrete Association (NRMCA) North Central Region Benchmark values and are categorized by concrete compressive strength for normal-weight and lightweight mixes.

GWP limits for CMU and precast concrete products are listed as “TBD” (to be determined) and will be established at a future date by the Task Force once adequate data are available. Collection of robust EPD data for these materials will be essential for setting future GWP benchmarks and aligning with market/industry feasibility, thus it is recommended that EPDs still be required for CMU and precast, though they are not bound by GWP limits at this time.

A distinct advantage that contributes to cohesive analysis, benchmarking methodologies, and recommendations, is that Minnesota’s Buy Clean policy houses both buildings and transportation projects under one roof. Research and GWP data from recent MnDOT pavement projects included in a report entitled *Development of Process to Lower Global Warming Potential of Construction Materials*[35] indicated that the NRMCA North Central regional average GWP could be utilized as a starting point limit for concrete pavements, in addition to concrete used in buildings. The data collected suggests that Minnesota concrete pavement mix designs have, on average, lower GWP impacts when compared to ready mix utilized for vertical construction applications in the same strength class, therefore, setting the same concrete GWP limits for both vertical and horizontal applications may be a conservative approach to set an initial limit for concrete pavement. However, further analysis is required to ensure benchmarking efforts and subsequent GWP limit setting aligns with pavement-specific mix designs and are based on representative, quality EPD data.

Table 2A.R. shows GWP limits based on the NRMCA North Central Region Baseline values that are recommended for concrete used in buildings.

For concrete pavement, it is recommended that product-specific EPD disclosure is mandatory for all eligible projects, though no GWP limits will be set at this time. In order to obtain adequate, quality data needed to establish paving-specific concrete benchmarks and subcategories to inform future GWP limit-setting efforts, EPD data collection will be essential in the path forward. The data landscape for pavement-specific concrete EPDs will be reassessed annually to determine if there is adequate data to establish GWP benchmarks, and if not, then another year’s worth of data will be added to the data set. This could result in development of GWP limit recommendations for concrete pavement that would roll out either in January 2027 or at the latest January 2028 (no later than 2028 per the legislation). Progress will be documented annually in updated Legislative Reports. Concrete paving and asphalt paving will follow a similar process for establishing GWP benchmarks and setting/adjusting limits, though their respective timelines may vary depending on the amount and quality of EPDs that are collected in the coming months and year(s).

[35] *Development of a Process to Lower GWP of Construction Materials.* Michelle Cooper (2025). https://mdl.mndot.gov/items/202524

Table 2A.R: Recommended GWP Limits for Concrete Materials

Material Category[1]			Maximum Allowable GWP Limit ($kgCO_2e$ per declared unit)
Ready-Mix Concrete[2] ($kgCO_2e/m^3$) based on concrete compressive strength	Normal-Weight concrete (NW)	≤2500 psi	241
		3000 psi	264
		4000 psi	312
		5000 psi	372
		6000 psi	394
		8000 psi	460
	Lightweight concrete (LW)	3000 psi	487
		4000 psi	537
		5000 psi	591
	Add 30% to these GWP limits where high early strength[3] concrete mixes are required for technical reasons.		
Concrete Masonry Units (CMU)			TBD[4]
Precast/Prestressed Concrete			TBD[4]

1. Only permanently installed materials must be considered.
2. (a) GWP values shown are categorized by 28-day concrete compressive strengths (psi) and are based on NRMCA's North Central Regional Baseline values published in NRMCA's National and Regional LCA Benchmark Report v3.2 (2022).

   (b) Limits shown do not apply to concrete pavement mix designs and mix designs for abutting concrete elements for roadway applications such as curbs, sidewalks, aprons, barriers, and retaining walls. GWP limits specific to concrete pavement and abutting concrete element applications will be developed at a later date, taking into account other factors, aside from concrete compressive strength, including but not limited to permeability, workability, smoothness, and functional application which may warrant creation of additional concrete subclassifications unique to pavement.

   (c) Portable/mobile batch plants need not meet the GWP limits shown, but required material EPD data shall be submitted as recommended in NSF PCR for Concrete v2.3 – 2025 Extension (NSF 1112-19 with 2024 deviation and 2025 Extension).

   (d) Requirements apply to concrete utilized on the project site including but not limited to: building elements (walls, beams, columns, slabs, foundations, etc.), hardscape, curbs, site retaining walls, sidewalks, aprons, barriers, and other cast-in-place concrete elements on building sites.
3. “High early strength” is concrete that, through the use of additional cement, high-early-strength cement, or admixtures, has accelerated early-age strength development. High early strength concrete produced using additional cement should be avoided where possible, due to its higher embodied carbon. An affected project delivery team must submit documentation from the Structural Engineer of Record (SEOR) on whether high early strength concrete is necessary for technical reasons, and obtain written approval from the Department of Administration or Department of Transportation prior to procurement. This 30% allowance reflects input from building sustainability experts, general contractors, engineers, and ready-mix or cement producers.
4. Lack of data at this time. It is anticipated that limits will be set for these materials once data availability and accuracy improve. Please note: Items (mixtures, materials, products) for which GWP limits are not set per this table require mandatory EPD disclosure, though they are not bound by GWP limits at this time.

Exception Pathway - Carbon Budget/Project Average

In order to minimize administrative burden that would be involved for project teams to calculate, document, verify, and track material quantities throughout the life of the project from design through construction that would be required to determine material eligibility, it is recommended that the Project Average approach is designated as an exception (and not a part of every eligible project). Project teams must apply for an exception prior to procurement and installation of any materials/products on site. Exceptions via the Carbon Budget/Project Average approach would be reviewed by the state. Note that the Project Average approach should only be used for products within the same material category, i.e. ready-mix concrete, structural steel, asphalt mixtures, etc. Table 2A.5 shows an example project with four cast-in-place concrete mix designs. Though one or more of the concrete mixes may exceed the GWP limit for the individual mix, as long as the GWP of all of the mixes on the project are below the carbon budget, then the project would meet the requirements for this expectation pathway.

Table 2A.5: Ready-Mix Concrete - Carbon Budget Example (metric units)

Mix No.	Mix Strength/Description	Quantity (m^3)	GWP Limit ($kgCO_2e/m^3$)	Qty x GWP Limit = Carbon Budget ($kgCO_2e$)	Actual GWP from EPD ($kgCO_2e/m^3$)	Qty x GWP Actual ($kgCO_2e$)
1	4000psi - FOUNDATIONS	850	312	265,200	292	248,200
2	4500psi - EXTERIOR SLABS AND WALLS	400	342	136,800	332	132,000
3	5000psi - INTERIOR SOG/SLAB ON METAL DECK	550	372	204,600	368	202,400
4	6000psi- COLUMNS/PIERS AND INTERIOR WALLS	300	394	118,200	412	123,600
	TOTALS	**2,100**		**724,800**		**707,000**

Future Task Force Considerations

Adjustment of program requirements will need to be aligned with any updates to PCRs, industry-wide recommendations, and/or future publications of NRMCA's Regional Benchmark Report.

There are a number of opportunities for future improvements of PCRs that could greatly increase EPD data precision for concrete products. One area of focus is the quality of upstream data (especially that of cement) and increasing the adoption of supply chain–specific primary source data. Cement LCA impacts can vary depending on manufacturing processes, efficiency, and fuel source. Cement accounts for as much as 95% of the impacts of the concrete mixes included in NRMCA's Industry-Wide EPD, and manufacturer specific cement impacts could result in as much as a 48% variation in GWP.[36] This underlines the importance of upstream data specificity and quality. Additionally, PCRs may consider requiring disaggregated reporting of GWP for Modules A1 (Raw Material Supply), A2 (Transport), and A3 (Manufacturing), to help identify sources of variability and the presence of data gaps that may affect future benchmarking. While NRMCA has published a statistical addendum[37] which includes benchmarking study results of A1, A2, and A3 data by region, Buy Clean programs may have difficulty in setting and verifying GWP limits specific to each life cycle module until PCRs are revised.

[36] NRMCA Industry Average Ready Mix Concrete EPD v3.2 www.nrmca.org/wp-content/uploads/NRMCA_EPDV3.2_2023.pdf
[37] NRMCA v3.2 Statistical Addendum www.nrmca.org/wp-content/uploads/NRMCA_Statistical_Addendum.pdf

2B. Asphalt

Material Background

Asphalt mixtures, or bituminous mixtures, are a combination of mineral aggregates, asphalt binder, and additives. These mixtures are commonly used for paving roadways, highways, driveways, parking lots, bike/pedestrian paths, and recreational surfaces. According to the *Minnesota Department of Transportation's Bituminous Manual* (2019), Minnesota's roadway network comprises approximately 138,794 centerline miles, of which roughly 50% are gravel, 45% are bituminous, 3% are dirt, and 1.6% are concrete. Bituminous-related pay items represent about two-thirds of the Minnesota Department of Transportation (MnDOT) construction budget, highlighting the significant potential for emissions reductions in asphalt paving across the state. To drive market transformation and maximize carbon reductions in pavements, it is essential to understand the primary contributors to carbon emissions, identify where they occur across the asphalt life cycle, and assess how the life cycle assessment (LCA) data ecosystem can evolve to support Minnesota's climate goals.

State of the Market

As of March 2025, the EC3's database includes 9,552 product-specific EPDs for asphalt paving mixtures in the U.S. – a substantial increase from just 1 EPD in 2021. In Minnesota, the number of published asphalt EPDs has grown from 0 to 45 over a similar time period. However, EPD counts alone may not be the most reliable indicator of market readiness for GWP data accounting, tracking, and reporting. An alternative indicator is the ability to generate EPDs on demand using tools such as NAPA's Emerald Eco-Label EPD Tool. Despite this progress, asphalt producers remain hesitant to publicly disclose EPDs due to concerns surrounding the dissemination of proprietary product information. Asphalt mix design–comprising specific ingredients, quantities, and admixtures– are often tailored to meet performance specifications and are considered trade secrets.

To address these concerns, one potential solution involves automated transfer of EPD data via a secure electronic format from LCA Program Operators directly to state agencies. The National Asphalt Pavement Association (NAPA) is actively collaborating with state DOTs to develop this capability. The goal is to integrate LCA and EPD tools into pavement design and construction workflows, enabling a streamlined, secure process for generating, verifying, and submitting EPD data.

Benchmarking

The current Product Category Rule (PCR) for asphalt mixtures (Version 2.0, published April 2022)[38] requires separate reporting of Global Warming Potential (GWP) for the following life cycle modules: A1 (Raw Material Supply), A2 (Transport), and A3 (Manufacturing). These modules, along with their aggregated sum, represent the "cradle-to-gate" impacts of asphalt mixtures.

Analyzing data for A1, A2, and A3 separately is critical to capturing variability in GWP and establishing meaningful GWP limits that can drive carbon reductions without penalizing projects for factors outside a contractor's control, such as based regionality material availability or climate conditions.

[38] NAPA PCR for Asphalt Mixtures v2.0 www.asphaltpavement.org/uploads/documents/EPD_Program/NAPA_PCR_AsphaltMixtures_v2.pdf

The NAPA EPD Benchmark Report (August 2024) provides a recommended methodology for establishing region-specific baselines values for A1, A2, and A3 life cycle stages. Table 2B.1 summarizes this approach and how it can be applied to develop Minnesota-specific GWP benchmarks.

Table 2B.1: Summary of Asphalt Benchmark Methodology by Life Cycle Stage.

LCA Phase	Benchmark methodology* and recommendations
A1	**1. Develop state-specific A1 values using the deterministic approach:** ● Identify functional applications to categorize asphalt mixes typically procured for projects into functional classes based on MnDOT standard mixes and construction specifications. For example: Surface vs Non-Surface Mixes (based on NMAS size) and Application (Highway/DOT/non-DOT). ● Identify a family of realistic mixture designs for each functional classification which includes actual design proportions for each of the constituent materials. ● Utilize Equations 1 and 2 from NAPA's EPD Benchmark Report (shown below) to calculate GWP benchmarks/thresholds for each category of mixes, utilizing GWP intensities for upstream materials provided in the LCA supporting the PCR, which are provided in Appendix 2 of the NAPA report (GWP intensities may be updated to reflect supply chain specific EPDSs for upstream materials, as the data becomes available) $GWP_{A1\text{-}bench} = (x_1y_1 + x_2y_2 + \cdots + x_ny_n)$ **Equation 1.** Breaking out A1 from cradle-to-gate GWP calculation. $s.t. \sum_{i=1}^{n} x_i = 1\ tonne$ **Equation 2.** Mass-based constraint on Equation 1. where: ■ $GWP_{A1\text{-}bench}$ = Total reported A1 life cycle impacts ■ x_i = Total amount of ingredient i in tonnes per tonne of mix (% total mix by mass) ■ y_i = GWP intensity of one tonne of ingredient i A1 impacts calculated utilizing the deterministic/formulaic approach can serve as an initial GWP starting point, and can be validated and refined as Minnesota EPDs are collected and GWP distributions are analyzed, as described below. **2. Develop state-specific A1 GWP distributions by collecting published EPDs:** ● Collect published EPDs, which are geographically representative (both by climate and by political/market boundaries) and are representative of each of the different types of asphalt mixtures (mixture classifications). ● Perform statistical analysis of EPD A1 GWP data. Based on statistical distributions of EPD and mixture data, compare, validate, and/or refine functional classifications of mixes and corresponding A1 GWP values that were obtained via the deterministic approach.

A2*	**<u>Utilize region-specific distribution-driven thresholds:</u>** A2 GWP impacts are calculated based on the combined transport impacts of aggregate, binder, and RAP. Transportation distances are dictated by local material availability, which reflects local geology. Based on state benchmarking data collected for Minnesota, state-specific A2 GWP reference values ($kgCO_2$ per tonne) are tabulated in Table 21 of the NAPA report with an average value = 4.76, 40th percentile = 2.66, and 20th percentile = 0.99 for Minnesota*.
A3*	**<u>Utilize climate-based, regionally-specific data:</u>** A3 impacts are driven by the energy consumed by production facilities, and account for energy from sources such as grid electricity and fuels combusted in the asphalt burner, oil heaters, and onsite equipment. Using state benchmarking data collected, A3 GWP reference values ($kgCO_2$ per tonne) are tabulated in Table 22 of the NAPA report with an average value = 24.42, 40th percentile = 22.92, and 20th percentile = 22.2 for Minnesota*.

*Methodologies, equations, and reference values shown in this table are based on recommendations presented in NAPA's EPD Benchmark Report (August 2024)[39]. NAPA's Minnesota-specific A2 and A3 GWP values reported were based on data representing 20 participating sites and 8 participating organizations. Another approach to obtaining A2 and A3 GWP benchmark values may involve a more detailed analysis of subregions within Minnesota and/or a wider region of data that might include neighboring states that supply asphalt materials for Minnesota projects. It is important to ensure benchmarks are established utilizing data that is representative not only of Minnesota's Metro area, but also of Greater Minnesota, including rural and/or portable plants.

During the summer of 2025, Minnesota-specific plant data from The NAPA Benchmarking Report (August 2024) was analyzed, with the assistance of WAP Sustainability[40], to gain a deeper understanding of the representativeness of the data and data variability in the context of Minnesota's asphalt market. Of the 20 plants and 8 unique companies that participated in the NAPA study, there were 15 stationary and 5 portable plants. There was an even split between the number of urban and rural plants. Figure 2B-1 below shows a map of the number of Minnesota plants represented in NAPA's August 2024 benchmarking data. Some MnDOT districts had higher representation than others with 7 facilities in the Metro District, 0 facilities from District 2, and 1-3 participating plants in the other districts. One approach to examine representativeness of the data could involve comparing the represented plants with the total asphalt production market, as it is unclear from the benchmarking data alone whether this adequately represents the weighted production within Minnesota. For this reason, MnDOT and industry stakeholders have developed a plan to implement benchmarking methodology that utilizes data from actual EPDs collected on projects, which is described in the next section of this report.

[39] NAPA PCR for Asphalt Mixtures v2.0 www.asphaltpavement.org/uploads/documents/EPD_Program/NAPA_PCR_AsphaltMixtures_v2.pdf
[40] WAP Sustainability wapsustainability.com

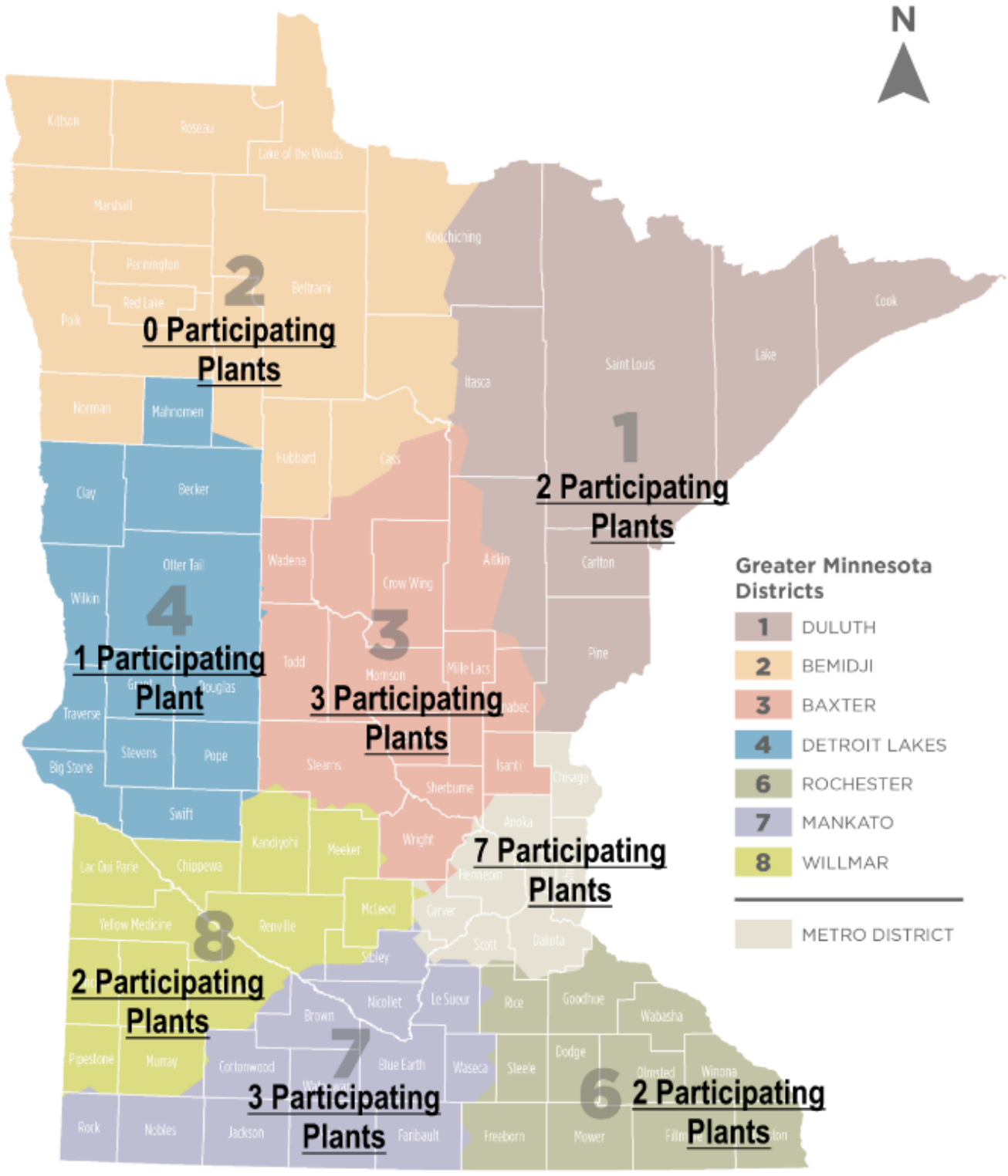

Figure 2B-1: Number of Participating Minnesota Asphalt Plants Included in NAPA's August 2024 Benchmarking Report. Background image source: www.minnesotago.org/final-plans/gmtip-draft-plan/chapter-2

MnDOT Implementation of Benchmarking Methodology

MnDOT has elected to implement Method 2—developing state-specific A1 GWP distributions by collecting published EPDs—as the primary approach for establishing asphalt GWP benchmarks. Method 1, which uses deterministic calculations based on national average upstream GWP values, was deemed less suitable due to its limited ability to differentiate between functional mix classes at the state level. While some trends (e.g., higher GWP for polymer-modified binders, lower GWP with increased RAP) are observable, other mix parameters show little variation using average data.

By contrast, Method 2 enables MnDOT to collect product- and region-specific data, allowing for a more accurate and representative analysis of A1 GWP values. MnDOT has initiated this effort by collecting EPDs through change orders on nine active projects across the state. These projects were selected to ensure geographic and functional diversity. In parallel, MnDOT is screening upcoming lettings to identify additional opportunities to request EPDs as part of contract requirements.

Next Steps and Policy Context

Once representative and appropriate asphalt benchmark values for A1, A2, and A3 GWP are established, after consulting with MnDOT, GWP limits will be established based on these benchmarks. Additional thresholds may be developed to incentivize deeper carbon reductions. Data analysis may also reveal the need for separate benchmarks for rural or portable plants. Generally, the approach for establishing maximum GWP limits for Minnesota will remain cohesive across material types (asphalt, concrete, steel, etc.), unless specific conditions justify a differentiated strategy.

MnDOT's efforts are coordinated with other U.S. state initiatives. In January 2025, Colorado DOT (CDOT) issued GWP limits for asphalt and other materials, based on EPDs published between October 2021 and November 2024. These limits were set at the 90th percentile values for each functional category[41]. As of March 2025, the only other asphalt GWP limits that were established by policy were those included GSA and FEMA federal programs, which applied a single aggregated A1-A3 threshold. Federal values did not account for regional factors such as material availability or climate, which can disadvantage some states. Other state DOTs, including California DOT (Caltrans) and New York State DOT, currently require submission of asphalt EPDs and are in the process of collecting and analyzing data to inform future GWP limit-setting.

[41] Colorado Department of Transportation Buy Clean Colorado Act Policy
www.codot.gov/business/designsupport/materials-and-geotechnical/epd-documents/buy-clean-colorado-act-policy_accessible_6-3-25_pdf.pdf

2B(R). Asphalt Recommendations

Material Scope

The recommendations herein apply to asphalt mixes used on eligible Minnesota Buy Clean projects. The following product types are currently excluded from scope but may be considered for inclusion in the future at the discretion of the Task Force and the Commissioners of Administration and Transportation: Seal coats or chip seals (e.g. emulsions and/or aggregate seals).

According to the legislative language, an eligible project is defined as *"new construction or reconstruction of two or more lane-miles of a trunk highway."* Minnesota Department of Transportation (MnDOT) interprets this definition to include new construction, rehabilitation, mill and overlay, and reconstruction of two or more lane-miles of a trunk highway pavement. During program implementation, MnDOT will publish documents such as Special Provisions and updated project specifications to clarify project/material scope and provide guidance for meeting requirements.

After conferring with MnDOT, subject matter experts, and industry stakeholders, and analyzing current asphalt EPD data available, it has been determined that there is not adequate data at this time to establish geographically representative benchmarks or GWP asphalt limits based on benchmarks. While NAPA's August 2024 Benchmarking Report included some Minnesota-specific plants, it is not recommended to adopt the estimated GWP thresholds listed in the NAPA Report for Minnesota's A2 and A3. For more details on the data represented in NAPA's Benchmarking report and the benchmarking methodology, please see the previous subsections.

In order to obtain adequate,quality data for benchmarking, it is recommended to require **mandatory submission of product-specific asphalt EPDs** for all eligible projects. Once sufficient data has been collected, the benchmarking approach outlined in the following section will be utilized to establish benchmarks and GWP limits based on those benchmarks. The data landscape for asphalt EPDs will be reassessed annually to determine if there is adequate data to establish GWP benchmarks, and if not, then another year's worth of data will be added to the data set. This could result in development of GWP limit recommendations that would roll out either in January 2027 or at the latest January 2028 (no later than 2028 per the legislation). Collecting and analyzing quality EPD data will be crucial to establishing representative benchmarks to be able to set GWP limits in the future. Progress will be documented in updated Legislative Reports. Asphalt paving and concrete paving will follow a similar process for establishing GWP benchmarks and setting limits, though their respective timelines may vary depending on the amount and quality of EPDs that are collected in the coming months and year(s).

Benchmarking Approach and GWP Recommendations

MnDOT is applying a data-driven methodology for establishing GWP benchmarks for asphalt mixtures. This approach involves collecting product-specific, Minnesota-representative EPDs to develop statistically valid A1 GWP distributions and inform future benchmarks for A2 and A3. This approach—corresponding to Method 2 in the NAPA Benchmark Report—is favored over Method 1, which relies on national average GWP values and deterministic calculations. While Method 1 offers general insights, it lacks the resolution needed to differentiate functional mix classes or reflect the realities of Minnesota's supply chains.

A1 – Raw Material Supply

The NAPA report outlines a deterministic methodology for calculating A1 impacts using mixture design proportions and upstream GWP intensity factors from the PCR. While this approach is technically sound, it is limited by the use of national average data. Minnesota did not contribute A1 EPD data to the NAPA benchmarking dataset, and as such, the report does not include Minnesota-specific A1 reference values. Additionally, the report cautions against using average mix designs or unclassified mixtures for benchmarking, emphasizing the need for functional classifications based on realistic, representative designs.

Given these limitations, MnDOT will use Method 2 to collect EPDs from active and upcoming projects to develop state-specific A1 GWP distributions. This will enable more accurate benchmarking and support the identification of functional classifications based on actual Minnesota mixtures, including distinctions related to binder type and RAP content—both of which are shown in the NAPA report to significantly influence A1 GWP.

A2 – Transport

A2 GWP impacts are driven by the transport of aggregate, binder, and RAP, and are highly dependent on local material availability and sourcing distances. The NAPA report provides Minnesota-specific A2 reference values based on a sample size of 20 projects, with an average A2 GWP of 4.76 kg CO_2e/tonne. While this data provides a useful starting point, the sample size is relatively small and may not fully capture the variability in Minnesota's material transport conditions. Therefore, this value will be used provisionally as a reference point, with the intent of refining the data as more EPDs are collected.

A3 – Manufacturing

A3 impacts are associated with energy consumption at the asphalt production facility and are influenced by factors such as fuel type, plant efficiency, and climate. The NAPA report uses AASHTO climate regions to regionalize A3 values and includes Minnesota in the Wet Freeze category. Minnesota-specific A3 data is based on 20 projects, with an average A3 GWP of 24.42 kg CO_2e/tonne. Given that the sample size is relatively small, these values will also be used provisionally as a reference point, with the expectation that future EPDs will provide more representative data for Minnesota's asphalt production conditions.

Recommended GWP Limits

MnDOT is currently collecting supply chain-specific Environmental Product Declarations (EPDs) for asphalt paving mixtures used in Minnesota projects. This effort is part of a broader initiative to develop a robust, localized dataset that reflects the actual materials and processes used in the state. The data will include global warming potential (GWP) values for each life cycle stage—A1 (raw material supply), A2 (transport), and A3 (manufacturing)—as well as the combined total (A1–A3).

This information will support efforts to establish GWP benchmarks that are representative of Minnesota-specific supply chains and production practices. By focusing on supply chain-specific data, MnDOT aims to ensure that any future thresholds are both technically sound and aligned with the environmental performance of materials used in practice.

2C. Structural Steel and Carbon Steel Rebar

Material Background

Steel is made using a combination of primary raw materials (ore) and secondary/recycled materials, through two main production methods: blast furnace-basic oxygen furnace (BF-BOF) and electric arc furnace (EAF). Primary steel production (BF-BOF production) requires coke (cooked coal) to process raw iron ore into molten iron, also known as pig iron, which is then made into steel. Because coal is a primary ingredient and this process involves high heat (upwards of 1800 degrees Fahrenheit), primary steel production results in considerably more carbon emissions than secondary steel production (EAF). Figure 2C-1 shows an overview of the BOF and EAF production processes.

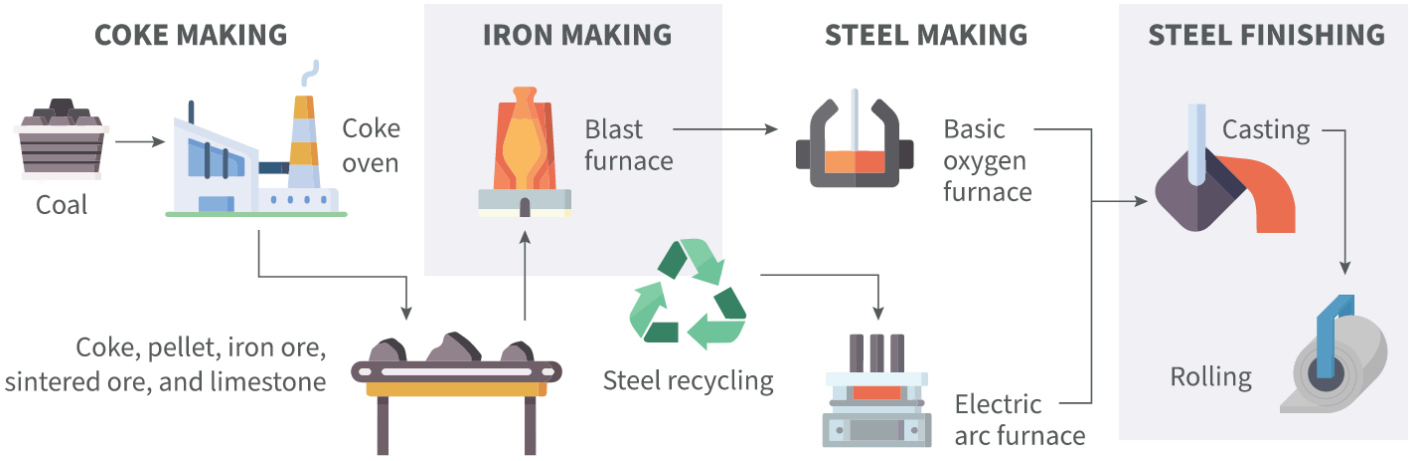

Figure 2C-1: Steps in BOF and EAF Steel Production. Source: *Buy Clean and Beyond*, RMI, 2023[42].

Minnesota Context

According to the Minnesota Department of Natural Resources, Minnesota is the largest producer of iron ore in the nation.[43] Figure 2C-2 shows a map of the nation's steel production facilities by technology and capacity. Iron ore/taconite is extracted through mining operations in the Mesabi Range and processed into pellets that are shipped primarily to BF-BOF steel mills on the Great Lakes. These pellets are primarily melted in blast furnaces and then blown with oxygen in a Basic Oxygen Furnace (BOF), but a small amount of the pellets produced in Minnesota can be reduced via the Direct Reduced Iron (DRI) process and then fed into an Electric Arc Furnace (EAF) to produce crude steel. Direct Reduced Iron (DRI), also called sponge iron, is produced from the direct reduction of iron ore via solid-state processes, utilizing either coal or natural gas. The DRI process, a blast furnace alternative for some types of steel, can result in lower carbon emissions than a traditional blast furnace, especially when utilizing natural gas and cleaner fuel sources such as hydrogen.

[42] Buy Clean and Beyond | RMI rmi.org/wp-content/uploads/dlm_uploads/2023/11/buy_clean_and_beyond_roadmap_report.pdf
[43] Mining in Minnesota | DNR www.dnr.state.mn.us/education/geology/digging/mining.html

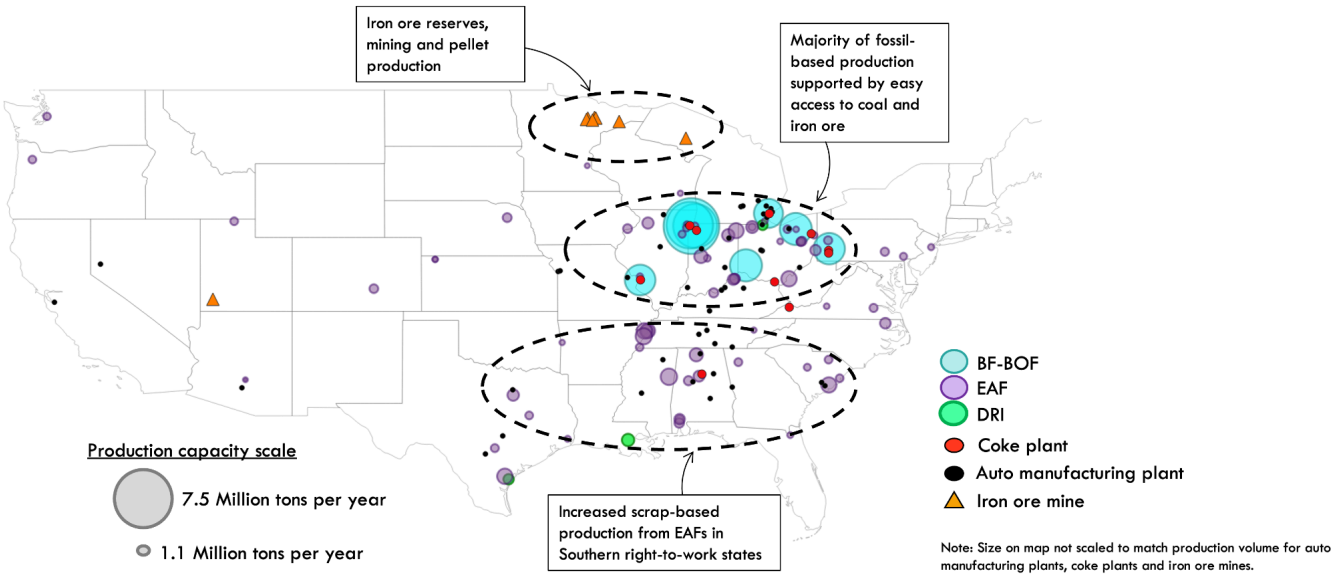

Figure 2C-2: Map of Steel Production Facilities by Technology. Source: *Opportunities for Near-Zero-Emissions Steel Production in the Great Lakes*, RMI, 2023[44].

The following steel products were examined as part of the work of the Task Force, taking into consideration steel production processes and EPD data availability and quality, to inform steel material recommendations presented in this report:

- Concrete Reinforcing Steel (rebar)
- Structural Steel:
    - Hot-Rolled Sections (wide-flange/I-beams, channels, angles, T sections)
    - HSS (Hollow Structural Sections)
    - Plate
- Steel Deck
- Open-Web Steel Joists
- Cold-Formed Steel Framing (stud, track, framing, etc.)
- Prestressed Concrete Steel Wire Strand / Post Tensioned Steel Tendons
- Steel Coil

[44] rmi.org/gap-analysis-for-near-zero-emissions-steel-production-in-the-great-lakes/

State of the Market

Different types of steel construction products utilized in today's market have varying percentages of primary (i.e. made from iron ore) and secondary (i.e. made from scrap or recycled material) steel. For example, steel reinforcing bars are produced with secondary steel, and thus have a significantly lower GWP than other structural products such as cold-rolled steel/steel plate.

Steel decking, hollow structural sections (HSS), and cold-formed steel products are manufactured using hot-rolled or cold-rolled coil, a mill product, which can be uncoated or galvanized. The coil can be produced via electric arc furnace (EAF) or integrated blast furnace-basic oxygen furnace (BF-BOF) steel production technologies. A significant portion of the GWP impacts of products such as steel decking and HSS are attributed to the upstream manufacturing of the coil, and coil data utilized to generate EPDs for such products varies, sometimes including coil produced via EAF, BOF, or a mix of both. Information available to HSS manufacturers and steel deck manufacturers when developing EPDs in recent years has not consistently tracked/reported GWP breakdown based on EAF vs. BOF coil, so a blended EAF/BOF value was used in establishing industry-wide EPDs. Currently there are very few HSS manufacturers that have updated their EPDs to break out BOF production, and it will take some time before there is adequate data available to establish industry-wide averages based specifically on EAF or BOF production.

While there is considerable variation in the percentage of primary and secondary steel amongst different steel products, there is also variation in how GWP data is tracked and reported in EPDs, as well as number of EPDs. Table 2C.1 shows a summary of EPD representation for steel product categories (note that the counts shown are not necessarily the same as the number of participants who contributed data to the respective product's industry-wide EPDs, and the number of valid EPDs might have changed since the publishing of the 2024 steel industry report, *Global Warming Potential Impacts of Domestic Steel Construction Products*[45]).

Table 2C.1: Summary of Steel Product EPD Representation. Source: AISC et. al., 2024.

Product Category	Product- and Facility-specific EPDs	Share of US Market Production Represented[1]	Industry-Wide EPD published by Applicable Trade Association?
Reinforcing Bar	26	High	Y
Steel Plate	9	High	Y
Hot-rolled Structural Sections	6	High	Y
Hollow Structural Sections	23	High	Y
Steel Deck	23	High	Y

[1]Key (Coverage of EPDs as estimate of market production represented):
High 67% to 100%
Medium 34% to 66%
Low 0% to 33%

[45] www.aisc.org/globalassets/aisc/sustainability/steel-industry-report-for-fhwa-lctm-program-dec-2024.pdf

In the U.S. market, steel reinforcing bar (rebar) is produced exclusively via EAF (there are no BOF rebar mills domestically). Hot-rolled structural sections, such as wide-flange, channel, angle, and T-shapes, are primarily made using EAF steel production. However, HSS, steel plate, steel deck, and cold-formed steel framing could be manufactured using integrated/BOF production, secondary/EAF production, or a blend of both. While industry-wide EPDs for these products don't currently report emissions data disaggregated by steel production method, some facility-specific EPDs include this type of disaggregated data. Facility-specific EPDs for HSS, steel plate, and steel deck are summarized in Tables 2C.2, 2C.3, and 2C.4 below. It is important to note that some companies/facilities listed in these tables may not have participated in data contributing to their respective product's industry-wide EPDs. See Table 2C.5 for a list of industry-wide EPDs, including a description of participating companies. Industry-wide EPDs report the production-weighted average GWP impacts across participating sites.

Table 2C.2: Facility-Specific HSS EPDs. Source:www.aisc.org/sustainability/steels-environmental-footprint

Company	Location	GWP As Published Cradle-to-Manufacturer-Gate (kg CO_2e / kg steel)	Based on Primary Manufacturing Data from
Atlas Tube	Birmingham, AL	1.22	2021-22
	Blytheville, AR	1.38	2021-22
	Blytheville, AR (Jumbo)	1.28	2021-22
	Chicago, IL	2.12	2021-22
	Harrow, ON (non-domestic, EAF)	1.32	2021-22
	Harrow, ON (non-domestic)	1.72	2021-22
	Plymouth, MI	1.64	2021-22
Bull Moose	Burlington, ON (non-domestic)	1.75	2020
	Casa Grande, AZ (Blend)	1.91	2020
	Casa Grande, AZ (EAF)	1.38	2020
	Chicago Heights, IL (Blend)	1.68	2020
	Chicago Heights, IL (EAF)	1.39	2020
	Elkhart, IN (Blend)	1.69	2020
	Elkhart, IN (EAF)	1.16	2020
	Gerald, MO (Blend)	1.82	2020
	Gerald, MO (EAF)	1.49	2020
	Masury, OH (Blend)	1.72	2020
	Masury, OH (EAF)	1.35	2020
	Sinton, TX (EAF)	1.06	2024
	Trenton, GA (Blend)	1.75	2020
	Trenton, GA (EAF)	1.28	2020
Maruichi America	Santa Fe Springs, CA	1.90	2019-20
Maruichi Leavitt	Chicago, IL	1.71	2019-20
MOST	Portland, OR	1.62	2019-20
Nucor Tubular Products	Birmingham, AL (EAF)	1.22	2022
	Chicago, IL (EAF)	1.13	2022
	Decatur, AL (EAF)	1.12	2022
	Marseilles, IL (EAF)	1.18	2022
	Trinity, AL (EAF)	1.20	2022
Searing Industries	Cucamonga, CA	1.69	2019-20
	Cheyanne, WY	1.61	2019-20
Vest, Inc	Vernon, CA	1.63	2019-20

Notes:
- The table represents the most recently published GWP data from relevant domestic structural steel locations as of October 21, 2025.
- The table is intended solely to provide a quick reference summary for those trying to comply with GWP procurement policies such as Buy Clean.
- The table is not intended to provide a basis from which policy makers could determine industry average performance. Industry-average performance is reported in industry-average EPDs, listed further down on this page. If you are a Buy Clean policy author, see AISC's Buy Clean Guidance for Structural Steel Products.
- The table is not intended to make direct comparisons between products. Life Cycle Assessment (LCA) literature (including ISO standards, the North American Steel Construction Products Product Category Rule (PCR), and each EPD itself in the table) makes clear that EPD comparability is limited and urges caution when comparing EPDs outside the context of a robust whole-building LCA. In order to make comparisons, differences in background datasets, age of primary data, impact assessment factors, LCA methodologies, PCR versions, and more must be considered.

Table 2C.3: Facility-Specific Steel Plate EPDs. Source:www.aisc.org/sustainability/steels-environmental-footprint

Company	Location	GWP As Published Cradle-to-Mill-Gate (kg CO_2e / kg steel)	Based on Primary Production Data from
Cleveland Cliffs	Burns Harbor, IN (BOF)	2.37	2021-22
	Coatesville, PA (EAF)	1.48	2021
Nucor	Hertford County, NC (EAF)	0.987	2022
	Tuscaloosa, AL (EAF)	0.951	2023
SSAB	Axis (Mobile), AL (EAF)	1.02	2019
	Muscatine, IA (EAF)	0.849	2019
EVRAZ	Portland, OR (EAF Canada)	1.44	2018-19

Notes:
- The table represents the most recently published GWP data from relevant domestic structural steel locations as of October 21, 2025.
- The table is intended solely to provide a quick reference summary for those trying to comply with GWP procurement policies such as Buy Clean.
- The table is not intended to provide a basis from which policy makers could determine industry average performance. Industry-average performance is reported in industry-average EPDs, listed further down on this page. If you are a Buy Clean policy author, see AISC's Buy Clean Guidance for Structural Steel Products.
- The table is not intended to make direct comparisons between products. Life Cycle Assessment (LCA) literature (including ISO standards, the North American Steel Construction Products Product Category Rule (PCR), and each EPD itself in the table) makes clear that EPD comparability is limited and urges caution when comparing EPDs outside the context of a robust whole-building LCA. In order to make comparisons, differences in background datasets, age of primary data, impact assessment factors, LCA methodologies, PCR versions, and more must be considered.

Table 2C.4: Facility-Specific Steel Deck EPDs. Source:www.aisc.org/sustainability/steels-environmental-footprint

Company	Location	GWP As Published Cradle-to-Manufacturer-Gate (kg CO_2e / kg steel)	Based on Primary Manufacturing Data from
ASC Steel Deck	Kalama, WA (EAF)	1.98	2019-20
	Kalama, WA (BOF)	3.13	2020
Canam Steel Corp.	Jacksonville, FL	2.25	2019-20
	South Plainfield, NJ	2.25	2019-20
	Peru, IL (EAF)	1.62	2019-20
	Peru, IL (Blend)	2.23	2019-20
New Millennium	Butler, IN (EAF)	1.75	2020
	Butler, IN (Blend)	2.36	2020
	Butler, IN (BOF)	3.20	2020
	Hope, AR (EAF)	1.54	2020
	Hope, AR (Blend)	1.63	2020
	Hope, AR (BOF)	2.99	2020
	Memphis, TN (EAF)	2.04	2020
	Memphis, TN (Blend)	2.30	2020

	Memphis, TN (BOF)	3.59	2020
	Lake City, FL (EAF)	1.71	2020
	Lake City, FL (Blend)	1.95	2020
	Lake City, FL (BOF)	3.17	2020
	Salem, VA (EAF)	1.72	2020
	Salem, VA (Blend)	2.25	2020
	Salem, VA (BOF)	3.16	2020
Verco (Nucor)	Antioch, CA (EAF)	1.81	2021
	Antioch, CA (BOF)	2.22	2021
	Fontana, CA (EAF)	1.79	2021
	Fontana, CA (BOF)	2.21	2021
	Phoenix, AZ (EAF)	1.79	2021
	Phoenix, AZ (BOF)	2.23	2021
Vulcraft (Nucor)	Chemung, NY (EAF)	1.62	2021
	Florence, SC (EAF)	2.22	2021
	Fort Payne, AL (EAF)	1.55	2021
	Grapeland, TX (EAF)	1.85	2021
	Norfolk, NE (EAF)	1.63	2021
	Saint Joe, IN (EAF)	1.60	2021
	Ancaster, ON (non-domestic, Blend)	1.83	2023
Canam Group Inc.	Boucherville, QC (non-domestic)	2.05	2023
	Calgary, AB (non-domestic)	2.22	2023
	Mississauga, ON (non-domestic)	2.01	2023

Notes:

- The table represents the most recently published GWP data from relevant domestic structural steel locations as of October 21, 2025.
- The table is intended solely to provide a quick reference summary for those trying to comply with GWP procurement policies such as Buy Clean.
- The table is not intended to provide a basis from which policy makers could determine industry average performance. Industry-average performance is reported in industry-average EPDs, listed further down on this page. If you are a Buy Clean policy author, see AISC's Buy Clean Guidance for Structural Steel Products.
- The table is not intended to make direct comparisons between products. Life Cycle Assessment (LCA) literature (including ISO standards, the North American Steel Construction Products Product Category Rule (PCR), and each EPD itself in the table) makes clear that EPD comparability is limited and urges caution when comparing EPDs outside the context of a robust whole-building LCA. In order to make comparisons, differences in background datasets, age of primary data, impact assessment factors, LCA methodologies, PCR versions, and more must be considered.

The legislation states that *"the commissioner may set different maximum global warming potentials for different specific products and subproduct categories that are examples of the same eligible material based on distinctions between eligible material production and manufacturing processes, such as integrated versus secondary steel production"* (Minnesota Statute 16B.312 Subd. 2 paragraph c). The Task Force recognizes the importance of distinguishing between integrated (BOF) and secondary (EAF) steel production processes and this is reflected in Table 2C.R-2 in the steel recommendations section. Four products in Table 2C.R-2 have separate rows for a blended GWP limit (blend of EAF/BOF data), a secondary production (EAF-only) GWP limit, and an integrated (BOF-only) GWP limit, including HSS, Plate, Steel Deck, and Cold Formed Metal Framing. Current industry EPD data for these product categories includes a blend of EAF and BOF data, both due to the inclusion of products manufactured primarily utilizing an EAF or BOF process or due to products being manufactured using multiple parts/pieces/portions of source material that may have been produced via EAF/BOF processes.

After reviewing available industry-wide and facility-specific EPD data and consulting with subject matter experts, the Task Force has compiled current GWP values for three of the four aforementioned products, including HSS, Plate, and Steel Deck, based on production-weighted data collected and published by the respective industry organizations. Analysis of the data currently available for these

three product types indicates that there is not adequate data to accurately set EAF-only or BOF-only, but rather a blend of EAF and BOF data for these products, thus the GWP values shown in Table 2C.R-2 are the blended EAF/BOF production-weighted averages calculated in the respective industry-wide EPDs. Once sufficient disaggregated data is available to distinguish EAF/BOF products separately, these values may be adjusted. Additional analysis of the available facility-specific Cold Formed Metal Framing EPDs in the context of the Minnesota construction market will be required in the future to be able to set appropriate GWP limits for this product category. Table 2C.R-2 summarizes these recommendations in the next section of this report.

Setting a single, blended GWP benchmark value each for HSS, Plate, and Steel Deck would reduce complexities in tracking and reporting steel product data inherent in the steel supply chain, however, it is recommended that more data is collected with the end goal of implementing GWP limits in 2028 which are reflective of the market. Furthermore, depending on the size of the project, the specific steel products/members specified in design, and material availability during construction, Minnesota-based subcontractors and local steel fabricators don't always procure steel products directly from the mills where they are manufactured. Steel products are often shipped from mills across the U.S., from states such as Indiana, Pennsylvania, North Carolina, Arkansas, etc., to steel service centers, and then shipped from service centers to local fabricators. Thus, simplifying GWP requirements for steel products will be important to consider to ensure practical implementation and integration into the procurement process.

In addition to the steel products represented in Table 2C.1, industry-wide EPDs and several product/facility-specific EPDs have been published for Open-Web Steel Joists (OWSJ) and Cold-Formed Steel (commonly abbreviated as CFS or CF) Framing. The Steel Joist Institute (SJI) published an industry-wide EPD for Open-Web Steel Joists and Joist Girders[46], which represents steel joists produced by all SJI members and includes data from Canam Steel Corporation, Vulcraft (Nucor Corporation), and New Millennium Building Systems, which accounts for more than 90% of North American Membership production. The Steel Framing Industry Association (SFIA), which consists of manufacturers, designers, suppliers, and construction professionals representing about 80% of the CFS framing products produced in the U.S., published the latest industry-wide EPD for CF Framing[47] valid through May 27, 2026 (EPD-07103), which is based on a production-weighted average across ten different manufacturing facilities/companies. Table 2C.5 summarizes industry-wide EPDs referenced for these and other steel construction products examined as a part of the Task Force work.

Pre-tensioned or post-tension (PT) steel cables/tendons, which are utilized in concrete construction to introduce compressive stresses into the concrete after it has been cast, are made from Special Bar Quality (SBQ) steel. SBQ steel is commonly used for high-stress or more rigorous end-use applications (such as gears, bearings, axles, drivetrains, and PT steel strand), and thus must be manufactured to meet more stringent performance standards than compared to Merchant Bar Quality (MBQ) steel, which is frequently used for products like rebar, channels, and angles that don't require heightened mechanical properties. While some EPDs are available for SBQ products, more market development is needed to quantify carbon impacts specifically for pre-tensioned or post-tension (PT) steel cables/tendons to understand product EPD representation and data specificity/quality that would be needed to establish GWP benchmarks.

[46] SJI OWSJ and Joist Girders Industry-Wide EPD steeljoist.org/wp-content/uploads/2022/02/101.1_SJI_EPD_2022-Steel-Joist_022122.pdf
[47] SFIA Cold-formed Steel Framing Industry-Wide EPD www.steelframing.org/environmental-product-declaration

Table 2C.5: Industry-Wide EPDs for Domestic Steel Products

Product	Publisher	Date of Issue	Participating Member Information
Fabricated Steel Reinforcing Bar (Rebar)*	Concrete Reinforcing Steel Institute (CRSI)	September 2022	Industry average is based on data collection from 19 CRSI-member mills producing reinforcing bars. Primary data for steel production was collected by the CRSI and represents 2019-2020 production. Weighting was based on production data. As of October 2025, 104 steel fabricators (CRSI Fabricator Members) are listed on CRSI's website (www.crsi.org/sustainability/environmental-product-declaration) as eligible to utilize this Industry-Wide EPD data representative of rebar GWP impacts.
Fabricated Hot-Rolled Structural Steel Sections*	American Institute of Steel Construction (AISC)	January 2021**	The industry average is based on data collection from 100% of all six heavy structural mills rolling hot-rolled sections. Weighting was based on production data. This EPD represents fabricated hot-rolled structural steel sections produced by AISC's membership, representing 2019 and 2020 production data. More than 75 AISC members contributed data for EPD development. Results are weighted according to production totals at participating fabricators.
Fabricated Hollow Structural Sections (HSS)*	American Institute of Steel Construction (AISC) & Steel Tube Institute (STI)	February 2022	This EPD represents fabricated HSS produced by STI's and AISC's membership. The following STI members contributed to the EPD: Atlas Tube, Maruichi American Corporation, Maruichi Leavitt Pipe & Tube, Maruichi Oregon Steel Tube (MOST), Nucor Tubular Products, Searing Industries, Vest Inc., and Wheatland Tube.
Fabricated Steel Plate*	American Institute of Steel Construction (AISC)	January 2021	Six major facilities, of both EAF and BOF steelmaking, are represented in this industry-wide EPD. Primary data for steel production was collected by the American Iron and Steel Institute (AISI) and represents the 2017 production year. Primary data for fabrication were collected during the years 2019 and 2020. This EPD is intended to represent fabrication in 2019.
Steel Decking (Roof and Floor Deck)	Steel Deck Institute (SDI)	January 2022	Several steel deck manufacturers contributed data for EPD development with production facilities within the United States, including Alabama, Arizona, Arkansas, California, Florida, Illinois, Indiana, Nebraska, New Jersey, New York, South Carolina, Tennessee, Texas, and Virginia. The data collected represents over 85% of North American membership production. The SDI members that contributed to EPD development are: ASC Steel Deck, Canam, Cordeck, DACS Inc., CSM Products and Solutions, Epic Metals Corp., Gooder-Henrichsen Co., Intsel Steel East, Marlyn Steel Decks Inc., Miami Metal Deck, New Millennium Building Systems, OEG Building Materials, Roof Deck Inc., Seyco Deck, Sloan Supply Company Inc., Tri-State Decking Inc., Valley Joist, Verco Decking Inc. (a Nucor company), and Vulcraft (Nucor Corporation).
Open Web Steel Joists and Joist Girders	Steel Joist Institute (SJI)	January 2022	This publication represents Steel Joist Institute's membership: Atecno, Canam Group Inc., Canam Steel Corp., ESJ, Gooder-Henrichsen, Joist Structural Systems, New Millennium Building Systems, Seyco Joist Company, Valley Joist, and Vulcraft (Nucor Corporation). This EPD represents steel joists produced by all SJI member companies who contributed to the development of the EPD. The members that participated in data collection for this EPD are listed below and account for more than 90% of North American membership production: Canam Steel Corporation, New Millenium Building Systems, and Vulcraft (Nucor Corporation).
Cold-Formed Steel (CFS) Framing	Steel Framing Industry Association (SFIA)	Issued May 2021, Version Updated September 2025	Participating manufacturers include CEMCO, ClarkDietrich, Delineate, Frametek, Mill Steel Framing, MRI Steel Framing, Panel Rey, RAM Steel Framing, State Building Products, and Steeler. One manufacturing facility was chosen from each company, and for companies with multiple facilities, locations were chosen in order to provide the greatest geographic and capacity representativeness across the US. Results in this EPD are based on a production-weighted average across the ten manufacturing sites.

*The unfabricated GWP values shown in this report were back-calculated from fabricated values using the industry-wide fabrication impacts in the respective industry-wide EPDs.

**An updated version of the Hot-Rolled Structural Steel EPD was published in October 2025, which indicates a more than 10% decrease in embodied carbon from its 2021 predecessor, due to less use of ore-based metallics (OBMs), a greener U.S. electrical grid, and more on-site renewable energy generation. However, GWP values referenced in this report are based on the 2021 version of the industry-wide EPD.

Emissions Due to Fabrication

Fabrication refers to the processing of materials in preparation for use at the construction jobsite (e.g., bending, cutting, drilling, and painting), and the fabrication process, downstream of steel mills and manufacturers, is a highly case-specific activity based on a wide variety of different scenarios. Tracking and reporting GWP associated with many different downstream scenarios would involve significant time and cost to fabricators and LCA practitioners, which does not seem justifiable given that fabrication is typically 10% or less of the overall reported GWP for fabricated steel products[48]. Therefore, it is recommended that GWP limits set in Buy Clean policies refer to unfabricated values based on cradle-to-mill or cradle-to-manufacturer-gate emissions.

When the cradle-to-mill-gate or cradle-to-manufacturer-gate LCA scopes are not listed explicitly in individual steel product EPDs, this is likely due to the values being reported as cradle-to-fabricator-gate LCA scopes. In this case, equivalent GWP limits can be converted for a fabricated product based on the industry-average fabrication values shown in Table 2C.6 for structural steel and reinforcing bar. These conversion factors include the effects of scrap rates (sometimes referred to as “waste rates”), transportation to fabrication, and fabrication. Impacts for structural products are taken directly from the 3rd-party verified AISC fabrication background LCA report (February 2021) documenting a scrap rate of 7.71% (A1 multiplier), transportation (A2) of .0446 tons/ton, and fabrication (A3) of .0967 tons/ton. Impacts from reinforcing bars are from the CRSI industry-wide EPD (2022) and indicate a scrap rate of 3.0% (A1 multiplier), transportation (A2) of 0.0490 tons/ton, and fabrication (A3) of 0.0270 tons/ton[49]. Updates to the steel product category rule (PCR) emphasize unfabricated material values, though EPDs based on earlier versions might only show fabricated values, and thus conversion values are helpful for comparison purposes.

Table 2C.6: Industry-Average Fabrication GWP (kg CO_2e / kg steel). Source: AISC et al., 2024.

	Transport to Fabricator	Fabrication	Waste Rate[3] (%)
Structural Steel[1]	0.0446	0.0967	7.71
Reinforcing Bar[2]	0.0490	0.0270	3.10

[1] *Fabricated Hot-Rolled Structural Sections* 2021, *Fabricated Steel Plate* 2021, and *Fabricated Hollow Structural Sections* 2022, all published by the American Institute of Steel Construction, and based on *EPD Background Report: Fabricated hot-rolled sections, plates and hollow-structural sections*, American Institute of Steel Construction, 2021

[2] *Environmental Product Declaration: Fabricated Steel Reinforcement*, Concrete Reinforcing Steel Institute, 2022

[3] Waste rates represent the industry-average loss of primary material during fabrication

[48] Global Warming Potential Impacts of Domestic Steel Construction Products (2024) www.aisc.org/globalassets/aisc/sustainability/steel-industry-report-for-fhwa-lctm-program-dec-2024.pdf

[49] Global Warming Potential Impacts of Domestic Steel Construction Products (2024) www.aisc.org/globalassets/aisc/sustainability/steel-industry-report-for-fhwa-lctm-program-dec-2024.pdf

Definition of Structural Steel

The Minnesota Buy Clean statute (16B.312 included in Appendix A) defines structural steel as “steel that is used in structural applications in accordance with industry standard definitions.”

According to the 2022 Code of Standard Practice for Steel Buildings and Bridges (ANSI/AISC 303-22)[50] and the requirements of the Minnesota Buy Clean statute as interpreted, the following steel products are covered when used as elements of the structural frame that are shown and specified in the structural documents:

- Hot rolled sections consisting of W-, S-, C-, MC-, and M- shapes, angles, and tees
- Hollow Structural Sections(HSS) consisting of carbon or low-alloy steel that is cold-formed and welded (ASTM A500, A847 or A1085) in round, square and rectangular configurations
- Steel plate
- Open-Web Steel Joists
- Structural Cold-Formed Framing (studs, track, etc.) at the exterior building envelope or interior load-bearing walls

Specifically excluded are uses of structural sections for sheet and bearing piles, guard rails, light stanchions, pressure vessels, and crane rails.

[50] AISC Code of Standard Practice for Steel Buildings and Bridges www.aisc.org/globalassets/aisc/publications/standards/a303-22w.pdf

2C(R). Steel Recommendations

Steel GWP recommendations are shown in Tables 2C.R-1 and 2C.R-2 and are based on industry-average, production-weighted values published in industry-wide EPDs for each of the respective steel products and associated industry organizations[51].

Table 2C.R-1 shows the maximum GWP limits for carbon reinforcing steel bar (rebar) recommended to be implemented into program requirements in 2026. Table 2C.R-2 shows GWP values for other steel products aligned with current industry data available, however, it is recommended that GWP limits for these products are integrated into program requirements in 2028, once adequate, market-representative product data is collected and analyzed. GWP values that are listed in Table 2C.R-2 as “TBD” (to be determined) are not currently shown due to inadequate data and will be established by the Task Force once adequate data are available. Collection of robust EPD data for these materials will be essential in the process to develop GWP benchmarks and establish/update GWP limits to align with market feasibility as the program progresses. Thus, it is recommended that EPD disclosure is mandatory for all steel categories/products listed in the tables, though some products may not be bound by GWP limits.

The legislation (Sect. 16B.312 Subd. 2.c) states, “The commissioner may set different maximum global warming potentials for different specific products and subproduct categories that are examples of the same eligible material based on distinctions between eligible material production and manufacturing processes, such as integrated versus secondary steel production.” This allows for different maximum global warming potential (GWP) values to be established for products manufactured via integrated (BF-BOF or Blast Furnace-Basic Oxygen Furnace) and secondary (EAF or Electric Arc Furnace) steel production. The Task Force recognizes this distinction.

After reviewing available data and consulting with subject matter experts, it has been determined that for certain products, including HSS (Hollow Structural Sections), Plate, and Steel Deck—there isn't adequate data available at this time to establish statistically significant BOF-only or EAF-only values. Current industry-wide EPD data for these product categories includes a blend of EAF and BOF data, both due to the inclusion of products manufactured primarily utilizing an EAF or BOF process or due to products being manufactured using multiple parts/pieces/portions of source material that may have been produced via EAF/BOF processes. Therefore, a single, blended GWP value for these products, based on published production-weighted industry averages, is provided in Table 2C.R-2 until more comprehensive, disaggregated data is available to establish separate EAF/BOF industry-wide benchmark values. For additional background information, please reference Section 2C of this report.

[51] Steel's Environmental Footprint | AISC www.aisc.org/sustainability/steels-environmental-footprint

Table 2C.R-1: Recommended GWP Limits for Steel Reinforcing Bar (Rebar)

Steel Product Category	Maximum GWP[1] Limit at Mill or Manufacturer Gate	Equivalent GWP[1] Limit Converted for use with Fabricated[2] Product EPD
Steel Reinforcing Bar (Rebar)[3]	0.755	0.854

1. GWP limits shown are in dimensionless standard units (ton CO2e / ton steel or kg CO2e / kg steel). GWP limits are based on a 100-year lifetime impact (GWP-100) in accordance with the Product Category Rule (PCR) for Designated Steel Construction Products.The GWP value shown for fabricated reinforcing steel is based on the Industry Wide EPD: *Environmental Product Declaration: Fabricated Steel Reinforcement, Concrete Reinforcing Steel Institute (CRSI), 2022*. The unfabricated value is back-calculated from the report.
2. GWP Limits are based on cradle-to-mill-gate or cradle-to-manufacturer-gate LCA scopes, as appropriate for the particular steel product. When interpreting individual steel product EPDs, care should be taken to identify the GWP value that corresponds to the correct LCA scope. When multiple scope values are present in an EPD, preference shall be given to the cradle-to-mill-gate or cradle-to-manufacturer-gate LCA scopes when evaluating compliance with the above table.

   When the cradle-to-mill-gate or cradle-to-manufacturer-gate LCA scopes are not listed explicitly in individual steel product EPDs, this is likely due to the values being reported as cradle-to-fabricator-gate LCA scopes. In that case, one may use the values listed in the column, Equivalent GWP Limit Converted for use with Fabricated Product. The values in this column include the effects of scrap rates, transportation to fabrication, and fabrication. Impacts from reinforcing bars are from the CRSI industry-wide EPD (2022) and indicate a scrap rate of 3.0% (A1 multiplier), transportation (A2) of 0.0490 tons/ton, and fabrication (A3) of 0.0270 tons/ton.
3. The Reinforcing Steel Bar product category includes all rebar grade ASTM A615(M) and ASTM A706(M).

Table 2C.R-2: Current GWP Values for Steel Products, Based on Respective Industry-Average EPDs

Steel Product Category[7]		GWP[1] at Mill or Manufacturer Gate	Equivalent GWP[1] Converted for use with Fabricated[2] Product EPD
Structural Steel	Hot-Rolled Sections (W-, S-, C-, MC-, and M- shapes, angles, and tees)	1.00	1.22
	HSS[3] (Hollow Structural Sections) (EAF/BOF blended)[4]	1.71	1.99
	HSS from Secondary Steel Production (EAF-only)[5]	TBD	TBD
	HSS from Integrated Steel Production (BOF-only)[5]	TBD	TBD
	Plate (EAF/BOF blended)[4]	1.47	1.73
	Plate from Secondary Steel Production (EAF-only)[5]	TBD	TBD
	Plate from Integrated Steel Production (BOF-only)[5]	TBD	TBD
Open Web Steel Joists (OWSJ)		1.43	n/a
Steel Deck (EAF/BOF blended)[4]		2.32	n/a
Steel Deck from Secondary Steel Production (EAF-only)[5]		TBD	n/a
Steel Deck from Integrated Steel Production (BOF-only)[5]		TBD	n/a
Cold-Formed Steel Framing (EAF/BOF blended)[6]		TBD	TBD
CFS Framing from Secondary Steel Production (EAF-only)[4]		TBD	TBD
CFS Framing from Integrated Steel Production (BOF-only)[4]		TBD	TBD

1. GWP values shown are in dimensionless standard units (ton CO_2e / ton steel or kg CO_2e / kg steel). GWP values are based on a 100-year lifetime impact (GWP-100) in accordance with the *Product Category Rule (PCR) for Designated Steel Construction Products*. GWP values shown are based on production-weighted averages calculated and published in industry-wide EPDs for each of the respective product categories.
2. GWP values are based on cradle-to-mill-gate or cradle-to-manufacturer-gate LCA scopes, as appropriate for the particular steel product. When interpreting individual steel product EPDs, care should be taken to identify the GWP value that corresponds to the correct LCA scope. Guidance is provided at www.aisc.org/epd. When multiple scope values are present in an EPD, preference shall be given to the cradle-to-mill-gate or cradle-to-manufacturer-gate LCA scopes when evaluating compliance with the above table.

When the cradle-to-mill-gate or cradle-to-manufacturer-gate LCA scopes are not listed explicitly in individual steel product EPDs, this is likely due to the values being reported as cradle-to-fabricator-gate LCA scopes. In that case, one may use the values listed in the column, Equivalent GWP Limit Converted for use with Fabricated Product. The values in this column include the effects of scrap rates, transportation to fabrication, and fabrication. Impacts for structural products are taken directly from the 3rd-party verified AISC fabrication background LCA report (February 2021) documenting a scrap rate of 7.71% (A1 multiplier), transportation (A2) of .0446 tons/ton, and fabrication (A3) of .0967 tons/ton..

3. HSS (Hollow Structural Sections) consisting of carbon or low-alloy steel that is cold-formed and welded (ASTM A500, A847 or A1085) in round, square and rectangular configurations.
4. GWP values shown are based on production-weighted averages calculated and published in the current Industry-wide EPD for each respective material product, which includes a mix/blend of products/subproducts manufactured utilizing secondary steel production (EAF or Electric Arc Furnace), integrated steel production (BF-BOF or Blast Furnace-Basic Oxygen Furnace) methods, or a combination thereof.
5. The Task Force recognizes merit in separate GWP limits for secondary steel production (EAF or Electric Arc Furnace) and integrated steel production (BF-BOF or Blast Furnace-Basic Oxygen Furnace) methods in these product categories. Once adequate data is available to accurately report GWP impacts distinguishing between EAF and BOF methods for the product category, the Task Force may develop recommendations to update one or more GWP values for products made via secondary steel production, integrated steel production, or a combination thereof to reflect market developments.
6. Cold-formed steel framing, also called cold-formed metal framing, includes stud, track, U-channel, furring channel, L-headers, and built-up sections using one or more of these shapes.
7. Please note: Steel products listed in this table require mandatory EPD disclosure, though they are not bound by GWP limits at this time.

2D. Other Materials

The Task Force examined construction materials such as lumber and mass timber, glass, insulation, aluminum, and others, to evaluate and recommend additional materials that should be added to Minnesota's program now or in the future, beyond those already included in the policy (concrete, asphalt, structural steel, and carbon steel reinforcing bar).

Minnesota-specific material quantity data in aggregated (or disaggregated) form was not available to perform a material analysis across a large sample size of the state projects in the timeframe to produce this report, so the Task Force referenced several studies which were performed on a national or international level to compile a list of other common building materials that might significantly contribute to the carbon emissions. An analysis published in RMI's *Buy Clean and Beyond Roadmap* (2023) estimates the percentage of carbon emissions of common building materials across a federal portfolio - shown in Figure 2D-1 below.

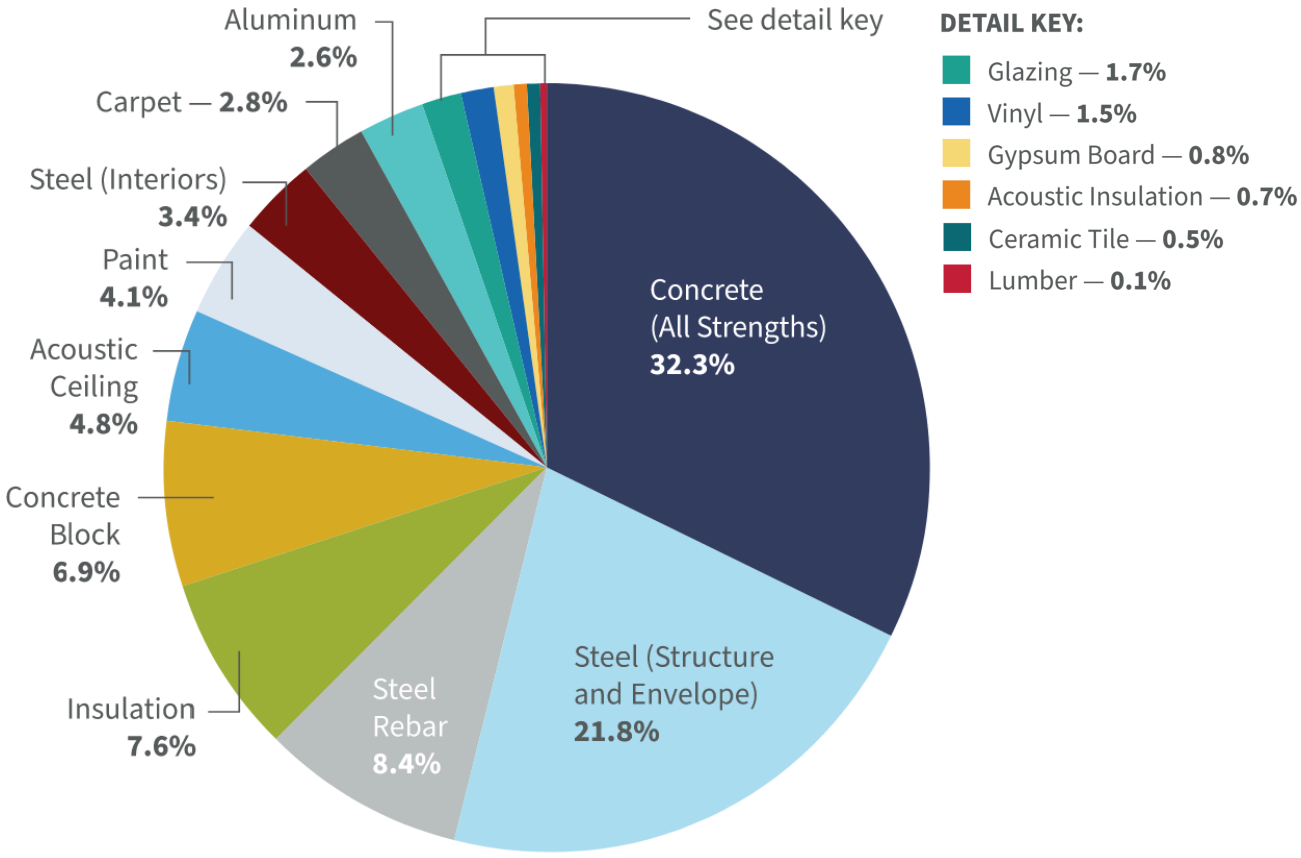

Figure 2D-1: Estimated federal carbon emissions distribution of common building materials (RMI, 2023)[52]

While percentage values for relative carbon impacts of specific building materials vary from state to state, this analysis helps to identify additional/other materials that could have a noticeable impact on emissions that should be examined further by the Task Force. Perhaps there is a future research opportunity to gather and analyze Minnesota-specific construction material quantity data representative

[52] Buy Clean and Beyond | RMI rmi.org/wp-content/uploads/dlm_uploads/2023/11/buy_clean_and_beyond_roadmap_report.pdf

of actual buildings and transportation project portfolios, if the data is attainable within a feasible time frame. In the meantime, the Task Force has compiled research for some of these materials.

The Center for Sustainable Building Research (CSBR) at the University of Minnesota conducted a building bay analysis to examine relative embodied carbon impacts of building construction materials, utilizing a structural bay model (500 square feet of floor area) with several different iterations of structural material systems and architectural cladding types. Figure 2D-2 represents one of the iterations of the study.

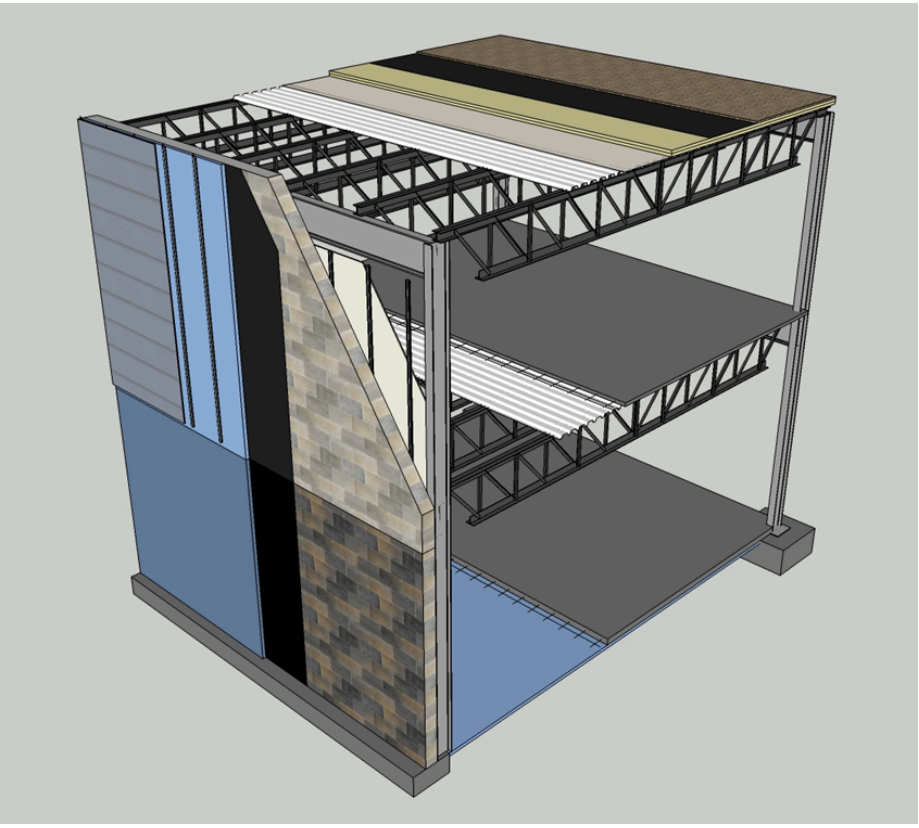

Figure 2D-2: Graphical representation of one of the iterations included in CSBR's building bay analysis.

The study utilized Athena Impact Estimator v5.5 with a proprietary LCI database updated regularly from a mix of North American sources and conforming to ISO 14040/14044. Results from the analysis are summarized in Figure 2D-3, showing the embodied GWP for the different material/system types.

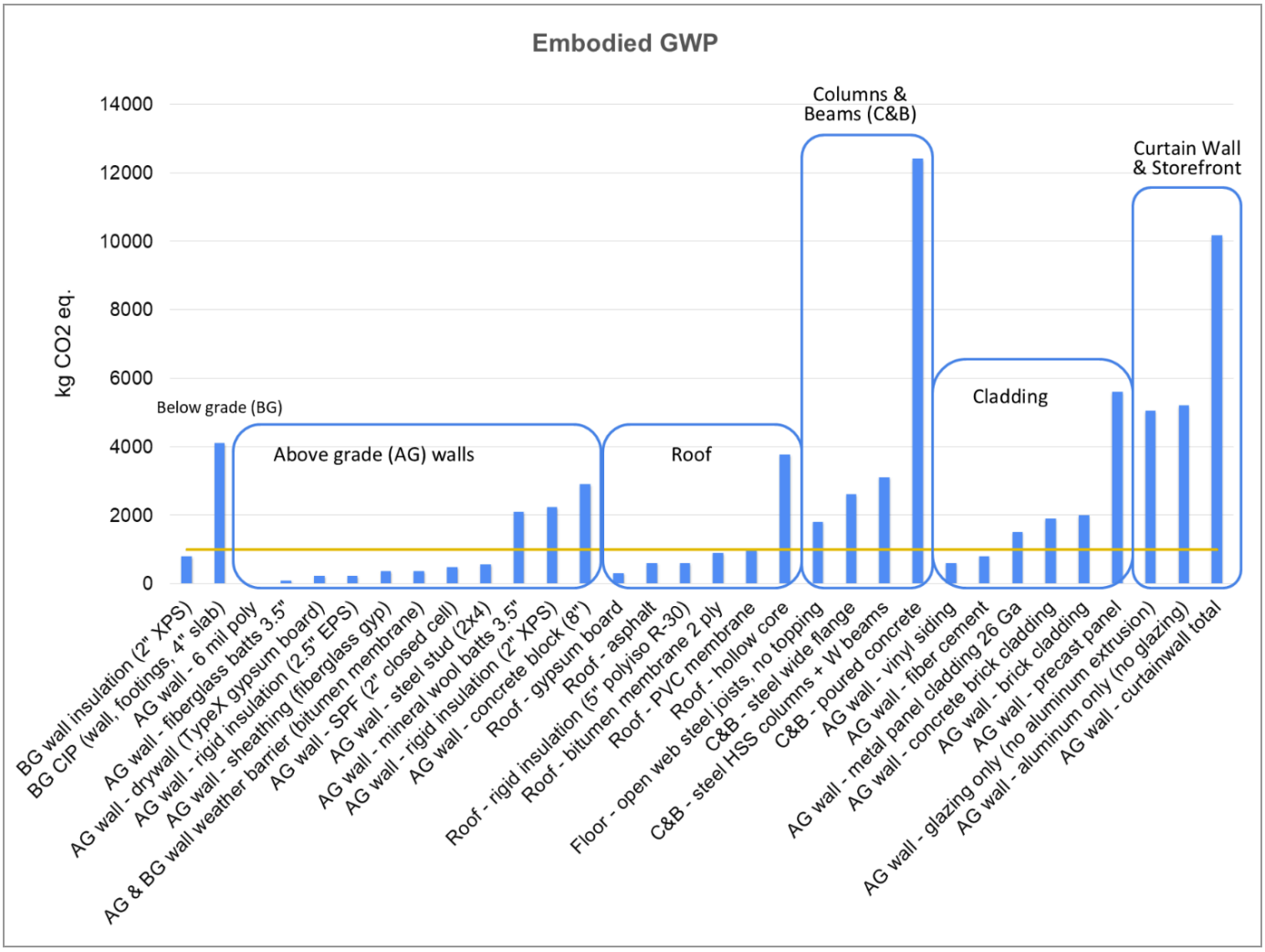

Figure 2D-3: Embodied GWP impacts of structural and architectural materials from CSBR's bay analysis.

The most impactful building materials generally fell into one of four categories:

1. Contains cement (concrete & concrete products)
2. Requires high heat or energy to manufacture (aluminum, glass, steel, mineral wool, brick)
3. Uses chemistry with potent greenhouse gases (XPS with HFC or HCFC blowing agents)
4. Is composed primarily of oil or an oil-based product (PVC, bitumen)

The research gathered helped to identify some additional materials that contribute to a building's carbon footprint, beyond concrete and steel, including aluminum, glass, and several different types of insulation.

While the studies mostly revolved around buildings, materials (such as insulation) were also examined by the Task Force in the context of horizontal construction. The following subsections provide an overview of some of the materials examined. Task Force Recommendations are presented in section 2D(R) Other Materials Recommendations, immediately following the individual material subsections below.

Glass

Glass utilized in the construction industry can be produced in the form of flat glass, processed glass, and insulated glazing units (IGUs). The term glass pane can refer to a sheet of glass, or a glass 'lite', that is untreated/uncoated (flat glass) or glass that has been treated by tempering, laminating, or coating (processed glass). Two or more panes can be fabricated into an IGU, utilizing various pane thicknesses and spacer configurations. It is estimated that 78% of the embodied carbon of an IGU is due to the manufacturing of the flat glass (which involves energy-intensive heating to float the glass), roughly 12% is attributed to the fabrication process, and 10% comes from the process of adding low-e coatings and heat treating, which is graphically shown in Figure 2D-4.[53]

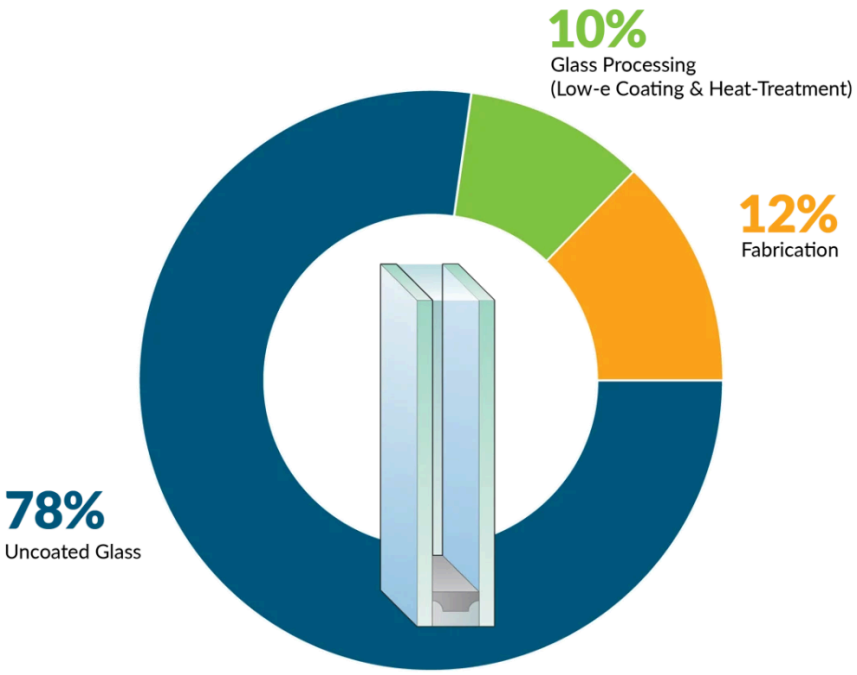

Figure 2D-4: Estimated GWP Attributed to Manufacturing an IGU[54]

Glass products are included in material scope in several Buy Clean policies, each including tailored definitions and subcategories for glass scope and requirements, which are summarized in Table 2D.1.

[53] Embodied Carbon and Glass | Vitro www.vitroglazings.com/design-resources/sustainability/embodied-carbon-in-glass

[54] Embodied Carbon and Glass | Vitro www.vitroglazings.com/design-resources/sustainability/embodied-carbon-in-glass

Table 2D.1: Glass Material Scope Definition & GWP Limits in Buy Clean Policies

Entity/ Program	Glass Material Scope Definition	GWP Limit Setting Methodology	GWP Limit*
GSA (IRA)	“Flat glass” describes all glass produced in a flat form, such as float glass, sheet glass, plate glass and rolled glass. Flat glass can be heat- or surface-treated to make processed glass, or built into assemblies such as insulating glass units (IGUs), laminated glazing units, and vacuum insulating glazing. Flat glass assemblies are often part of curtain walls, storefronts, transparent walls, window units, skylights, canopies, doors, and solar panels.	GWP limits were determined based on the 20th percentile, 40th percentile, and mean (respectively) of search results from EC3 per product type, including product EPDs and industry EPDs weighted at 20x.	1401
FEMA (IRA)	Glass (including, but not limited to, flat/float glass, processed glass, and insulated glazing units)	GWP limit based on Industry-wide EPD or Industry-wide LCA report	1430
California	Float or rolled glass that is clear or tinted either installed by itself or as a part of a window assembly. Processed glass (e.g., tempered, coated, or laminated) is out of scope of the BCCA.	GWP limit based on Industry-wide EPD or Industry-wide LCA report	1430
Colorado	Designs specifying processed glass and flat glass as a component of processed glass assemblies. Consultants shall track the EPD of the flat glass used for processed glazing products from the glass fabricator. Consultants shall verify that glass fabricators utilize flat glass that meets the GWP limit.	GWP limit based on GSA Draft LEC Material Standards report (January 2023), where draft limits were "based on distributions of 'Uncertainty-Adjusted GWP' data" from EC3.	1510
NYS (EO 22)	Flat Glass Processed Glass Insulated Glazing Units	EPD and material quantity disclosure/reporting required (no limits yet) Main goals of collecting EPDs: Drive the demand for and creation of EPDs in the market. Drive demand for reduced embodied carbon construction materials. Start to benchmark NYS’s performance on the environmental impact of construction materials – with a view to setting limits in the future	TBD

*GWP Limits shown are in $kgCO_2e$ per metric tonne

The National Glass Association (NGA) published an industry-average EPD for flat glass produced in the US in December 2019, but the EPD has since expired (valid until December 20, 2024), and the referenced PCR by NSF (UN CPC 3711) is only valid through September 2025. The processed glass PCR, which also covers EPD standards for IGUs, was established in August 2016 and UL Solutions[55] is currently working with industry stakeholders to update the PCR.[56] The PCR for fenestration assemblies (e.g. windows, curtain walls, storefront systems, and ribbon walls) was recently updated and is valid until December 2028 (NSF 1102-23[57]).

It is important to note that functional units utilized in EPDs to report GWP are different for panes (weight in kgs or metric tonnes) versus IGUs (area in square meters). Since flat glass is typically ordered by area, NGA has published a table with flat glass area to weight conversion factors for different glass thickness designations. This conversion is helpful for reporting and tracking glass products consistently on a project, however, durability and performance must be held constant to fairly make comparisons between like-for-like products.

The question of durability and performance trade-offs between embodied carbon of a building's glazing system and potential operational carbon savings (i.e. using a triple-glazed system in place of double-pane to increase energy efficiency) was recently explored in an analysis[58] performed by NGA's energy code consultant, Tom Culp of Birch Point Consulting LLC. This type of analysis is outside the scope of most Buy Clean programs (operational emissions would fall into Module B of the life cycle, which is not included in EPDs), but consideration of trade-off scenarios like this can be captured in WBLCA and will be essential in understanding the whole carbon picture.

Insulation

Given the climate zone, insulation of some type is utilized in the construction of almost all buildings in Minnesota, whether in the form of rigid board, spray foam, batt, or blanket. Insulation is also used for roadway applications as lightweight fill. Not only does insulation come in different physical forms, but depending on the application and installation method, carbon impacts can vary greatly. Similar to glazing selection, there are often trade-offs that balance embodied carbon with operational carbon, but as mentioned in the previous section, operational carbon is outside the scope of EPDs. Focusing on what *is* in the scope of EPDs, insulation materials derived from petrochemicals or plastics tend to have a much higher carbon footprint. This is particularly true for rigid polyurethane spray foam, sealants, and XPS products that utilize hydrofluorocarbons (HFCs) in their manufacture or installation. These products have faced bans[59] and/or significant limitations in an increasing number of states within the U.S and Canada, due to their high carbon intensities - especially given that there are alternative products available on the market that are functionally equivalent with much less detrimental impact to the environment. Figure 2D-5 below shows the relative carbon impacts of several different insulation types, with XPS and HFC-blown closed cell spray foam shown with the largest impacts, followed by HFO-blown spray foam and EPS (expanded polystyrene).

[55] UL Solutions www.ul.com
[56] NGA Sustainability and Recyclability www.glass.org/advocacy/initiatives/sustainability
[57] NSF 1102-23 PCR for Fenestration Assemblies www.nsf.org/nsf-standards/product-category-rules
[58] NGA Triple Glazing and Embodied Energy www.glass.org/triple-glazing-and-embodied-energy-yes-juice-worth-squeeze
[59] HFC Policy Tracker nasrc.org/hfc-policy-tracker

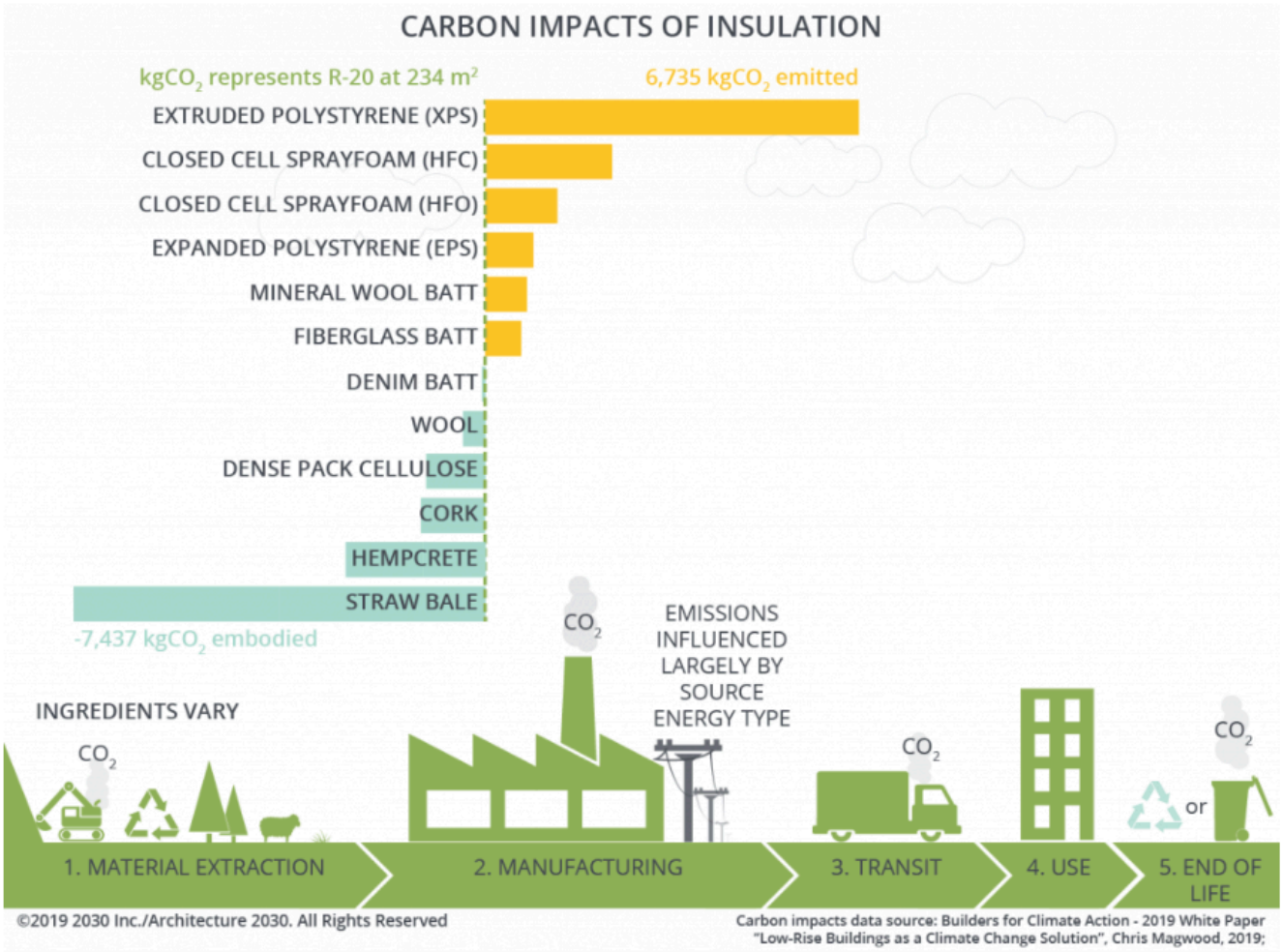

Figure 2D-5: Relative Carbon Impacts of Insulation. Source: Architecture 2030 (2019).

While several states have restricted the use of certain high-GWP insulation products, only one has incorporated insulation GWP requirements into Buy Clean legislation - California. A recent revision to their policy (SB 1207) modified the eligible material list to specify “insulation” rather than “mineral wool board insulation”, thereby expanding the material scope to capture a broader range of insulation subcategories, which California DGS will begin identifying in 2025.[60]

Aluminum

Aluminum is a commonly used material in buildings, typically as a part of a fenestration assembly, as it is lightweight and durable. Carbon emissions of aluminum can vary greatly due to differences in the production process and the sources of energy utilized for electrical power and heat. The two main factors that lead to variability in emissions associated with producing aluminum include[61]:

1. The Energy Source used in the smelting process where the primary aluminum billet is manufactured. Prime content Emissions Factors (EFs) range from ~4 tonnes of CO_2e per tonne of aluminum (tCO_2e / tAL) in hydroelectric-based regions up to ~20-25 (tCO_2e / tAL) in coal

[60] Buy Clean California Act www.dgs.ca.gov/pd/resources/page-content/procurement-division-resources-list-folder/buy-clean-california-act
[61] Carbon Footprint of Recycled Aluminium (2021) www.climateaction.org/news/carbon-footprint-of-recycled-aluminium

power-based regions. China, which is heavily reliant on coal energy for the smelting process, has an average EF of ~20, while the world average is about 16.5 (tCO_2e / tAL), and the average for North American billet is roughly 8.5 (tCO_2e / tAL).

2. The % Recycled Content.
   The recycling process of aluminum requires a lot less energy than primary aluminum production with an approximate EF of ~0.5 (tCO_2e / tAL).

It is important to note that process scrap of up to 20-30% can typically be generated during the processing of new aluminum products, such as extruded aluminum profiles or rolled foil. The recycling rate of this type of scrap is very high, but since it hasn't yet fulfilled its purpose as a construction product, the carbon footprint of this recycled processed scrap aluminum would be much higher, equal to the GWP of the original primary aluminum + 0.5 (tCO_2e / tAL).

Since aluminum is part of a larger product when used as extruded aluminum profiles in fenestration assemblies, and because there are multiple PCRs that could apply to the product depending on the fenestration type, it could be challenging to develop functional categories to track and report GWP impacts. This is especially true when the supply chain flow for aluminum billet/pieces and/or the fabrication process varies greatly.

Wood

Wood construction products can include sawn lumber (dimensional lumber), plywood and OSB sheathing/decking, cladding, and engineered wood/mass timber. Wood products, especially engineered wood, can be composed of many individual parts sourced from different locations with a wide range of tracking and documentation, which makes it potentially challenging and time consuming to develop product EPDs with supply-chain specific upstream data. Figure 2D-6 shows what is typically included and not included in EPD scope for a wood-based product.

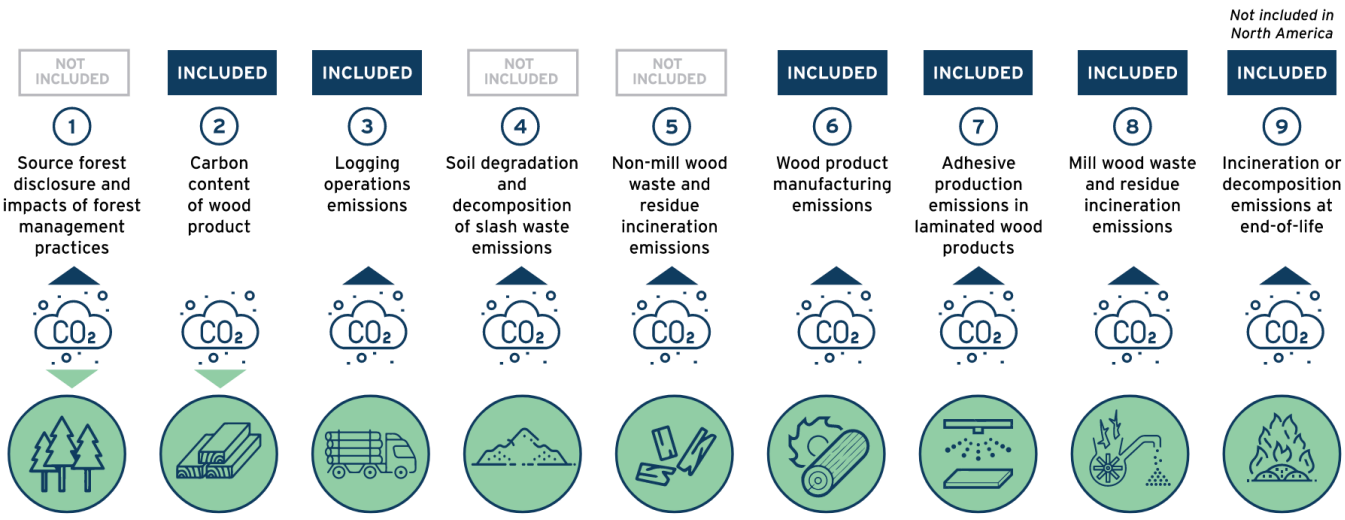

Figure 2D-6: Wood Life Cycle Data typically included in EPD Scope.
Image Source: RMI's 2023 Report: *Driving Action on Embodied Carbon in Buildings*[62]

Biogenic carbon refers to carbon removed from the atmosphere by photosynthesis and stored in wood (or other biological materials). It has been a controversial topic as to how and when to account for this carbon benefit (or net negative carbon) in calculating the carbon impacts of wood. Additionally, biogenic carbon accounting is complicated, and it is difficult to capture accurately in a static LCA. According to the current product category rule (PCR) that governs North American wood product EPDs, stored biogenic carbon must be reported as net-zero in the cradle-to-gate (A1-A3) life cycle stages, under the assumption that biogenic carbon will be released back into the atmosphere completely at the end of the product life (C3-C4). In reality, this may not be what happens, depending on the actual end-of-life scenario. If end-of-life scenarios for a WBLCA result in permanent biogenic carbon, then the PCR allows a net negative biogenic carbon flow to be reported in the WBLCA (but not EPDs).[63] Additional research is needed to provide a set of recommendations to include and set requirements in Minnesota's program for Wood.

[62] Driving Action on Embodied Carbon in Buildings | RMI rmi.org/insight/driving-action-on-embodied-carbon-in-buildings

[63] How to Include Biogenic Carbon in an LCA | WoodWorks www.woodworks.org/resources/how-to-include-biogenic-carbon-in-an-lca/

2D(R). Other Materials Recommendations

In order to prioritize materials and identify when/how they might be integrated into Buy Clean program requirements, the Task Force developed a 3-tiered categorization system, based on a number of factors to determine the current feasibility of setting GWP limits and integrating into program requirements. This is a similar approach presented in GSA's Federal Buy Clean RFI (October 2022), which categorized materials into 3 tiers to help identify additional materials for prioritization, with Tier 1 including "the most carbon intensive materials that the Federal government purchases, which are the highest priority for Buy Clean". GSA's Tier 1 items included Concrete (including prefabricated products), Steel (including structural and rebar), Asphalt, and Flat Glass (including window assemblies). GSA's Tier 2 items included Aluminum (including curtain walls and storefronts), Insulation (including enclosure, equipment, piping, and acoustical), Roofing Materials, and Gypsum Board. Included in Tier 3 was Structural Engineered Wood (including mass timber and cross-laminated timber).

The Task Force, in collaboration with the Department of Administration, developed a working definition for "High-Impact Materials" to utilize in the framework of prioritizing materials, informed by definitions/justifications presented by the EPA, GSA, and other policies.

Defining High-Impact Materials - Working Definition

DEPARTMENT OF ADMINISTRATION | Environmental Standards Procurement Task Force

The Task Force must examine which construction materials should be subject to the program requirements and which construction materials should be considered to be added, ***while taking into consideration materials with the highest embodied carbon impacts in scale and/or individually to prioritize materials that offer the most significant opportunities to lower the embodied greenhouse-gas emissions of construction projects.***

In addition to the potential carbon impact of construction materials, several other factors were included to define a prioritization schema. Table 2D.R-1 presents a 3-tiered prioritization schema developed by the Task Force.

Table 2D.R-1: Material Prioritization Schema & Recommendations

Priority	Description	Recommendations
Tier 1	Tier 1 includes materials that are high-impact with established EPD data ecosystems. For these materials, adequate GWP data/EPDs are either available to set a limit now or it is anticipated there will be adequate data in the near future as more EPDs become available on the market.	These materials should be prioritized and included in the policy now. <u>Tier 1:</u> ● Concrete (including ready mix, paving mixtures, and prefabricated products) ● Steel (including rebar and structural steel) ● Asphalt
Tier 2	Tier 2 includes materials that are impactful, but cannot feasibly be integrated into program requirements due to one or more of the following reasons: ● Lack of representative EPD/GWP data: ○ Not enough plant/facility-specific EPDs ○ EPDs not geographically representative ○ Data quality/variability issues ○ Underlying PCRs are currently being updated/refined or will need to be in order to produce robust, high quality EPDs ● Market-readiness, supply-chain feasibility ● Subcategories/categorization - complexity in categorizing products to set limits and/or track/report ● Additional stakeholder/industry engagement and/or feedback needed ● Other roadblocks (e.g. political or industry-driven)	These materials should be actively tracked and added to the policy once all of the feasibility items listed in the Tier 2 description have been addressed. <u>Tier 2:</u> ● Glass ● Aluminum ● Insulation
Tier 3	Tier 3 includes materials that might be impactful, but more market/industry development is needed and/or additional research must be conducted to assess the potential carbon reduction impacts relative to higher priority materials.	These materials should be tracked and moved to Tier 2 once there is more market development or research to demonstrate significant carbon reduction potential. <u>Tier 3:</u> ● Wood (including dimensional lumber and engineered wood) ● Gypsum board ● Membranes (including but not limited to roofing materials) ● Sealants, Emulsions, Paints ● Plastics (HDPE/pipe)

Table 2D.R-2 provides additional details specific to each of the materials with respect to research, Task Force perspectives, and potential next steps for Tier 2 and Tier 3 materials.

Table 2D.R-2: Task Force Perspectives and Potential Next Steps

Priority	Material	Task Force Perspectives and Potential Next Steps
Tier 1	Concrete Asphalt Steel	*Additional analysis of facility-specific EPDs data is required for the following Tier 1 material subcategories in order to establish future GWP limits:* ● *Concrete: Concrete Pavement, Precast Concrete, Concrete Masonry Units* ● *Asphalt: Asphalt Pavement* ● *Steel: Structural Steel* *It is recommended that EPDs are collected for all Tier 1 products to help inform future benchmarking and limit-setting efforts, though GWP limits are not set at this time. For more information, reference the respective materials sections of this report – 2A, 2B, and 2C.*
Tier 2	Glass	*Of the Tier 2 and 3 materials examined, glass is probably the material that is closest to being able to move to Tier 1. For that to happen, the following next steps are recommended: Engage local manufacturing and industry organizations. Compare local EPDs to Industry Average. Determine scope/subcategories: Flat glass, Processed Glass, IGUs. Examine functional units and ability to normalize efficiency in comparisons (e.g. triple pane vs double) to ensure durability and performance are held constant when comparing alternative materials/products.*
	Aluminum	*Aluminum as a material is a separate category from glass, which each are governed by separate PCRs, and when aluminum is included in fenestration assemblies, there are multiple PCRs that could apply, making it hard to define categories for limits. More research is needed to see how fragmented the market and the data are (are there many smaller manufacturers, what are the supply chain flows for aluminum pieces, how much does the fabrication process vary, etc.). It might be challenging to determine whether to set limits based on the material itself or final product(s).*
	Insulation	*There are many types of insulation and many applications, which make it challenging to define subcategories that would make sense in terms of reporting, tracking, and setting limits. Roadway applications for insulation should also be considered (lightweight fill - EPS), which is used to reduce roadway settlement or for frost-heave protection. Limited EPD data. Additional industry stakeholder and market engagement needed to determine feasibility of potential program inclusion for insulation.*
Tier 3	Wood (Dimensional Lumber and Engineered Wood)	*Hard to get supply-chain specific product level EPDs. Are PCRs developed/updated to ensure feasible and standardized data/tracking? Can/should biogenic carbon be included? Not enough product-specific EPD data to accurately set limits at this point in time. Also, compared to other materials, it is relatively low in embodied carbon, and thus might not be a high priority to focus on at this time.*
	Gypsum Board	*Listed as a Tier 2 item in GSA's initial list of priorities. Not enough research, EPD data, or market development to pursue at this time.*
	Membranes	*Membranes could cover roof or wall applications, air and weather barriers, vapor barriers, and other various types. PCRs and EPDs are fragmented depending on the product as well as CSI divisions/accessory materials (071000 - Damp-proofing & Waterproofing - could fall into sealants; 075000 Membrane Roofing: built-up, EPDM, TPOs).*
	Plastics (HDPE/Pipes)	*The Plastics Pipe Institute (PPI) published a technical report[64] in 2021 summarizing LCA results comparing corrugated HDPE (High-density Polyethylene) pipe utilized for municipal stormwater drainage to alternative material piping systems, including PVC, reinforced concrete, and steel. The study included the full life cycle (beyond just the product phase), thus LCA results included in this report might not correlate to GWP impacts included in EPDs.*

[64] PPI LCA of North American Stormwater Pipe Systems TR-53 plasticpipe.org/common/Uploaded%20files/Technical/PPI-TR-53.pdf

		Additional research is needed to estimate environmental impacts of pipe systems and determine relative potential carbon impacts for this material/application used on MnDOT projects.
	Sealants, Emulsions, Paints	*Could have large carbon impacts (especially on roadway applications) based on high quantities of lane-miles/square footage and preliminary EPD values (high carbon intensity). This category might include liquid polymer coatings and sealants and paints of all kinds.*

In addition to the materials summarized in Table 2D.R-2, refrigerants were discussed as a potential high-impact substance, but are not recommended to be included in the scope of the Buy Clean policy, as EPA and Minnesota Pollution Control Agency (MPCA) have released guidance on limiting/phasing out certain refrigerants.

The Task Force recommends mandatory submission of EPDs for Tier 1 materials/products. After reviewing the progress and state of EPD data, market developments, and industry engagement feedback, the Task Force may recommend requiring submission of EPDs for Tier 2 items in the future. In addition to re-evaluating Tier 1 material requirements in the program every 2-3 years at a minimum (per legislative requirements), industry stakeholders and the Task Force technical advisory group should review Tier 2 and Tier 3 materials in the same timeframe.

3. Program Mechanics

This section presents an overview of program mechanics to ensure successful policy implementation and smooth integration into procurement and bidding processes, including GWP limit-setting, incentives, data management and tracking, the submittal process, exceptions and waivers, and training/education.

Setting Limits

The general approach for setting GWP limits for materials involves setting an initial maximum GWP limit based on third-party benchmarks and/or robust, geographically representative EPD data, reevaluating the limit roughly every 2 to 3 years, and adjusting limits accordingly depending on the market shift. While specific GWP limit values/thresholds and the time frames to set/adjust them will vary based on the evolution of material/product data and market shifts in each industry, Figure 3-1 illustrates the general limit-setting approach over time. This timeline will satisfy Minnesota's legislative requirements to review the maximum acceptable global warming potential *"not later than three years after establishing the maximum global warming potential for an eligible material, and not longer than every three years thereafter"* and allows for reevaluating GWP limits more frequently due to market shifts and material innovation, if necessary. Materials/products that do not have adequate data to set meaningful GWP limits at this time can follow a similar timeline to engage industry stakeholders and subject matter experts to reassess the state of the market and data ecosystem every 2 to 3 years (or more frequently as adequate data becomes available) as a part of the Task Force work. Adjustment of program requirements will need to be aligned with any updates to PCRs, industry-wide recommendations, and/or future publications of benchmark reports/data.

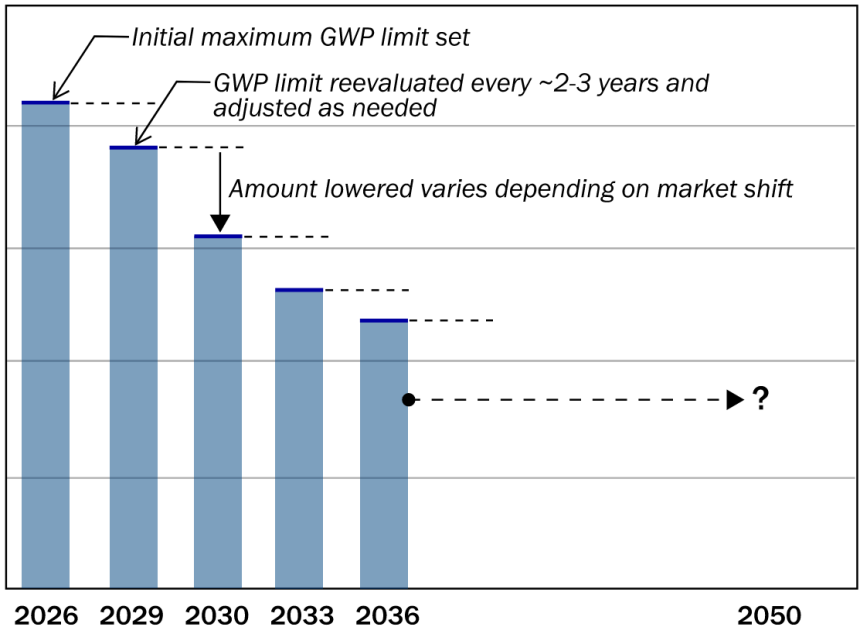

Figure 3-1: GWP Limit Setting Timeline. Image based on CLF (2020) with modifications by CSBR.

For some material types it may be appropriate to set more than one GWP threshold, informed by material subject matter experts and key stakeholders involved in bidding, procurement, and construction of infrastructure projects in Minnesota, to allow for tracking of potential incremental/incentive targets that could be adopted by state agencies. An example of this approach includes GSA's 3-tiered limits with GWP thresholds at better than average, top 40% and top 20%. While some Buy Clean programs require a single GWP limit per eligible product, which simplifies the requirements, another approach, recommended in CLF's report *Implementing Buy Clean* (2022), involves setting two limits - one limit that would be less aggressive and apply to the majority of projects built with current best practices and a second limit that would be more stringent and only apply to a smaller subset of materials and/or contracts with the intent of driving larger reductions and encouraging innovation. GWP limits may be broken down into specific life-cycle stages, depending on how GWP data is being reported in the industry and/or requirements listed directly in material PCRs.

Bidding & Procurement

Bidding methods and procedures, including differences between vertical and horizontal construction, are important to examine to ensure program requirements can be equitably applied across project types and can be integrated successfully into the established project processes. Minnesota state projects, whether they involve buildings or roadways, are usually executed utilizing one of three main project delivery methods, and are summarized in Table 3.1.

Table 3.1: Summary of Typical Project Delivery Methods

Project Delivery Method	Description
Design-Bid-Build (DBB)	The state hires a designer/consultant to create plans, then solicits bids from contractors to build based on those plans. This method has traditionally been used by many agencies/project teams, is the most common method, and is generally a good fit for well-defined and/or non-complex projects. Design-Bid-Build is used to deliver 98% of MnDOT projects and a majority of state buildings projects
Design-Build (DB)	The state hires one team to handle both design and construction. This can accelerate the project schedule and allow for innovation, but requires careful team selection.
CM at Risk (CMAR)	The state hires a construction manager (CM) to help plan, manage, and construct the project. The CM assumes the risk of completing the project within a Guaranteed Maximum Price (GMP), including cost overruns. Involvement of the CM early on in projects fosters collaboration and can be especially beneficial for complex projects or projects with significant uncertainties such as historic reviews, a lack of full site knowledge, existing structures, etc.
Construction Manager/General Contractor (CMGC)	Similar to CMAR described above, the state hires a construction manager (CM) to help design and construct the project, but risk is allocation can vary depending on the contract(s), which can be separate contracts for preconstruction and construction. While both CMGC and CMAR involve the CM in earlier phases of design, CMGC might focus more on constructability input and streamlining the construction process, whereas CMAR often involves a more integrative approach.

Depending on the project cost/size and the project delivery method, bid selection criteria and contract types will vary, which is important to understand in how specific contract requirements and/or potential incentive mechanisms might be implemented to achieve project goals. Table 3.2 summarizes common bid selection methods and when they are typically used.

Table 3.2: Summary of Typical Bid Selection Methods

Bid Selection Method	Description
Low Bid	Typically used with the Design-Bid-Build delivery method. The contract is awarded to the lowest “responsible and responsive” bidder, considering only cost in selection criteria.
Best Value	Typically used with Design-Build or CMGC/CMAR delivery methods. Proposals are evaluated based on weighted criteria which include price and additional project-specific factors tailored to the project goals that might include: project approach, contractor technical capabilities, individual qualifications of the contractor's key personnel, ability to prepare appropriate project plans, subcontractor management plans, previous project experience, and ability to accelerate project schedule. The award must be made to the contractor offering the best value applying the weighted selection criteria.

Incentives

There are several types of incentive mechanisms that could be employed at various stages of a project, depending on the project type, delivery method, and bid selection criteria, including bid incentives, performance incentives, and financial incentives. It is important to differentiate between vertical and horizontal construction, as adopting one incentive structure for both applications may not be practical due to differences in the bidding process.

Bid Incentives can take into consideration certain criteria alongside cost during the bid selection process. Some examples of where carbon might be incorporated include:

- Weighted bid scoring, which can include additional factors alongside price, such as carbon, project approach, technical capabilities, individual qualifications of the contractor's key personnel, or ability to accelerate project schedule
- Applying a discount rate by ranking bids according to submitted GWP values and providing a price discount to the lowest carbon bids
- Carbon Shadow Pricing, which involves converting estimated carbon into a cost and adding it to each bid price

These types of bid incentives have been utilized by the private sector, but public agencies have not yet employed these mechanisms in the context of carbon, though some are examining feasibility of bid incentive options. New York Senate Bill S542A (Section 4) proposes that the office of general services “examine the use of incentives, including bid credits, related to bids within five percent of the lowest price, to encourage the usage and innovation of low embodied carbon concrete on state agency projects”. Oregon’s House Bill 4139 (enacted in 2022) tasks the ‘technical advisory committee’ and industry stakeholders with devising a scoring methodology that considers EPDs in ranking or scoring a bid proposal that ensures fairness among bidders and proposers, but would not be implemented until after January 1, 2027.

MnDOT has developed a formalized process to implement weighted bid scoring for transportation projects by assigning points, or weights, to different evaluation factors (in addition to price) including factors such as accelerated project schedule, contractor’s qualifications, project quality, or performance-based criteria, though carbon/material criteria have not been included in this manner as of yet. It is important to note that this type of incentive could not be used on *Low Bid* procurement, where only price may be considered, and since *Low Bid* is most commonly used for procurement on *Design-Bid-Build* projects, the incentives might only be available for alternative

delivery methods (Design-Build, CMGC, or CMAR) which are less commonly used for state-funded projects as they are relatively newer project delivery methods. Unless *Best Value* bid selection can be used across all projects, it would be difficult to implement bid incentives equitably for all project delivery methods.

Performance Incentives are mechanisms designed to motivate contractors and project teams to achieve certain performance objectives. Examples of these objectives may be similar to factors included in weighted bid scoring criteria, such as accelerated schedule, cost savings, or improved quality, and can be awarded in the form of a bonus or other compensation if objectives are met, or conversely through imposition of a penalty for noncompliance. The strategic application of performance incentives serves to ensure project goals and priorities are maintained through project completion and rewards contractors for exceeding established performance thresholds, and can be especially effective when paired with bid incentives. If carbon reduction is incorporated as a rewarded performance goal in this manner, this approach has the potential to drive significant market transformation toward lower-emissions materials and practices within the construction sector. Task Force stakeholders have expressed that performance incentives as a preferred mechanism with the most potential to drive down GWP values. While MnDOT already has the structure in place to execute this type of mechanism, clearly outlined program criteria and contractor/client buy-in will be extremely important to ensure successful implementation and program compliance."

Financial Incentives can take many forms, including grants, rebates, tax breaks, subsidies, and more. Though these mechanisms may not be preferred due to additional administrative burden and uncertainty in reimbursements, as well as other industry challenges, financial incentives of these types have or are being implemented as a part of other federal or state programs. Some examples of grants to incentivize the use of lower-carbon construction materials and increase material transparency have included potential allocation of IRA funding through EPA EPD Grant Program, FEMA, FHWA (LCTM), and GSA (LEC Program), as well as EPD assistance grant funding programs made available as a part of state policies in Maryland (HB0261/SB0424), Minnesota, and Oregon (HB4139). Tax incentives are utilized in several states, such as Colorado and New Jersey. In Colorado, all materials that are considered 'eligible decarbonizing materials' are exempt from state sales tax beginning July 1, 2024 (SB 22-051)[65]. New Jersey (Assembly Bill 2234[66]) offers tax credits for costs of generating EPDs for low carbon concrete and for use of low carbon “concrete” (structural and non-structural masonry and precast concrete in addition to ready-mix concrete) upon meeting GWP thresholds established by the New Jersey Department of Environmental Protection (DEP).

Incentive mechanisms have great potential to drive significant reductions in carbon. However, bid and performance incentives that apply for both vertical and horizontal construction are not a viable option to mandate in Minnesota’s policy, given the differences in current standard procedures and workflows in place for proposals, bid selection, and contract execution between state-funded building projects (which are managed by Real Estate and Construction Services aka RECS and/or delegated state agencies) and state-funded horizontal construction (managed by MnDOT). Agencies are still encouraged to pursue implementation of these types of incentives, though specific incentive mechanisms will not be defined or included as a part of Minnesota’s Buy Clean policy recommendations.

[65] Colorado Climate Friendly Tax Incentives tax.colorado.gov/climate-focused-tax-incentives
[66] New Jersey Assembly Bill 2234 legiscan.com/NJ/text/A2234/id/2614174

Databases & Data Management

A centralized, accessible database is important to store EPD data and track program compliance, but also to measure program efficacy and contribute to evolutionary advancement of the LCA data ecosystem for infrastructure projects in Minnesota and beyond.

The Task Force explored viable database options taking into consideration:

- Accessibility and ease of use
- Consistency with data governance procedures of the state
- Data quality assurance, quality control, verification
- Data maintenance efforts
- Compatibility for data sharing with other states and federal agencies
- Integration capabilities and compatibility with other programs/tools/systems
    - Compatibility for data sharing with other states and federal agencies
    - Ability to interface/transfer data direction from EPD Generator tools on the market and nationally recognized EPD databases
- Alignment in reporting data fields, terminology, and functional units across industry (referencing the CLF ECHO project LCA framework, Federal LCA Commons, Common Materials Framework, and trends for GWP data tracking for life cycle stage A4 and A5)

Table 3.3 summarizes the existing material databases explored by the Task Force.

Table 3.3: Existing Material Databases Explored

Database Name	Description
Building Ease	BuildingEase is a free online platform with an extensive library of material products catalogued for different material applications/scopes and filterable by different green certifications. EPD data is just one component of this larger database system. Agencies/firms can create a single Master List (similar to an Outline Spec) or many, accounting for different scopes (interiors, site/landscape, structure) or for different building types (healthcare, hospitality, K-12). These lists of materials can be used to create standards and refined for use on different projects with capabilities for portfolio wide tracking and reporting (or strategic targeting for improvement) and tabulated as-built data (what was installed where, at what price, etc.) with full Bill of Materials (BoM).
EC3 (Embodied Carbon in Construction Calculator)	EC3, which stands for Embodied Carbon in Construction Calculator, is a free, open-source online database/tool, hosted and maintained by Building Transparency, a Washington State-based 501c(3) nonprofit. The cloud-based tool is focused on analyzing, tracking, calculating, and reporting the upfront emissions of construction materials utilizing building material quantities from construction estimates and/or BIM models and a robust database of digital, third-party verified Environmental Product Declarations (EPDs). Backed with one of the most comprehensive online EPD libraries in North America, the EC3 tool can be implemented in both the design and procurement phases of a construction project to track and report a project's overall embodied carbon emissions. Project portfolios can be organized and shared with internal teams or published publicly. A Civil Projects module was recently added to the tool to be able to track roadway and infrastructure projects in addition to Buildings Projects. New York State, as a part of Executive Orders 22 and 23 utilizes EC3 for tracking EPDs and embodied carbon data for projects using eligible materials (as of January 2025). Several other agencies/programs are also leveraging EC3 to support their EPD data management efforts including Colorado and Washington state.

BuiltCold	BuiltCold is an online platform to assist state and local agencies with collecting and managing EPDs, tracking program compliance, and reporting key metrics. Partnering with Building Transparency (www.buildingtransparency.org), BuiltCold offers streamlined EPD data management with real-time project tracking, built-in project team communication workflows, and automated data verification to support stakeholders across the built environment for efficient integration of BuyClean requirements into existing systems and processes. Several agencies have collaborated with BuiltCold to support implementation of low-carbon material initiatives, such as the Federal Buy Clean Initiative (former Executive Order 14057, no longer active), the Buy Clean Colorado Act, and Washington State's Buy Clean and Buy Fair program.
Locus Technologies	This online platform is utilized by the Port Authority of New York and New Jersey (PANYNJ). Contractors populate Microsoft Excel sheets regularly throughout the project, usually monthly, which then get imported into the Locus platform. The Port was able to build out a database to track A1-A3 for both vertical and horizontal construction, which other existing databases were not set up to do. The Port plans to also track A4 emissions data (including transportation mode, source location, and distance to site) and might also collect data on A4 (construction emissions) on projects. One limitation to this platform, since it is a subscription service that is contracted out to a separate entity, is that the Port Authority is not able to make changes directly to modify what data fields are collected, how the information is stored, or other database parameters that are hard-wired into the coding framework.
Caltrans EPD Data Collection System	Caltrans (California DOT) developed an online platform designed for contractors and suppliers to submit, search, upload, and review EPDs for construction materials, and to submit quantity and intended use information for Caltrans projects. The new website launched in 2025 and is designed to improve the user experience and streamline the processes of entering and submitting EPDs. Additional future updates to the database may include features to allow submission of electronic EPD file formats, automation of data collection and reporting, and expansion of dashboard/interface capabilities.

Database Recommendations

Of the existing databases explored on the market, Building Transparency's EC3 tool[67] seems to be the most viable option at this point in time, at least with respect to tracking and reporting buildings projects. While historically geared toward assessing upfront carbon of buildings (vertical construction) projects, recent updates have provided additional features and material categories to incorporate data for civil/transportation (horizontal construction) projects. Further exploration of utilizing the EC3 tool in the context of Minnesota's program would be required to ensure asphalt and concrete pavement categorization and data filter options within EC3 align with Minnesota's functional mix categories (which will be developed once adequate asphalt and concrete pavement EPD data have been collected).

MnDOT is collaborating with other DOTs and industry to explore data management solutions that interface with EC3, such as BuiltCold, and other custom-built solutions, with the end goal of integrating streamlined EPD data transfer into existing project workflows. To create a simplified data collection process and a unified approach, it would be ideal to implement a database solution that can effectively manage EPD data for a variety of project types (e.g. transportation/civil projects and buildings) and integrate smoothly into existing design, bidding, and procurement processes. It is the intent to align the data collection and database approach for horizontal and vertical construction, but due to the differences

[67] The EC3 Tool | Building Transparency www.buildingtransparency.org/tools/ec3

in project procurement processes, material/technical properties, and resource limitations, there may be the need for separate data collection methods/databases initially, until data integration is practical and achievable.

Additional database research, planning, and development is currently ongoing and will be further developed in the next phase of program implementation. Efficient database design, deployment, training, and maintenance will be important to meet both the initial and long-term program needs and will be vital to be able to establish/adjust appropriate material/product GWP thresholds in the future as required by state policy.

Submittal Process & Documentation

For all eligible projects, the required data and EPDs must be submitted prior to procurement of construction materials, and validated at the construction site. This will initially be done through an online platform and/or through data submission via a dedicated state agency EPD collection email address or other form of electronic data transfer, and is currently being developed for the next phase of program implementation. To minimize administrative effort on project teams, it is the intent that data input and verification processes be automated where possible.

Project teams will be required to submit the following data to the state, including but not limited to:

- Project Name, Project Type, Description, Size
- Project Contacts
    - Owner, Project Manager, General Contractor/Construction Manager, Architect of Record, Engineer of Record
- For all eligible materials/products
    - Product Name
    - Product Description
    - Product Application/Use
    - Manufacturer Name
    - Manufacturer Location
    - Material Quantity
    - Product Category Rule (PCR)
    - EPD Third-Party Verification Body
    - EPD Expiration Date
    - Global Warming Potential - The reported GWP should either be based on the Tool for Reduction and Assessment of Chemicals and Other Environmental Impacts (TRACI) 2.1 or the Intergovernmental Panel on Climate Change, IPCC AR5 (or dated 2013 or later). Reference most current ISO standards and applicable Product Category Rule(s).

Data Quality

According to Minnesota Statute 16B.312, EPDs must be supply-chain specific, third-party verified, type III EPDs, must meet ISO 14025 standards, and must contain a material production life cycle assessment of the environmental impacts of manufacturing a specific product by a specific firm, including the impacts of extracting and producing the raw materials and components that compose the product. ISO 21930 complements ISO 14025 by providing a core set of rules specifically for construction products, which establishes requirements that inform sub-category PCRs. ISO 21930 and sub-category PCRs allow for varying levels of data specificity across different product categories, while still complying with ISO 14025. Depending on the material sub-category, some PCRs currently do not require that primary supply-chain specific data be utilized to develop the EPD, in which case secondary, industry-assumed averages are often used in place of primary data, which can greatly impact the final

GWP reported. Some PCRs require disclosure of primary versus secondary data sources included in the EPD, while some do not. Until PCR requirements become more standardized and stringent across material/product types, it is recommended that when primary site-specific data is available for upstream processes and materials, it should be utilized in the development of an EPD.

Exceptions and Waivers

Exception Pathway - Carbon Budget/Project Average

In order to minimize administrative burden that would be involved for project teams to calculate, document, verify, and track material quantities throughout the life of the project from design through construction that would be required to determine material eligibility, it is recommended that the Project Average approach is designated as an exception (and not a part of every eligible project). Project teams must apply for an exception prior to procurement and installation of any materials/products on site. Exceptions via the Carbon Budget/Project Average approach would be reviewed by the state. Note that the Project Average approach should only be used for products within the same material category, i.e. ready-mix concrete, structural steel, asphalt mixtures, etc.

Table 3.4 shows an example project with four cast-in-place concrete mix designs. Though one or more of the concrete mixes may exceed the GWP limit for the individual mix, as long as the GWP of all of the mixes on the project are below the carbon budget, then the project would meet the requirements for this expectation pathway.

Table 3.4: Ready-Mix Concrete - Carbon Budget Example (metric units)

Mix No.	Mix Strength/Description	Quantity (m^3)	GWP Limit ($kgCO_2e/m^3$)	Qty x GWP Limit = Carbon Budget ($kgCO_2e$)	Actual GWP from EPD ($kgCO_2e/m^3$)	Qty x GWP Actual ($kgCO_2e$)
1	4000psi - FOUNDATIONS	850	312	265,200	292	248,200
2	4500psi - EXTERIOR SLABS AND WALLS	400	342	136,800	332	132,000
3	5000psi - INTERIOR SOG/SLAB ON METAL DECK	550	372	204,600	368	202,400
4	6000psi- COLUMNS/PIERS AND INTERIOR WALLS	300	394	118,200	412	123,600
	TOTALS	**2,100**		**724,800**		**707,000**

Waiver Process

The material requirements can be integrated into the bidding process for eligible vertical and horizontal construction projects, by including specification language outlining the requirements for as a part of the project design/bidding documents. Training and education sessions are recommended to inform project teams and contractors of the specific requirements, including how and when EPD data must be submitted, prior to procurement of eligible materials.

Waivers/exceptions to the material requirements will require project teams to submit a waiver request form demonstrating what efforts were undertaken to attempt meeting the requirements and must

indicate the specific justifiable circumstances that might warrant a waiver. Waiver requests will be assessed by the state on a case-by-case basis.

Justifiable circumstances that might warrant a waiver include:

1. Technically Infeasible.
   Some examples might include:
   - The particular material is not covered by the scope of the relevant PCR - for example, a type of steel that is not included in the PCR for structural steel.
   - The EPD is expired and cannot be renewed because the PCR has expired.
   - Geographic impracticability.
2. Significant Increase in Project Cost/Financial Hardship
3. Significant Delay
4. Results in Sole-Source of Material
5. Emergency or Director's Order

More detailed waiver justification descriptions, examples, and potential ways to address these issues will be developed as needed once program implementation has begun, after consulting with the Department of Administration, MnDOT, and the Task Force.

Grant Program

To offset the cost of obtaining environmental product declarations or otherwise collect environmental product declaration data from manufacturers, a grant program has been established as mandated by Minnesota's Buy Clean legislation. This section provides a summary of the grant program, requirements, and expected outcomes.

Grant program goals are to:

- Promote sustainability of construction materials and material transparency in the State of Minnesota
- Assist manufacturers in disclosing greenhouse gas emissions data associated with the production, use, and disposal of construction materials and products to create robust EPDs
- Spur market demand for construction materials and products that have lower embodied greenhouse gas emissions

Grant outcomes include:

- Creation and publication of supply chain specific Type III EPD(s) that
  (a) contains a material production life cycle assessment of the environmental impacts of manufacturing a specific product by a specific firm, including the impacts of extracting and producing the raw materials and components that compose the product;
  (b) is verified by a third party; and
  (c) meets the ISO 14025 standard developed and maintained by the International Organization for Standardization (ISO).
- Documentation of a process by which organizations will create and update EPDs in the future

- Geographic disbursement of EPDs developed, including EPD availability in regions of Minnesota that previously had few or no existing EPDs in a material / product category / supply chain

Eligible materials listed in the Grant request for proposal (RFP) are shown in Table 3.G.

Table 3.G: EPD Grants - Eligible Materials/Products

Material Category	Specific Materials/Products
Steel	Hot-Rolled Structural Sections (W-, M-, S-, C-, MC- shapes, and angles)
	HSS (Hollow Structural Sections)
	Plate
	Open Web Steel Joists
	Steel Decking
	Cold-Formed Metal Framing
	Carbon Steel Reinforcing Bar (A615/A706)
Concrete	Concrete Paving
	Ready-Mixed Concrete
	Precast/Prestressed Concrete
	Post-Tensioned Concrete
	Concrete Masonry Units
Asphalt	Asphalt Paving Mixtures
Glass	Flat Glass, Processed Glass, Insulating Glass Units (IGUs), and Fenestration Assemblies comprised of at least 80% glass by weight or volume

The first round of grant applications were collected and grantees were selected in April 2025. Grant projects selected thus far will support EPD productions for both ready-mix concrete plants and asphalt plants that supply materials/products for both vertical and horizontal construction projects in the state of Minnesota. Grant awardees were publicly announced in a press release in August 2025.[68]

Additional rounds of grant awards will be distributed through the established RFP/Application processes to allocate available funds in the future. It is recommended that grant funding be prioritized and maintained to provide adequate support for industries involved in Minnesota construction projects to meet the market demands for material transparency and lower carbon construction materials. Additionally, expanding the grant scope could provide support needed to not only report carbon impacts, but to also support plant/facility system upgrades to reduce upstream carbon emissions, training, and research/testing to ensure innovative material solutions maintain durability and longevity.

[68] mn.gov/admin/media/news/#/detail/appId/1/id/700464

Resources, Education, & Training

To develop and deliver cost-effective education and training, it will be vital for the Task Force to collaborate with manufacturers, contractors, industry organizations, and others in the building design and construction community.

Embodied carbon guidance as well as material-specific resources are provided on several industry organization websites. The Carbon Leadership Forum (carbonleadershipforum.org) has an extensive resource library on their website, including research, white papers, webinars, embodied carbon policy toolkits, and a policy tracking map, as well as . For example, the National Ready Mix Concrete Association (NRMCA) website (www.nrmca.org/association-resources/sustainability) provides links to various educational resources regarding EPDs in general and also concrete-specific resources including webinars, reports, and tools. The American Institute of Steel Construction (AISC) also provides resources on their website for EPD guidance (www.aisc.org/sustainability/steels-environmental-footprint) and a summary of Buy Clean policies (www.aisc.org/sustainability/buy-clean).

The Minnesota Department of Administration, MnDOT, and CSBR will maintain continued collaboration to support contractors, project owners, engineers, and other stakeholders with training and education opportunities and share resources to support program implementation, such as documents, guides, templates, and webinars including, but not limited to, topics such as EPD basics, submittal process guidance, and sample specification language.

Conclusion and Next Steps

The research, findings, and recommendations presented in this report are the result of the time and commitment of a wide breadth of individuals including industry stakeholders, subject-matter experts, researchers, consultants, and practiced designers and engineers. The Task Force has diligently examined and provided tailored recommendations for a range of key construction materials including concrete, asphalt, structural steel, carbon steel reinforcing bar, and other materials such as glass, insulation, wood, and aluminum, paving the way for a more sustainable built environment in Minnesota. While much progress has been made since the Task Force first convened near the end of 2023, there is still much work to be done to ensure successful implementation as we transition from program creation to technical advisory phase. Clarity in defining program requirements, development of guidance documentation, education/training to support industry, and efficient collection and management of data will contribute to achieving Minnesota’s carbon goals.

The Task Force will continue to track developments for each of the materials/products and convene to review and reevaluate program requirements to refine and adjust to meet market needs and integrate new insights into a rapidly evolving material ecosystem.

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Note: this list is not exhaustive. See footnotes included in the body of the report for additional references.

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Appendix A: Minnesota Statute 16B.312[69]

16B.312 CONSTRUCTION MATERIALS; ENVIRONMENTAL ANALYSIS.

Subd. 1. Definitions. (a) For purposes of this section, the following terms have the meanings given.

(b) "Carbon steel" means steel in which the main alloying element is carbon and whose properties are chiefly dependent on the percentage of carbon present.

(c) "Commissioner" means the commissioner of administration.

(d) "Electric arc furnace" means a furnace that produces molten alloy metal and heats the charge materials with electric arcs from carbon electrodes.

(e) "Eligible material" means:

(1) carbon steel rebar;

(2) structural steel;

(3) concrete; or

(4) asphalt paving mixtures.

(f) "Eligible project" means:

(1) new construction of a state building larger than 50,000 gross square feet of occupied or conditioned space;

(2) renovation of more than 50,000 gross square feet of occupied or conditioned space in a state building whose renovation cost exceeds 50 percent of the building's assessed value; or

(3) new construction or reconstruction of two or more lane-miles of a trunk highway.

(g) "Environmental product declaration" means a supply chain specific type III environmental product declaration that:

(1) contains a material production life cycle assessment of the environmental impacts of manufacturing a specific product by a specific firm, including the impacts of extracting and producing the raw materials and components that compose the product;

(2) is verified by a third party; and

(3) meets the ISO 14025 standard developed and maintained by the International Organization for Standardization (ISO).

(h) "Global warming potential" has the meaning given in section 216H.10, subdivision 6.

(i) "Greenhouse gas" has the meaning given to "statewide greenhouse gas emissions" in section 216H.01, subdivision 2.

(j) "Integrated steel production" means the production of iron and subsequently steel primarily from iron ore or iron ore pellets.

[69] www.revisor.mn.gov/statutes/2024/cite/16B.312

(k) "Material production life cycle" means an analysis that includes the environmental impacts of all stages of a specific product's production, from mining and processing the product's raw materials to the process of manufacturing the product.

(l) "Rebar" means a steel reinforcing bar or rod encased in concrete.

(m) "Secondary steel production" means the production of steel from primarily ferrous scrap and other metallic inputs that are melted and refined in an electric arc furnace.

(n) "State building" means a building owned by the state of Minnesota or a Minnesota state agency.

(o) "Structural steel" means steel that is used in structural applications in accordance with industry standard definitions.

(p) "Supply chain specific" means an environmental product declaration that includes specific data for the production processes of the materials and components composing a product that contribute at least 80 percent of the product's material production life cycle global warming potential, as defined in ISO standard 21930.

Subd. 2. Standard; maximum global warming potential.

(a) The commissioner shall, after reviewing the recommendations from the Environmental Standards Procurement Task Force made under subdivision 5, paragraph (c), establish and publish a maximum acceptable global warming potential for each eligible material used in an eligible project, in accordance with the following schedule:

(1) for concrete used in buildings, no later than January 15, 2026; and

(2) for carbon steel rebar and structural steel and, after conferring with the commissioner of transportation, for asphalt paving mixtures and concrete pavement, no later than January 15, 2028.

(b) The commissioner shall, after considering nationally or internationally recognized databases of environmental product declarations for an eligible material, establish the maximum acceptable global warming potential for the eligible material.

(c) The commissioner may set different maximum global warming potentials for different specific products and subproduct categories that are examples of the same eligible material based on distinctions between eligible material production and manufacturing processes, such as integrated versus secondary steel production.

(d) The commissioner must establish maximum global warming potentials that are consistent with criteria in an environmental product declaration.

(e) Not later than three years after establishing the maximum global warming potential for an eligible material under paragraph (a), and not longer than every three years thereafter, the commissioner, after conferring with the commissioner of transportation with respect to asphalt paving mixtures and concrete pavement, shall review the maximum acceptable global warming potential for each eligible material and for specific eligible material products. The commissioner may adjust any of the values downward to reflect industry improvements if, based on the process described in paragraph (b), the commissioner determines the industry average has declined.

Subd. 3. Procurement process.

The Department of Administration and the Department of Transportation shall, after reviewing the recommendations of the Environmental Standards Procurement Task Force made under subdivision 5, paragraph (c), establish processes for incorporating the maximum allowable global warming potential of eligible materials into bidding processes by the effective dates listed in subdivision 2. The Department of Administration and Department of Transportation must also incorporate into the bidding process a preference for materials mined, made, or assembled in Minnesota.

Subd. 4. Pilot program.

(a) No later than July 1, 2024, the Department of Administration must establish a pilot program that seeks to obtain from vendors an estimate of the material production life cycle greenhouse gas emissions of products selected by the departments from among those procured. The pilot program must encourage, but may not require, a vendor to submit the following data for each selected product that represents at least 90 percent of the total cost of the materials or components composing the selected product:

(1) the quantity of the product purchased by the department;

(2) a current environmental product declaration for the product;

(3) the name and location of the product's manufacturer;

(4) a copy of the vendor's Supplier Code of Conduct, if any;

(5) the names and locations of the product's actual production facilities; and

(6) an assessment of employee working conditions at the product's production facilities.

(b) The Department of Administration must construct or provide access to a publicly accessible database, which shall be posted on the department's website and contain the data reported to the department under this subdivision.

Subd. 5. Environmental Standards Procurement Task Force.

(a) No later than October 1, 2023, the commissioners of administration and transportation must establish an Environmental Standards Procurement Task Force to examine issues surrounding the implementation of a program requiring vendors of certain construction materials purchased by the state to:

(1) submit environmental product declarations that assess the material production life cycle environmental impacts of the materials to state officials as part of the procurement process; and

(2) meet standards established by the commissioner of administration that limit greenhouse gas emissions impacts of the materials.

(b) The Task Force must examine, at a minimum, the following:

(1) which construction materials should be subject to the program requirements and which construction materials should be considered to be added, including lumber, mass timber, aluminum, glass, and insulation;

(2) what factors should be considered in establishing greenhouse gas emissions standards, including distinctions between eligible material production and manufacturing processes, such as integrated versus secondary steel production;

(3) a schedule for the development of standards for specific materials and for incorporating the standards into the purchasing process, including distinctions between eligible material production and manufacturing processes;

(4) the development and use of financial incentives to reward vendors for developing products whose greenhouse gas emissions are below the standards;

(5) the provision of grants to defer a vendor's cost to obtain environmental product declarations;

(6) how to ensure that lowering environmental product declaration values does not negatively impact the durability or longevity of construction materials or built structures;

(7) how to create and manage a database for environmental product declaration data that is consistent with data governance procedures of the state and is compatible for data sharing with other states and federal agencies;

(8) how to account for differences among geographical regions with respect to the availability of covered materials, fuel, and other necessary resources, and the quantity of covered materials that the department uses or plans to use;

(9) coordinating with the federal Buy Clean Task Force established under Executive Order 14057 and representatives of the United States Departments of Commerce, Energy, Housing and Urban Development, and Transportation; Environmental Protection Agency; General Services Administration; White House Office of Management and Budget; and the White House Domestic Climate Policy Council;

(10) how the issues in clauses (1) to (9) are addressed by existing programs in other states and countries; and

(11) any other issues the Task Force deems relevant.

(c) The Task Force shall make recommendations to the commissioners of administration and transportation regarding:

(1) how to implement requirements that maximum global warming impacts for eligible materials be integrated into the bidding process for eligible projects;

(2) incentive structures that can be included in bidding processes to encourage the use of materials whose global warming potential is below the maximum established under subdivision 2;

(3) how a successful bidder for a contract notifies the commissioner of the specific environmental product declaration for a material used on a project;

(4) a process for waiving the requirements to procure materials below the maximum global warming potential resulting from product supply problems, geographic impracticability, or financial hardship;

(5) a system for awarding grants to manufacturers of eligible materials located in Minnesota to offset the cost of obtaining environmental product declarations or otherwise collect environmental product declaration data from manufacturers based in Minnesota;

(6) whether to use an industry average or a different method to set the maximum allowable global warming potential, or whether that average could be used for some materials but not others; and

(7) any other items the Task Force deems necessary in order to implement this section.

(d) Members of the Task Force must include but are not limited to representatives of:

(1) the Departments of Administration and Transportation;

(2) the Center for Sustainable Building Research at the University of Minnesota;

(3) the Aggregate and Ready Mix Association of Minnesota;

(4) the Concrete Paving Association of Minnesota;

(5) the Minnesota Asphalt Pavement Association;

(6) the Minnesota Board of Engineering;

(7) the Minnesota iron mining industry;

(8) building and transportation construction firms;

(9) the American Institute of Steel Construction;

(10) the Institute of Scrap Metal Recycling Industries;

(11) suppliers of eligible materials;

(12) organized labor in the construction trades;

(13) organized labor in the manufacturing or industrial sectors;

(14) environmental advocacy organizations; and

(15) environmental justice organizations.

(e) The Department of Administration must provide meeting space and serve as staff to the Task Force.

(f) The commissioner of administration or the commissioner's designee shall serve as chair of the Task Force. The Task Force must meet at least four times annually and may convene additional meetings at the call of the chair.

(g) The commissioner of administration shall summarize the findings and recommendations of the Task Force in a report submitted to the chairs and ranking minority members of the senate and house of representatives committees with primary jurisdiction over state government, transportation, and energy no later than December 1, 2025, and annually thereafter for as long as the Task Force continues its operations.

(h) The Task Force is subject to section 15.059, subdivision 6.

(i) Meetings of the Task Force are subject to chapter 13D.

(j) The Task Force expires on January 1, 2029.

Subd. 6. Environmental product declarations; grant program.

A grant program is established in the Department of Administration to award grants to assist manufacturers to obtain environmental product declarations or otherwise collect environmental product declaration data from manufacturers in Minnesota. The commissioner of administration shall develop procedures to process and evaluate grant applications, and to make grant awards. Grant applicants must submit an application to the commissioner on a form prescribed by the commissioner. The commissioner shall act as fiscal agent for the grant program and is responsible for receiving and reviewing grant applications and awarding grants under this subdivision.

EFFECTIVE DATE. This section is effective the day following final enactment.

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Appendix B: Task Force Members & Contributors

Table B.1: Task Force Members

ESPTF Member Representation	Organization and (Role)	Name*
(1a) Minnesota Department of Administration	Minnesota Department of Administration (Co-chair)	Betsy Hayes
	Staff	Julie Bayerl
(1b) Minnesota Department of Transportation	Minnesota Department of Transportation (Co-chair)	Curt Turgeon
	Staff	Emil Bautista
	Staff	Joseph Nietfeld
(2) Center for Sustainable Building Research, CSBR (Facilitation)	CSBR	Richard Graves
	Staff	Garrett Mosiman
	Staff	Natalie Georgieff
	Staff	Roshni Desai
	Staff	Rolf Jacobson
(3) University of Washington, Civil & Environmental Engineering	Staff	Stephen Muench
(4) the Aggregate and Ready- Mix Association of Minnesota	AVR Concrete	Josh Edwards
	Cemstone	John Lee, Lars Anderson*
(5) the Concrete Paving Association of Minnesota (CPAM)	CPAM	Matt Zeller
	CPAM	Dan Labo
(6) the Minnesota Asphalt Pavement Association (MAPA)	MAPA	Abbey Bryduck
	Duininck Companies	Kris Duininck
(7) the Minnesota Board of Architecture, Engineering, Land Surveying, Landscape Architecture, Geoscience and Interior Design	MSR Design	Simona Fischer
	ESG	Laura Eder
	HGA	Jonathan Wacker
	University of Minnesota	Ann Johnson Stewart*
(8) a representative of the Minnesota iron mining industry	Cleveland Cliffs	Sandy Karnowski
(8a) building construction firms	Kraus Anderson	Kevin Bright
	AGC	Laura Ziegler
(8b) transportation construction firms	Kraemer North America	Stephen Kaldenbach
	Mathy Construction	Tara Wetzel
(9a) the American Institute of Steel Construction;	AISC	Max Puchtel
	AISC	Brian Raff
(9b) the Concrete Reinforcing Steel Institute;	CRSI	Parisha Chanodia, Amy Trygestad*
(10) the Institute of Scrap Metal Recycling Industries (ISRI);	ISRI	Luke Johnson
(11) suppliers of eligible materials	Aggregate Industries	Mark Bintzler
	Cargill	Susan Listberger, Dan Staebell*
	Gerdau	Ric Anderson

(12) organized labor in the construction trades	LIUNA MN	Kevin Pranis
	LIUNA MN	John Thorson
(13) organized labor in the manufacturing or industrial sectors	United Steel Workers	Bob Ryan
(14) environmental advocacy organizations	Blue Green Alliance	Bree Halverson, Abby Hornberger*
	Fresh Energy	Margaret Cherne-Hendrick
	Fresh Energy	Jacob Serfling
(15) environmental justice organizations	100% Campaign	Aurora Vautrin
	Clean Water Action	Sasha Lewis-Norelle

*Note: Some individuals listed may no longer be active on the Task Force at this time, but we would like to acknowledge them and thank them for their contributions and participation while on the Task Force.

Table B.2 ESPTF Stakeholders & Working Group Contributors

Organization	Name*
ARM of Minnesota	John Cunningham
Blue Green Alliance	Kyle Makarios, Charlie Martin*
Cemstone	Alex Olin
County Materials	Carlos Villareal
Ewald Consulting	Troy Olsen
Fresh Energy	Sam Friesen
Ingevity	Ashley Batson
ISRI Board Chair	Renee Toy
Koch Industries	Matthew Lemke
Midwest Building Decarbonization Coalition	Marnese Jackson
Nucor	Amari Jones, Joshua Cain, Mike Stober
Old Castle Infrastructure	Ben Gehrts
PCI Midwest	Mike Johnsrud, Ph.D., P.E.
Rinker Pipe	Steve Gentry
StanTec	Beth Tomlinson
Steel Manufacturers Association	Eric Stuart
Taft Advisors	Jeremy Estenson
Winthrop	Joe Bagnoli

*Note: Some individuals listed may no longer be active on the Task Force at this time, but we would like to acknowledge them and thank them for their contributions and participation.

Appendix C: Task Force Timeline

2023

- October 1 - Task Force established
- December 12 - ESPTF Meeting 1: Task Force Introductions and Kick-Off

2024

- February 22 - ESPTF Meeting 2: Embodied Carbon (EC) Context: Concrete and Asphalt
- March 14 - ESPTF Meeting 3: EC Context: Steel, Rebar and Other Materials
- April 25 and May 23 - ESPTF Meetings 3 and 4: Bidding and Procurement (Parts 1 and 2)
- July 1 - Pilot Program to estimate Global Warming Potential (GWP) from vendors on projects
- June thru October - Material-Specific Working Groups and Pilot Program Working Group (WG)
- October 23 - ESPTF Meeting 6: Concrete and Asphalt WG Report Outs
- November 20 - ESPTF Meeting 7: Steel and Rebar Working Group Report Out
- December 18 - ESPTF Meeting 8: Pilot Program and Other Materials Report Outs

2025

- March 19 - ESPTF Meeting 9: Task Force Recommendations
- May 8 - Draft Legislative Report Sent to Task Force for Comment
- April - Select Grant Awardees & Distribute Funds
- Summer/Fall - Staff Reviews, Revise Draft of Report as Needed
- September 23 - Updated Draft Sent to Task Force for Comment
- October 8 - ESPTF Meeting 10: Task Force Recommendation & Legislative Report Discussion
- December 1 - Report to the Legislature

2026

- January 15 - Commissioner to establish and publish a maximum GWP for concrete used in buildings no later than January 15, 2026.
- December 1 - Report to the Legislature

2027

- December 1 - Report to the Legislature

2028

- January 15 - Commissioner to establish and publish a maximum GWP for carbon steel reinforcing bar and structural steel and, after conferring with the commissioner of transportation, for asphalt paving mixtures and concrete pavement no later than January 15, 2028 (Task Force may recommend implementing requirements sooner for certain materials based on industry developments).
- December 1 - Report to the Legislature

2029

- January 1 - Task Force ends

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Appendix D: Pilot Program Summary

This section summarizes the goals and outcomes of the Pilot Program and recommendations for potential future research.

Goals

The main goals of the pilot program included gaining a better understanding of Minnesota's supply chain of certain construction materials, the relative availability of EPDs (Environmental Product Declarations), the potential upstream and downstream impacts of setting future GWP (Global Warming Potential) limits for materials, and exploring viable database options.

Minnesota Statute 16B.312 Subdivision 4 (see Appendix A) outlined the legislative requirements for the Pilot Program as follows:

"(a) No later than July 1, 2024, the Department of Administration must establish a pilot program that seeks to obtain from vendors an estimate of the material production life cycle greenhouse gas emissions of products selected by the departments from among those procured. The pilot program must encourage, but may not require, a vendor to submit the following data for each selected product that represents at least 90 percent of the total cost of the materials or components composing the selected product:

(1) the quantity of the product purchased by the department;

(2) a current environmental product declaration for the product;

(3) the name and location of the product's manufacturer;

(4) a copy of the vendor's Supplier Code of Conduct, if any;

(5) the names and locations of the product's actual production facilities; and

(6) an assessment of employee working conditions at the product's production facilities.

(b) The Department of Administration must construct or provide access to a publicly accessible database, which shall be posted on the department's website and contain the data reported to the department under this subdivision."

Projects & Findings

The pilot program focused on two main categories of projects: vertical construction (buildings) and horizontal construction (roadways). The pilot projects examined included several in-progress or recently completed state construction projects, including seven Minnesota state building projects, and several paving projects completed by MnDOT.

Buildings

Table D.1 summarizes general project data for the buildings included in the pilot and Figure D-1 shows a map with project locations. In addition to the buildings shown below, a sample project location of Duluth was selected to explore EPD availability for local material facilities/plant locations compared to more centrally located pilot projects.

Table D.1: Summary of Buildings Pilot Projects

Project Name	Building Size (sq. ft.)	Occupancy Date (from B3*)	Building Type	Primary Structural System	Substructure
Bell Museum	91,990	12/20/2017	Museum	Steel Framing	Shallow Concrete Foundations
U of M Fraser Hall	124,870	7/7/2025	Education	Concrete Framing	Pile & Shallow Concrete Foundations
MnSCU Mankato Clinical Sciences Building	80,152	1/1/2017	Education	Steel Framing	Shallow Concrete Foundations
Minnesota Veterans Home - Bemidji	80,618	12/19/2023	Supportive Housing	Steel Framing	Shallow Concrete Foundations
Minnesota Veterans Home - Preston	59,351	10/23/2023	Supportive Housing	Steel Framing	Shallow Concrete Foundations
Minnesota Veterans Home - Montevideo	94,232	11/9/2023	Supportive Housing	Steel Framing	Shallow Concrete Foundations
Northland Community & Technical College, Thief River Falls: Aviation Addition and Renovation	18,817	6/30/2016	Education	Steel Framing	Shallow Concrete Foundations

*Occupancy dates shown were reported by the project team through the B3 Guidelines (https://www.b3mn.org/guidelines/) online tracking tool. Actual occupancy dates may vary.

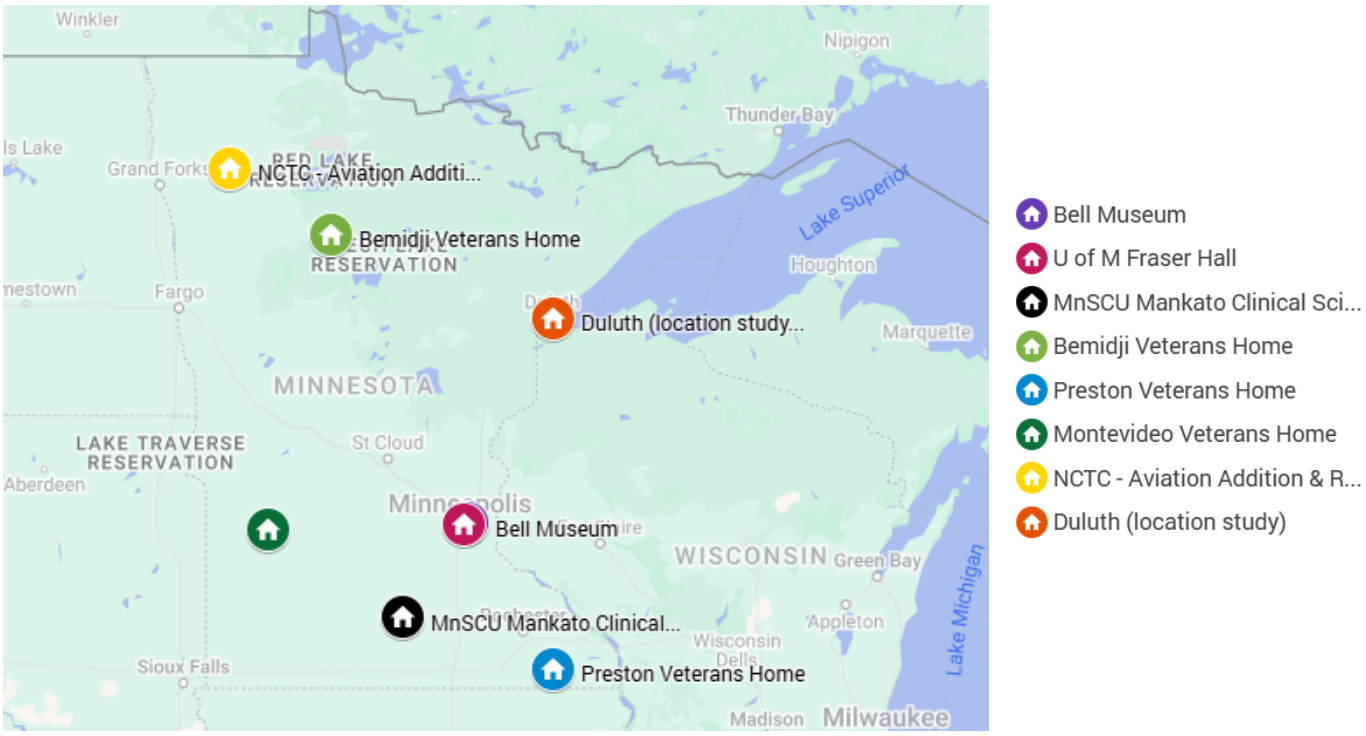


Figure D-1: Buildings Pilot Projects Map (map image generated using Google My Maps, 2025).

Project data was collected from projects teams and/or exported from the B3 (Buildings, Benchmarks, and Beyond) Guidelines[70] Tracking Tool, and included some of the following:

- Bid Documents (construction drawings and specifications)
- Project Submittals (including shop drawings, product data, informational submittals, mill certs / reports, invoices, etc. submitted to the project team during the construction process)
- Itemized Budget, Bill of Materials, and Pay Applications
- BIM (Revit) Models

Data was collected and analyzed for the following materials/products:

- Concrete
    - Ready-Mix (CIP)
    - Concrete Masonry Units (CMU)
    - Precast/Hollowcore Concrete
- Carbon Steel Rebar (used in Concrete and CMU)
- Structural Steel
    - Steel Plate
    - Hot-Rolled Structural Sections
    - Hollow Structural Sections (HSS)
    - Steel Deck
    - Open-Web Steel Joists
    - Cold-Formed and Galvanized
- Glass
- Aluminum
- Insulation

A majority of the pilot project buildings had already completed construction, thus availability of certain project data was limited. Project submittals oftentimes did not include tabulated material quantities or material costs, and sometimes it was difficult to determine actual facility/plant locations where the product originated, especially if a specialty subcontractor/fabricator was involved that could have sourced materials/products from a variety of possible manufacturing facilities. Copies of the vendor's Supplier Code of Conduct were not available for most manufacturers/products, with the exception of several material suppliers of steel, insulation, and glass materials, which were found on manufacturers' websites. Assessments of employee working conditions at the product's production facilities were not available, though some of this information might be contained in other types of reports such as Facility Registry Services (FRS) reports published by the EPA[71] for certain mills/facilities that are subject to environmental regulations or are of environmental interest, as well as facilities that had OSHA (The Department of Labor, Occupational Safety and Health Administration) inspections within the last 7 years.

EPDs were not included in the construction submittal packages retained by owners/project teams, however, EPDs for alternative comparable products were identified and included in the analysis when available. Current EPD availability was analyzed to determine if there are alternative or comparable product EPDs in proximity to the projects. Material EPD availability was mapped for the various

[70] Minnesota B3 Guidelines www.b3mn.org/guidelines/
[71] EPA Facility Registry Services (FRS) www.epa.gov/frs

materials/products relative to pilot project building locations, including the addition of a hypothetical Duluth project location, using Building Transparency's online *Map of Manufacturers with EPDs*[72] and *Google My Maps.* Figure D-2 shows locations of ready mix concrete plants with valid EPDs available in EC3 as of May 2025. Generally, EPDs were more available for larger manufacturers/plants in the Twin Cities Metro Area, with less plant coverage in Greater Minnesota. Future grants and assistance should focus on EPD development in more rural areas to support material transparency and reporting for smaller plants.

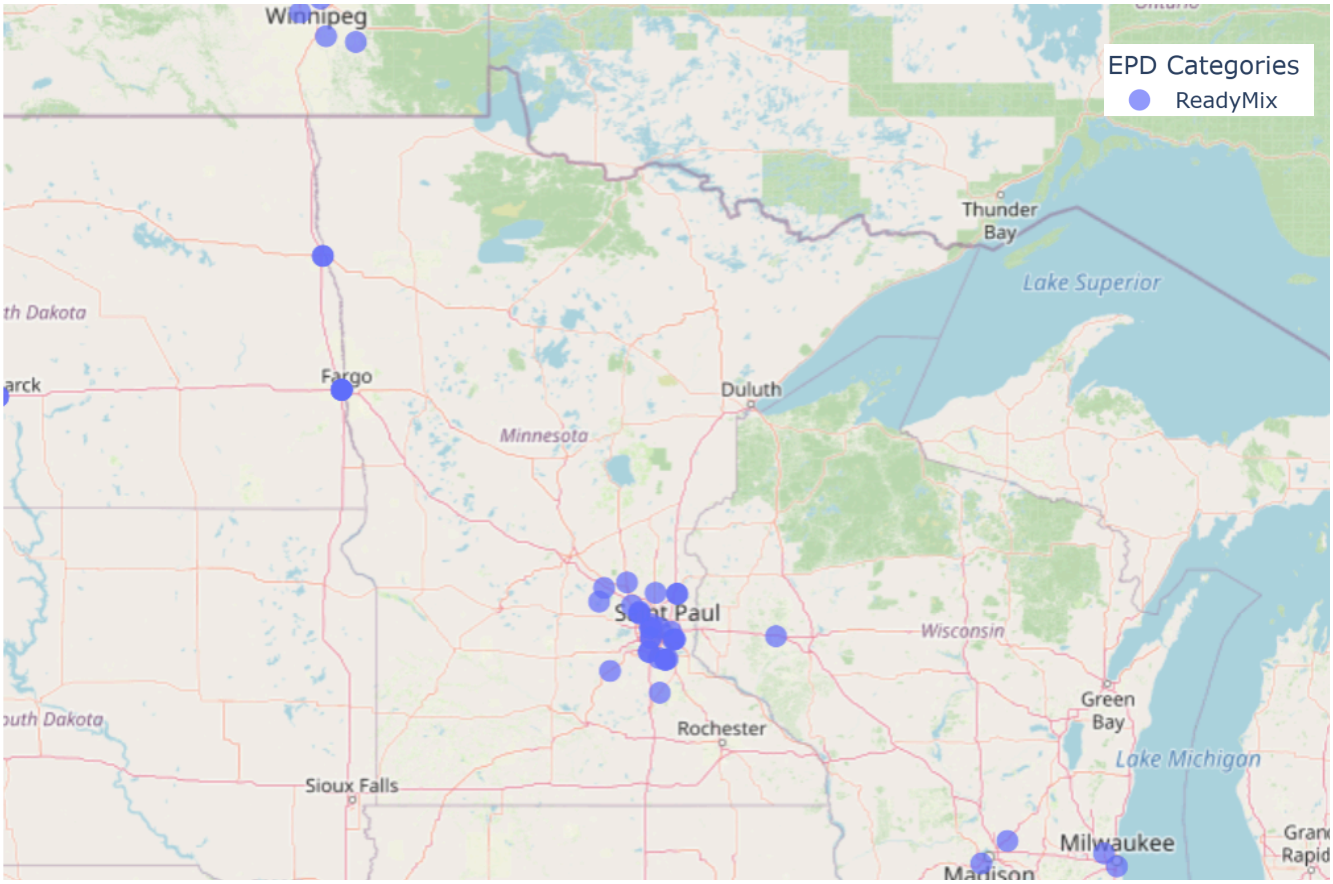


Figure D-2: Ready Mix Concrete Plants with EPDs Available in EC3 as of May 2025. Source: Building Transparency's *Map of Manufacturers with EPDs* www.buildingtransparency.org/maps.

For certain material categories, product names/descriptions included in current EPDs did not provide adequate specificity to verify suitability as a functionally equivalent substitute. For example, when searching for a 4,000psi ready-mix concrete EPD, while the plant name and location are included in the EPD data reported, the mix design number/designation, intended application/usage, and other important mix identifying data are not included, making it difficult to match with actual mixes utilized on projects.

EC3 was utilized to source and compare product-specific ready mix concrete EPDs, however, availability of product-specific EPD data for other materials such as CMU, steel, glass, aluminum, and insulation was more varied. Industry-wide EPDs for some of these materials were found on manufacturers' websites, which often include average GWP values and sometimes include facility-specific GWPs, depending on the product. For example, AISC's website (www.aisc.org/epd)

[72] Map of Manufacturers with EPDs www.buildingtransparency.org/maps

includes links to industry-wide average EPDs for three steel products (hot-rolled sections, plate, and HSS) and facility-specific EPDs for five steel products (hot-rolled sections, plate, HSS, open-web steel joists, and steel deck).

Along with project drawings, specifications, and construction submittals, 3D Structural and Architectural BIM models were provided by project teams for several of the pilot projects. Utilizing the 3D Revit[73] models and Tally LCA[74], a Revit plug-in, material quantities and hypothetical GWP impacts were estimated for the buildings' substructure, structure, and envelope assemblies. Certain products, such as steel rebar and cold-formed metal framing studs, are not typically modeled in 3D to represent all of the individual elements, which would be time-consuming and above the typical Level of Detail (LOD) that is standard for most designers/engineers, so these materials were estimated not based on volume of the element itself, but by an assumed steel reinforcing density per volume of modeled concrete or by an assumed product stud size, gauge, and spacing, which may or may not closely represent the actual materials used on the project, since data availability varied. These observations illuminate the importance of the data collection process including not only what material information is collected during procurement, but also when in the project it is collected, and how it is reported and stored in a database.

For the projects in which material quantities were estimated, EC3[75] was utilized to store and organize project material data for the various material categories. It is important to note the required quantity units format in EC3 varies depending on the material. For example, ready-mix concrete and CMU must be reported in volume (yd3 or m3), steel and precast concrete or brick must be reported by weight/mass (lbs or kg), while insulation products such as mineral wool board insulation or blown cellulose insulation are reported in units of area multiplied by the R-value of the insulation, in an effort to normalize reporting based on insulative performance. Since Tally LCA defaults to reporting material quantities in units of mass (kg), it was difficult to convert some material quantities to input into EC3 without complete material information for actual as-built products. This further illustrates the importance of collecting as-built product data and quantitative information from the project team at the time of procurement/bidding to ensure all of the material parameters and appropriate units of measure are included.

Collecting and analyzing data for the buildings pilot projects helped to identify what information will need to be collected (products, manufacturers, quantities, EPDs), when in the design/construction process to request this information, and potential pathways to implement and communicate material requirements in a project workflow (whether that be in design guidelines, contract language, project specifications/construction submittal requirements, and/or project drawings). For findings regarding database exploration, please see the body of the report (Section 3).

[73] Autodesk Revit www.autodesk.com/products/revit/overview
[74] Tally LCA choosetally.com
[75] The EC3 Tool | Building Transparency www.buildingtransparency.org/tools/ec3

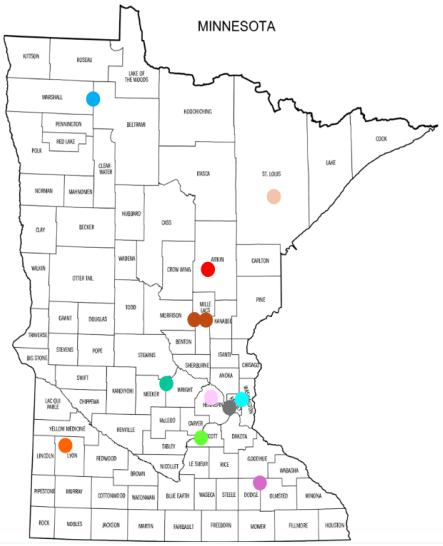
Roadways

MnDOT, with the leadership and support of research collaborators listed below, collected data on asphalt pavement projects and analyzed a number of EPDs for concrete pavements, as a part of separate initiatives that operated in parallel to the buildings pilot projects, with similar project goals: to understand and reduce the carbon footprint of pavement infrastructure in the state of Minnesota, estimate relative carbon impacts of A1-A3, A4, and A5 life cycle emissions typical for DOT projects, and develop recommendations on benchmarking, data collection, and integration of EPD requirements into the procurement process.

Asphalt Paving

Zhanping You and Amlan Mukherjee co-led a study entitled, “FHWA Climate Challenge: Using LCA to Reduce Embodied Carbon in Asphalt Pavement at MnDOT” (Contract Number: 1036337).

The research team at Michigan Tech University (MTU) selected 14 projects, of which, 12 were MnDOT projects. Included in the projects were a warm mix asphalt (WMA) project in the City of Minneapolis and a hot rubber chip seal project implemented by NRRA in Michigan. Figure D-3 shows the project locations (including the Minnesota District and County) and contractors.



No.	District	County	Contractor
1	8	Lyon	Central Specialties, Inc
2	6	Dodge, Olmsted	Rochester Sand and Gravel a division of Mathy Construction Company
3	8	Meeker, Wright	Duininck, Inc
4	7	Anoka	OMG Midwest, Inc. dba Minnesota Paving & Materials
5	2	Beltrami, Marshall	R. J. Zavoral & Sons, Inc.
6	Metro	Scott	Valley Paving, Inc.
7	Metro	Ramsey	McNamara Contracting, Inc.
8	Metro	Ramsey, Washington	Asphalt Surfacing Technologies Corporation
9	Metro	Aitkin	Hawkinson Construction Co., Inc.
10,11	3	Mille Lacs (Two projects)	Knife River Corporation - North Central
12	1	St. Louis	Ulland Brothers
13	5	City of Minneapolis	Bituminous Roadways
14	N/A	Bay (MI)	MDOT (Hot rubber chip seal project located in Michigan)

Figure D-3: Asphalt Paving Pilot Projects Locations (map courtesy of Zhanping You and the MTU research team).

Figure D-4 shows an example of preliminary A1-A5 results for 1 lane-mile of 1.5 inch thick paving wearing course (total asphalt tonnage of about 597), assuming 1 paver, 1 MTV, 3 rollers, 1 tack distributor truck, 1 skid loader, 1 water truck, and a transportation distance from plant to job site of 10 miles.

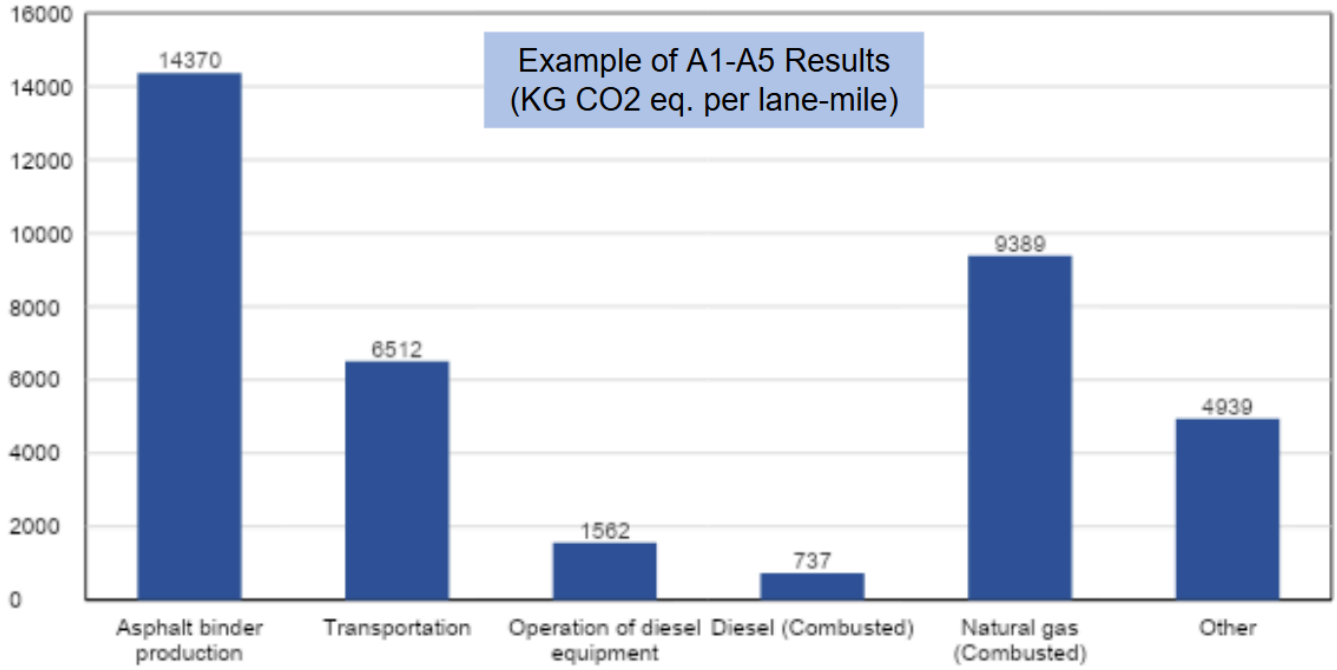


Figure D-4: Example of A1-A5 Impact Analysis Results per Lane-Mile (courtesy of Zhanping You and the MTU research team). Note: results are preliminary.

The impact analysis of the projects demonstrated that raw materials processing such as production of asphalt binder contributes the bulk of emissions in life cycle stages A1-A3. Additionally, the carbon footprint of paving operations for diesel equipment was relatively low when compared to the impact of the material acquisition, transportation, and production. In the A4-A5 stages, transportation from the asphalt plant to the job site played a major role in the carbon footprint, so reducing travel distance by selecting a plant closest to the job site is recommended to reduce carbon impacts.

In the next stage of analysis, the MTU team will establish benchmarks and develop specific thresholds for the A4 and A5 life cycle stages. The team will also analyze carbon impacts associated with maintenance and rehabilitation methods such as milling and overlay, or Cold in-Place Recycling (CIR), a road repair process whereby the top layer of asphalt is removed and replaced.

Integrating serviceability-based criteria into pavement LCA will be vital to provide a comprehensive analysis of performance, service life, and environmental impacts to inform project-level decisions that could have the potential for significant carbon reduction, without sacrificing durability, which the limited scope of EPDs (A1-A3) may not entirely capture

Concrete Paving

Michelle A. Cooper and Amlan Mukherjee co-led a study analyzing the carbon impacts of concrete pavement and published a report entitled, “Development of a Process to Lower GWP of Construction Materials”.[76] To assist MnDOT and the Minnesota pavement industry in quantifying the carbon emissions associated with concrete paving, the team collected and analyzed EPDs for Minnesota-based mixes and collaborated with industry members to obtain data to estimate emissions due to transportation of materials and equipment to the job site and construction operations.

Focusing on data pertaining specifically to concrete used in Minnesota in order to develop benchmarks, EPDs were collected from the following sources:

- Concrete ready-mix suppliers in and around Minnesota willing to collaborate (32 mix designs)
- Building Transparency’s EC3 Tool[77] (813 EPDs)
- NRMCA[78] (44 EPDs)

To categorize A1 impact analysis, three scenarios were identified based on approved project mixture designs from MNDOT: Paving, High-early-strength (HES), and All applications. The calculated A1 values are intended to set an initial benchmark, which can then be updated in the future with production-weighted benchmarks utilizing actual material production quantities and project-specific EPDs used on Minnesota DOT projects. Based on the benchmarking methodology presented in the team’s final report, GWP benchmarking values were developed and are shown in Table D.2 for A1, A2, and A3 life cycle stages.

Table D.2: Benchmark “Average” GWPs (based on data included in Table 7.1 of the final MnDOT report).

Life Cycle Stage	Paving Concrete	HES Concrete	All Other Applications
A1 GWP	217.49	252.80	251.64
A2 GWP	22.16		
A3 GWP	5.40		
A1+A2+A3	245.05	280.36	297.20

[76] Development of a Process to Lower Global Warming Potential of Construction Materials | MnDOT Digital Library. mdl.mndot.gov/items/202524
[77] The EC3 Tool | Building Transparency www.buildingtransparency.org/tools/ec3
[78] Environmental Product Declarations: Concrete product EPDs verified under NRMCA’s EPD. www.nrmca.org/association-resources/sustainability/environmental-product-declarations

Pilot Program Overall Takeaways & Next Steps

Data collection for the pilot projects illuminated the need to standardize the EPD data submission process and requirements to ensure all required information is collected, which is especially important to be able to match EPDs with actual materials utilized.

While A4 and A5 GWP data are not currently required to be reported as a part of an EPD, it will be important to track this data, perhaps voluntarily alongside EPD reporting, especially for pavement projects where A4 transportation and A5 construction emissions might contribute more to Module A impacts than previous studies and analyses have estimated.

Future opportunities for pilot project research could include additional GWP data collection for precast/post-tensioned concrete, mobile batch plants, and CMU products as these markets begin to develop more robust EPD data ecosystems. Additionally, future research and efforts to develop and maintain an automated data submission and validation system could greatly enhance project tracking, and the ability to measure and report progress in reducing carbon of construction materials.