



SUSTAINABLE STEEL

SPECIFICATION WRITING GUIDE

DECEMBER 2024

NUCOR[®]



NOTE TO SPECIFIER

This document is meant to serve as a guide to aid designers in specifying embodied carbon limits on steel materials through the addition of language to structural steel and concrete reinforcement specifications (CSI Masterformat Division 05 and Division 03, respectively), to meet a project's needs. All language and benchmark values included in this guide are to be reviewed and assessed on a project-by-project basis by a qualified professional to determine feasibility.

Nucor recommends meeting with ownership, the construction team and the design team to establish overall sustainability goals in the initial stages of a project. As always, Nucor's team of specialists are available to answer any questions or for additional project assistance.

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DISCLAIMER:

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ABOUT US

Nucor is the largest steel manufacturer and recycler in North America and we recognize our role in protecting the environment. We value the environment of the communities in which we operate, and recognize its importance to our teammates, their families and our continued welfare. Protecting the environment is critical to our operations and the company's long-term success. To this end, we endorse the following principles:

PERFORMANCE

To continuously improve the effectiveness of our ISO 14001:2004 or ISO 14001:2015 Environmental Management System (EMS), Nucor will:

- Pursue pollution prevention and waste minimization opportunities;
- Investigate and develop technologies and operations that improve environmental performance;
- Regularly evaluate the EMS and make appropriate improvements.

STEWARDSHIP

Nucor recognizes our potential for environmental impact on the communities in which we operate. We will continuously strive to minimize these effects by evaluating our operations and researching new technologies and opportunities.

RESPONSIBILITY

Environmental protection is the individual obligation of each Nucor teammate and a primary responsibility of management. Nucor requires our contractors, vendors and suppliers to comply with applicable environmental laws.

STANDARD

Nucor and its divisions will comply with the laws and regulations governing our operations. Environmental compliance is a priority for Nucor management equal with all other business functions.

OUTREACH


Nucor will strive to foster open dialogue so that we may effectively communicate with our teammates, our neighbors and other concerned parties.




BACKGROUND

Annually, nearly 40% of all global greenhouse gas (GHG) emissions can be attributed to the building and construction sectors. The carbon emissions directly associated with the manufacturing of building materials and building construction, commonly referred to as embodied carbon, are responsible for approximately 11% of the annual GHG emissions generated globally¹. According to Architecture 2030, the estimated global building floor area is expected to double by 2060. That's the equivalent of adding an entire New York City to the globe, every month, for the next 38 years. Therefore, it is imperative for the architecture, engineering, and construction (AEC) community to strive to reduce embodied carbon in their designs.


In 2022, the World Steel Association estimated that the average global production of one metric ton of steel created approximately 1.91 tons of CO₂ emissions².



THERE ARE TWO MODERN STEELMAKING METHODS:



Extractive Steel: Basic Oxygen Furnaces (BOF)
Steel as created using raw materials (iron ore, coal and limestone) as primary inputs and predominantly using coal power and natural gas as a fuel source. BOF steel can contain **up to 30% recycled content**, but the global average is much lower. This energy intensive process requires an average of 24 GJ³ to produce a metric ton of steel. The global average CO₂ intensity for BOF steel production was **2.33 tons of CO₂** per ton of steel in 2022.



Circular Steel: Electric Arc Furnaces (EAF)
Steel as created using recycled scrap steel and electricity as a primary heat source. EAF steel can contain **over 90% recycled content** and requires only around 10 GJ³ of energy to produce a metric ton of steel. The global average CO₂ intensity for EAF steel production was **0.77 tons of CO₂** per ton of steel in 2022.



MAKING STEEL WITH EAF PRODUCES ON AVERAGE LESS THAN 1/3 THE GLOBAL AVERAGE EMISSIONS OF STEEL MADE WITH BOF.

Through recycling, EAF steelmaking utilizes the scrap steel available to bypass the polluting step of processing raw materials in the BOF process. With less than half the energy demands and one-third of the CO₂ emissions, EAF made steel is much more energy efficient and environmentally friendly than steel produced by its BOF counterparts.

Globally, approximately 74% of steel is produced in BOFs, while the remaining 26% is produced in EAFs. However, these values are nearly reversed for steel produced in the United States, with approximately 70% of North American steel production coming from an EAF facility. The prevalent use of EAF mills domestically makes sourcing steel manufactured in the United States an ideal way to reduce a building's embodied carbon while reducing project risks associated with importing materials.

Structural steel specifications can be updated to inform material procurement practices, creating a path to source steel with fewer carbon emissions.

Public policies, building codes and certifications have primarily focused on reducing operational energy and carbon. However, the ratio between operation carbon and embodied carbon, which is associated with the manufacturing of the building materials, can potentially be one-to-one. Therefore, the effort to decarbonize the building sector has expanded to include embodied carbon alongside operational carbon.

Policies at municipal, state, and federal levels have been implemented to influence procurement practices on building projects. For example, the Buy Clean California Act, which went into effect in July 2022, established limits on embodied carbon for different construction materials, including structural steel. Whether required by legislation or motivated by project sustainability goals, architects and engineers need to be knowledgeable on how to incorporate sustainability into their design procedures and add procurement parameters into their construction documents. Upfront communication with all parties involved, especially the general contractor and steel fabricator, will ensure proper procurement of required materials.



ENVIRONMENTAL PRODUCT DECLARATIONS

INTRODUCTION INFO



A key tool for measuring a building material's environmental impacts is an environmental product declaration (EPD). An EPD is an independently verified and registered document that communicates transparent and comparable information about the environmental impact of a product over its life cycle. In some ways an EPD is like a nutrition label, stating what a product is made of and estimating how the production of it impacts the environment. When designers, contractors and owners have a better understanding of the impact each material will have on their building with data reporting like EPDs, they can make the best choices to achieve project-specific sustainability goals.

The creation of an EPD must be regulated to ensure the document is a verified, accurate, apples-to-apples comparison of products. When EPDs are created, they must follow the guidelines and requirements of a product category rule (PCR). The current PCR regulating structural steel is the "North American Product Category Rule for Designated Steel Construction Products." Additionally, all EPDs must follow the requirements and guidelines of an International Organization for Standardization (ISO) standard; the structural steel industry-wide EPD is governed by ISO 14025.



Steel EPDs provide the impact of each step of steel making, including raw ingredients, transportation to manufacturing, and the manufacturing process itself. Industry-wide EPDs calculate a weighted average from multiple manufacturers of a certain product, where as product-specific or facility-specific EPDs provide data specific to one manufacturer and its facilities.

EPDs of different materials are not directly comparable. Full conformance with a PCR allows EPD comparability only when the PCR-mandated stages of a life cycle have been considered. For example, one ton of wood does not equal one ton of steel; therefore, it is important that a whole building life cycle analysis (WBLC) and design be performed to accurately determine a structure's environmental impacts and material quantities.



On January 1, 2021, Nucor had only one EPD for one product, covering one Nucor facility. As of 2024, Nucor offers EPDs for almost all of our steel products and are continuously collecting new data to ensure our EPDs are up-to-date. Requiring the submission of EPDs will encourage manufacturers to produce more EPDs for their products, thus improving documentation, transparency and further benchmarking within the industry.

COMMENTARY

PART 1.A.1

The specifier must explicitly state which products will require the submission of EPDs for their project. For example, the Buy Clean California Act (BCCA) mandates the submission of EPDs for structural steel (hot-rolled sections, hollow structural sections and plate). These products fall under Section 051200.

In addition to structural steel products, Nucor recommends requiring EPDs for steel floor and roof decking [Section 053100], steel joist framing [Section 052100], and concrete reinforcing (rebar) [Section 032100], as required by the project, and sample language is included for all four specification sections are included in this guide.

PART 1.A.2

Global warming potential (GWP) is the primary metric, or impact category, indicated on EPDs that is required for their direct work as noted in Part 1.A.2.a, but the balance of impact categories (Part 1.A.2.b to Part 1.A.2.f) shall also be reported. These impact categories are required to produce a comprehensive building life cycle assessment and are required for meeting targeted LCA LEED v4 points. Adding language to this section will allow EPD requirements to remain in one part of the overall project specification and avoid the duplication of information. If LEED credits are not being pursued, or the designer prefers for LEED language to be located solely in another specification section, then it is acceptable to omit the language for non-GWP impact categories (Part 1.A.2.b to Part 1.A.2.f).

PART 1.A.3

As previously noted, there are two different types of EPDs: industry-wide (IW-EPDs) and manufacturer-specific EPDs. For the purposes of early-phase project studies or embodied carbon calculations, it is recommended that specifiers use IW-EPDs for each building product, as the manufacturer of the product may not be known in the early phases of a project. The parties responsible for procurement should be selecting products based on GWP criteria from manufacturer-specific EPDs. Once the project reaches a phase when sourcing of a product is confirmed by the project's construction team, the manufacturer-specific GWP values from the appropriate facility may be used to further refine LCA studies or calculations.

Industry-wide EPDs are not acceptable for material procurement and may not be submitted for compliance. It is critical that each product covered under Part 1.A.1 be traceable back to a manufacturer. Thus, the GWP values indicated on an EPD must be associated with the specific plant location(s) matching the procured product.



EPD SAMPLE LANGUAGE – STEEL FRAMING

SECTION 05 12 00

STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.0X SUBMITTALS

A. Environmental Product Declarations (EPD): Submit manufacturer's EPD per the following:

1. EPDs to be submitted for each of the following structural steel types:
 - a. Hot-rolled structural sections (W, S, M).
 - b. Hollow structural sections (HSS).
 - c. Structural plate.
2. All EPDs are to be third-party verified in accordance with the current version of ISO 14025 (validated by a date that has not expired) and indicate the following Impact Categories:
 - a. Global Warming Potential (GWP): All GWP information submitted shall be in the form of kgCO₂eq/kg.
 - b. Ozone Depletion Potential (ODP): All ODP information shall be in the form of kgCFC-11/kg.
 - c. Acidification Potential (AP): All AP information shall be submitted in the form of kgSO₂/kg.
 - d. Eutrophication Potential (EP): All EP information submitted shall be in the form of kgN/kg.
 - e. Smog Formation Potential (SFP): All SFP information shall be submitted in the form of kgO₃/kg.
 - f. Energy Consumption: All energy consumption information shall be submitted in the form of MJ.
3. Manufacturer-specific GWP information will be one of the decision criteria when awarding this scope. The manufacturer EPD must indicate GWP information from the specific mill or plant facility from which the material is to be procured. EPDs including GWP information for more than one facility are acceptable as long as each facility's GWP information is reported separately. EPDs reporting GWP values as averages from multiple facilities only or industry-wide EPDs are not acceptable.
4. EPDs must clearly indicate the Product Flow Diagram disclosing if product fabrication is included within the "cradle-to-gate" life cycle scope (product stages A1-A3) of the EPD.



PART 1.A.4

EPDs for most building products will cover a “cradle-to-gate” product life cycle, with additional stages or modules provided in some cases. Cradle-to-gate refers to modules A1-A3, or the “Product Stage” of the steel product life cycle. It is important to note whether the EPD provided considers the product to be fabricated or unfabricated.

- An unfabricated steel product is the product supplied directly by a steel mill or plant. For example, a wide-flange column that has not been drilled, welded to or modified is referred to as unfabricated. The life cycle for this type of product is referred to as “Cradle- to-Mill Gate.”
- A fabricated steel product is one that has been manufactured by a steel producer, transported to a fabricator or secondary processor, and then altered into its final form prior to installation. Following the previous example, once the wide-flange column is drilled for field bolting, cut as required or has connection material welded to it, the product is now considered to be fabricated. The life cycle for this type of product is referred to as “Cradle-to-Fabricator Gate.”

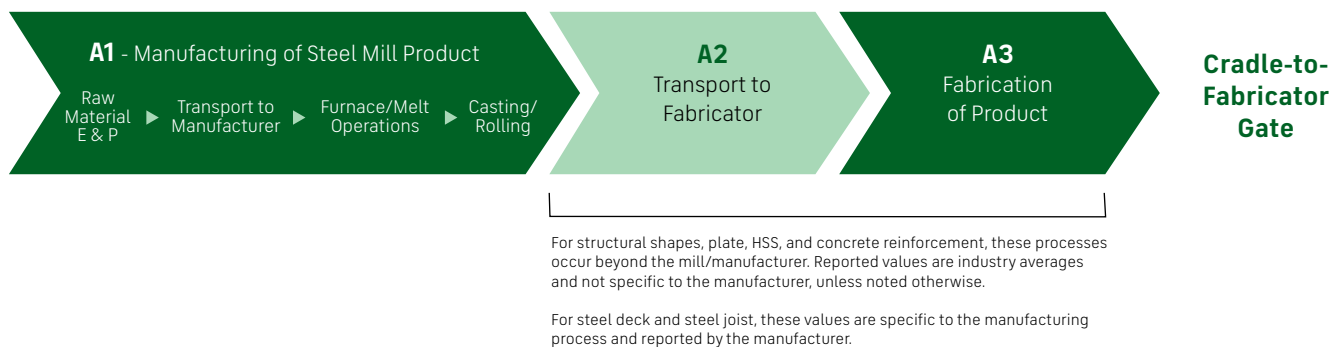
Hot-rolled structural shapes, plate, HSS, and rebar EPDs can publish either fabricated or unfabricated GWP values. It is also common for fabricated steel EPDs to include unfabricated GWP values. To minimize confusion with EPD collection, it is acceptable to allow both fabricated and unfabricated EPDs for structural steel and concrete reinforcement to comply with this requirement, so long as the data is specific to the facilities in which the product is manufactured. Steel deck and steel joist are inherently fabricated products that do not require additional fabrication before being transported to the job site. At deck and joist facilities, raw steel materials (Module A1) are transported to the facility (Module A2), where they are fabricated into construction products (Module A3). Therefore, Modules A1 through A3 capture the full environmental impacts of manufacturing the product prior to delivery to job site, which are reported by the manufacturer.

The Product Stage modules A1-A3 differ between the two types of products as depicted in the graphic below.

UNFABRICATED STEEL PRODUCT LIFE CYCLE STAGES



FABRICATED STEEL PRODUCT LIFE CYCLE STAGES



Some manufacturer EPDs will provide GWP information for the “End of Life Stage” (Module C) or additional benefits beyond the system boundaries (Module D) to account for material reuse or recycling. It is important to note which product stages are included in an EPD – in addition to various other information including manufacturer, facility locations, product specific inputs and system boundaries.

It is recommended to use the unfabricated steel mill product GWP as the standard measure of GWP. Additionally, unfabricated product GWP can be derived from a fabricated product EPD. The inverse is not true. However, it is ultimately up to the specifier to choose whether fabricated or unfabricated EPDs shall be submitted based on project preference.

- For an unfabricated steel product, the controlling GWP is the sum of values from modules A1, A2 and A3 indicated within the EPD.
- For a fabricated steel product, the controlling GWP is only the value from module A1, which represents the mill product and “Cradle-to-Mill Gate” life cycle. Refer to the Appendix for an example showing how to calculate the GWP of an unfabricated product when a fabricated product EPD is provided.

EPD SAMPLE LANGUAGE – STEEL DECKING

SECTION 05 31 00 STEEL DECKING

PART 1 - GENERAL 1.0X SUBMITTALS

A. Environmental Product Declarations (EPD): Submit steel floor or roof deck manufacturer’s EPD per the following:

1. All EPDs are to be third-party verified in accordance with the current version of ISO 14025 (validated by a date that has not yet expired) and indicate the following Impact Categories:
 - a. Global Warming Potential (GWP): All GWP information submitted shall be in the form of kgCO₂eq/kg.
 - b. Ozone Depletion Potential (ODP): All ODP information shall be in the form of kgCFC-11/kg.
 - c. Acidification Potential (AP): All AP information shall be submitted in the form of kgSO₂/kg.
 - d. Eutrophication Potential (EP): All EP information submitted shall be in the form of kgN/kg.
 - e. Smog Formation Potential (SFP): All SFP information shall be submitted in the form of kgO₃/kg.
 - f. Energy Consumption: All energy consumption information shall be submitted in the form of MJ.
2. Manufacturer-specific GWP information will be one of the decision criteria when awarding this scope. The manufacturer EPD must indicate GWP information from the specific mill or plant facility from which the material is procured. EPDs including GWP information for more than one facility are acceptable as long as each facility’s GWP information is reported separately. EPDs reporting GWP values as averages from multiple facilities only or industry-wide EPDs are not acceptable.
3. EPDs must clearly indicate the Product Flow Diagram disclosing if product fabrication is included within the “cradle-to-gate” life cycle scope (product stages A1-A3) of the EPD.

EPD SAMPLE LANGUAGE – STEEL JOIST FRAMING

SECTION 05 21 00 STEEL JOIST FRAMING

PART 1 - GENERAL 1.0X SUBMITTALS

A. Environmental Product Declarations (EPD): Submit steel floor or roof joist manufacturer's EPD per the following:

1. All EPDs are to be third-party verified in accordance with the current version of ISO 14025 (validated by a date that has not yet expired) and indicate the following Impact Categories:
 - a. Global Warming Potential (GWP): All GWP information submitted shall be in the form of $\text{kgCO}_2\text{eq/kg}$.
 - b. Ozone Depletion Potential (ODP): All ODP information shall be in the form of kgCFC-11/kg .
 - c. Acidification Potential (AP): All AP information shall be submitted in the form of kgSO_2/kg .
 - d. Eutrophication Potential (EP): All EP information submitted shall be in the form of kgN/kg .
 - e. Smog Formation Potential (SFP): All SFP information shall be submitted in the form of kgO_3/kg .
 - f. Energy Consumption: All energy consumption information shall be submitted in the form of MJ.
2. Manufacturer-specific GWP information will be one of the decision criteria when awarding this scope. The manufacturer EPD must indicate GWP information from the specific mill or plant facility from which the material is to be procured. EPDs including GWP information for more than one facility are acceptable as long as each facility's GWP information is reported separately. EPDs reporting GWP values as averages from multiple facilities only or industry-wide EPDs are not acceptable.



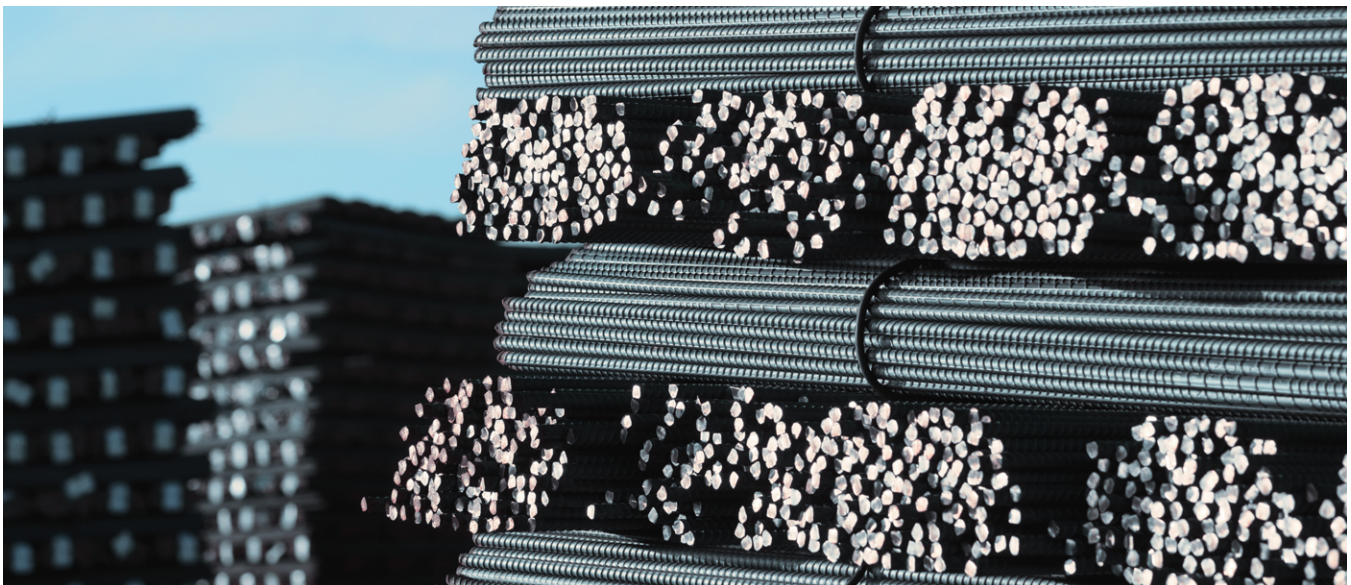
EPD SAMPLE LANGUAGE – CONCRETE REINFORCEMENT

SECTION 03 21 00 CONCRETE REINFORCEMENT

PART 1 - GENERAL 1.0X SUBMITTALS

A. Environmental Product Declarations (EPD): Submit reinforcing steel manufacturer's EPD per the following:

1. All EPDs are to be third-party verified in accordance with the current version of ISO 14025 (validated by a date that has not yet expired) and indicate the following Impact Categories:
 - a. Global Warming Potential (GWP): All GWP information submitted shall be in the form of $\text{kgCO}_2\text{eq/kg}$.
 - b. Ozone Depletion Potential (ODP): All ODP information shall be in the form of kgCFC-11/kg .
 - c. Acidification Potential (AP): All AP information shall be submitted in the form of kgSO_2/kg .
 - d. Eutrophication Potential (EP): All EP information submitted shall be in the form of kgN/kg .
 - e. Smog Formation Potential (SFP): All SFP information shall be submitted in the form of kgO_3/kg .
 - f. Energy Consumption: All energy consumption information shall be submitted in the form of MJ.
2. Manufacturer-specific GWP information will be one of the decision criteria when awarding this scope. The manufacturer EPD must indicate GWP information from the specific mill or plant facility from which the material is to be procured. EPDs including GWP information for more than one facility are acceptable as long as each facility's GWP information is reported separately. EPDs reporting GWP values as averages from multiple facilities only or industry-wide EPDs are not acceptable.
3. EPDs must clearly indicate the Product Flow Diagram disclosing if product fabrication is included within the "cradle-to-gate" life cycle scope (product stages A1-A3) of the EPD.





GLOBAL WARMING POTENTIAL

INTRODUCTION



A building's embodied carbon is the greenhouse gas emissions released during the following life-cycle stages: raw material extraction, transportation, manufacturing, construction, maintenance/renovation and end-of-life of the structure. It is reported as global warming potential (GWP), using the impact of one molecule of carbon dioxide as the frame of reference. Therefore, GWP is reported as kg CO₂e. Targeting more sustainable material procurement results in lower embodied carbon from the materials used in construction.

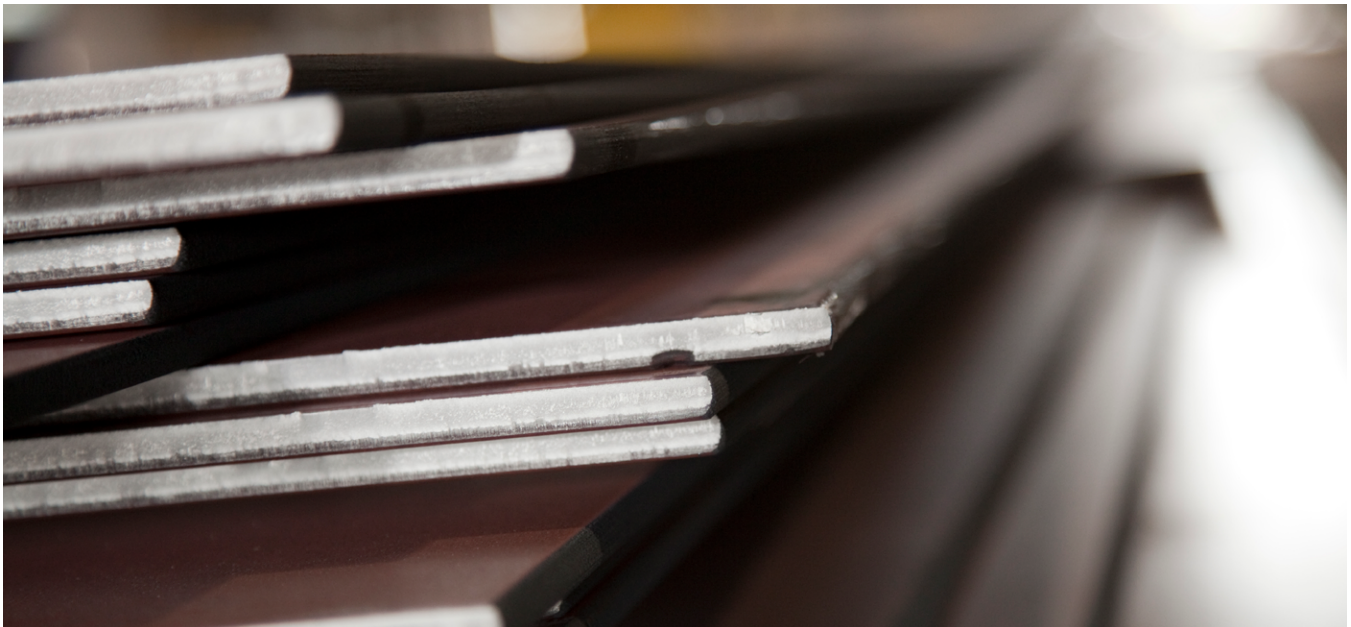


With nearly 40% of the annual, global GHG emissions attributed directly to the building and construction sectors, it is critical that the AEC community requests open and transparent documentation of building products' embodied carbon to continue to provide more sustainable structures for the future. Specifications can be used to limit the GWP of materials procured for projects. This builds upon the increasing availability of EPDs, making it possible to discern the embodied carbon impacts of different products.



North America's largest steel manufacturer, Nucor is committed to a net-zero steelmaking 2050 science-based GHG target as defined by the Global Steel Climate Council's (GSCC) "Steel Climate Standard", an ambitious standard consistent with the International Energy Agency Net Zero by 2050: A Roadmap for the Global Energy System glidepath for the industry (IEA NZE). These targets will result in:

- **By 2030:** Further 10% reduction of GHGs to 975 kg GHGs per metric ton of steel including Scopes 1, 2 and 3 as defined by GSCC
- **By 2050:** GHG reduction to 116 kg GHGs per metric ton of steel including Scopes 1, 2 and 3 as defined by GSCC



COMMENTARY

PART 2.A

In an ideal scenario, all material procured will meet the GWP limitations imposed by this section of the specification. Since that may not always be possible, it is recommended to leave an allowance for material (by overall tonnage percent) that does not meet the GWP limitations. This value should be discussed and agreed upon by the project team.

It is also recommended to include GWP limits in the construction documents as a part of the general notes section on structural steel, as shown in the Appendix. This gives prominence to the information in the drawings and encourages review of the values on each project.

PART 2.A.1 & 2.A.2

To minimize confusion between fabricated and unfabricated EPDs for structural steel framing products (Section 05 12 00) and concrete reinforcement (Section 03 21 00), Nucor recommends providing GWP limits for both types of values. As discussed on page 11, the fabricated GWP value comprises the impact of steelmaking (A1), as well as the impacts of transportation of material to the fabricator (A2) and the impacts of fabrication itself (A3).

A Fabricated A1 GWP value will include additional impacts beyond the mill-level production of one metric ton (the declared unit of a fabricated steel EPD) of unfabricated steel. This is because the fabrication process generates an amount of unused steel, such as from coping or drilling the material. The ratio of unfabricated material required to produce one unit of fabricated material is called the scrap rate. For example, one metric ton of hot-rolled structural product requires an average of 1.07 metric tons of unfabricated hot-rolled structural steel, so 1.07 is the scrap rate for hot-rolled structural steel. Refer to the Appendix for a fabricated to unfabricated product GWP sample calculation.

This distinction between fabricated and unfabricated GWP values is not required for steel floor and roof deck and steel joist framing, as these products will have EPDs which include the inherent fabrication required in the manufacturing process.

GWP SAMPLE LANGUAGE – STRUCTURAL STEEL FRAMING

SECTION 05 12 00 STRUCTURAL STEEL FRAMING

PART 2 - PRODUCTS 2.0X MATERIALS

A. Structural Steel Global Warming Potential (GWP): The GWP of structural products must not exceed the limits indicated in the table below. The intent is that 85 percent* of the product tonnage for the shapes indicated meet the requirements indicated. The controlling GWP value is to be taken as follows:

1. If an unfabricated Product EPD is provided, the sum of GWP from product stages A1, A2 and A3 (cradle-to-mill gate) is to be taken as the controlling GWP value.
2. If a fabricated product EPD is provided, the sum of the GWP from product stages A1, A2 and A3 (cradle-to-fabricator gate) is to be taken as the controlling GWP value.

PRODUCT	MAX. ACCEPTABLE UNFABRICATED GWP (MT CO ₂ EQ/MT STEEL)	MAX. ACCEPTABLE FABRICATED GWP (MT CO ₂ EQ/MT STEEL)
Hot-Rolled Structural Sections	**	**
Plate	**	**
Hollow Structural Section (HSS)	**	**

*Percentage of material required to comply with GWP limits is to be established by specifier.
 **Maximum acceptable GWP limits are to be established by specifier based on project goals.

GWP SAMPLE LANGUAGE - STEEL DECKING

SECTION 05 31 00
STEEL DECKING

PART 2 - PRODUCTS
2.OX MATERIALS

A. Steel Deck Global Warming Potential (GWP): The GWP of steel floor or roof deck over their "cradle-to-fabricator-gate" life cycle must not exceed the limits indicated in the table below. The intent is that 90 percent* of the product tonnage for the shapes indicated meet the requirements indicated. The controlling GWP value is to be taken as follows:

1. An EPD for each product is to be provided. The sum of GWP from product stages A1, A2 and A3 is to be taken as the controlling GWP value.

PRODUCT	MAX. ACCEPTABLE GWP (MT CO ₂ EQ/MT STEEL)
Floor or Roof Decking	**

*Percentage of material required to comply with GWP limits is to be established by specifier.
**Maximum acceptable GWP limits are to be established by specifier based on project goals.

GWP SAMPLE LANGUAGE - STEEL JOIST FRAMING

SECTION 05 21 00
STEEL JOIST FRAMING

PART 2 - PRODUCTS
2.OX MATERIALS

A. Steel Deck Global Warming Potential (GWP): The GWP of steel joist and joist girder products over their "cradle-to-fabricator-gate" life cycle must not exceed the limits indicated in the table below. The intent is that 90 percent* of the product tonnage for the shapes indicated meet the requirements indicated. The controlling GWP value is to be taken as follows:

1. An EPD for each product is to be provided. The sum of GWP from product stages A1, A2 and A3 is to be taken as the controlling GWP value.

PRODUCT	MAX. ACCEPTABLE GWP (MT CO ₂ EQ/MT STEEL)
Steel Joist and Joist Girder	**

*Percentage of material required to comply with GWP limits is to be established by specifier.
**Maximum acceptable GWP limits are to be established by specifier based on project goals.

GWP SAMPLE LANGUAGE – CONCRETE REINFORCING

SECTION 03 21 00 CONCRETE REINFORCMENT

PART 2 - PRODUCTS 2.0X MATERIALS

A. Concrete Reinforcement Global Warming Potential (GWP): The GWP of structural products over its “cradle-to-mill gate” life cycle must not exceed the limits indicated in the table below. The intent is that 85 percent* of the product tonnage for the shapes indicated meet the requirements indicated. The controlling GWP value is to be taken as follows:

1. If an unfabricated Product EPD is provided, the sum of GWP from product stages A1, A2 and A3 (cradle-to-mill gate) is to be taken as the controlling GWP value.
2. If a fabricated product EPD is provided, the sum of the GWP from product stages A1, A2 and A3 (cradle-to-fabricator gate) is to be taken as the controlling GWP value.

PRODUCT	MAX. ACCEPTABLE UNFABRICATED GWP (MT CO ₂ EQ/MT STEEL)	MAX. ACCEPTABLE FABRICATED GWP (MT CO ₂ EQ/MT STEEL)
Concrete Reinforcement (Rebar)	**	**

*Percentage of material required to comply with GWP limits is to be established by specifier.
 **Maximum acceptable GWP limits are to be established by specifier based on project goals.



A large, conical pile of brown, recycled paper or cardboard debris dominates the foreground and middle ground. The material is densely packed and appears to be a mix of shredded paper, cardboard fragments, and other organic-looking waste. The pile is set against a clear, bright blue sky. The lighting is bright, suggesting a sunny day, and the overall scene conveys a sense of industrial waste or a recycling facility.

**RECYCLED
CONTENT**

INTRODUCTION



Steel is a very sustainable material because it can be infinitely recycled with no loss to its material properties or strength. In North America, approximately 80 million tons of steel are recycled each year. Since scrap steel is the main ingredient in EAF steelmaking, less mining for raw materials is required to make new steel products. For every ton of recycled steel, approximately 2,500 pounds of iron ore, 1,400 pounds of coal and 120 pounds of limestone are saved, which means a much lower environmental impact for steel made from recycled scrap. Recycling steel also saves energy – EAF steel production uses nearly 60% less energy than BOF steel production.



Globally, only 26% of the more than 2 billion net tons of steel produced in 2020 was made by recycling scrap in EAF production. Scrap inputs for the total crude steel production globally have remained at around 35 percent since 2012. To effectively address the goals set by the Paris Climate Agreement, the International Energy Agency recommends that the global market share of EAF production must reach over 40% by 2030. Therefore, recycled content is another metric by which the sustainable impact of steel can be measured.



Nucor proudly implements circular steelmaking to recycle scrap into high-quality steel with low emissions, using one of the cleanest and most energy efficient steel-making processes available – EAF steel production. Steel can be infinitely recycled and reused without any quality loss. Nationwide, Nucor steel products are made with an average of 77% recycled content, with some products containing nearly 100% recycled content.

COMMENTARY

PART 1.A.1

Similar to the process of imposing GWP limits on products, adding recycled content as product procurement criteria will require the submission of additional documentation by the construction team for review. The procurement team shall submit recycled content letters or official documentation from the manufacturer of each building product covered under the specification language.

To align with LEED v4 language and "green building" application requirements, it is recommended to set minimum average recycled content values as the total of post-consumer recycled content percentage plus one-half of the pre-consumer recycled content percentage.

In an ideal scenario, all material procured will meet the minimum recycled content limitations imposed by this section of the specification. However, that may not always be possible, so leaving an allowance for material (by overall tonnage percent) that does not meet the limits is recommended. This value should be discussed amongst the project team and negotiated.

RECYCLED CONTENT SAMPLE LANGUAGE, PART 1 - STEEL FRAMING

SECTION 05 12 00

STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.0X SUBMITTALS

A. Recycled Content of Steel Products: Provide documentation in accordance with the current version of ISO 14021 from the manufacturer of each steel product listed below. For each product, both the post-consumer and pre-consumer recycled content percentage by weight must be indicated.

1. W and WT Shapes
2. Channels, Angles, M and S Shapes
3. Plates
4. Hollow Structural Sections (HSS)

RECYCLED CONTENT SAMPLE LANGUAGE, PART 1 - STEEL DECKING

SECTION 05 31 00

STEEL DECKING

PART 1 - GENERAL

1.0X SUBMITTALS

A. Recycled Content of Steel Products: Provide documentation in accordance with the current version of ISO 14021 from the manufacturer of steel floor and roof decking products. For each product, both the post-consumer and pre-consumer recycled content percentage by weight must be indicated.

RECYCLED CONTENT SAMPLE LANGUAGE, PART 1 - STEEL JOIST FRAMING

SECTION 05 21 00 STEEL JOIST FRAMING

PART 1 - GENERAL 1.0X SUBMITTALS

A. Recycled Content of Steel Joist Framing: Provide documentation in accordance with ISO 14021 from the manufacturer of each steel floor and roof joist products. For each product, both the post-consumer and pre-consumer recycled content percentage by weight must be indicated.

RECYCLED CONTENT SAMPLE LANGUAGE, PART 1 - CONCRETE REINFORCING

SECTION 03 21 00 CONCRETE REINFORCING

PART 1 - GENERAL 1.0X SUBMITTALS

A. Recycled Content of Concrete Reinforcing: Provide documentation in accordance with ISO 14021 from the manufacturer of each concrete reinforcement product. For each product, both the post-consumer and pre-consumer recycled content percentage by weight must be indicated.





RECYCLED CONTENT SAMPLE LANGUAGE, PART 2 - STEEL FRAMING

SECTION 05 12 00

STRUCTURAL STEEL FRAMING

PART 2 - PRODUCTS

2.OX MATERIALS

A. Recycled Content of Steel Products: Provide products with an average recycled content such that the post-consumer recycled content plus one-half of the pre-consumer recycled content is not less than the values indicated below. The intent is that 85%* of the product tonnage for these shapes meets the requirements listed.

1. W and WT Shapes: - **percent****
2. Channels, Angles, M and S Shapes: - **percent****
3. Plates: - **percent****
4. Hollow Structural Sections: - **percent****

*Percentage of material required to comply with recycled content limits is to be established by specifier.

**Recycled content limits are to be established by specifier.

RECYCLED CONTENT SAMPLE LANGUAGE, PART 2 - STEEL DECKING

SECTION 05 31 00

STEEL DECKING

PART 2 - PRODUCTS

2.OX MATERIALS

A. Recycled Content of Steel Products: Provide products with an average recycled content such that the post-consumer recycled content plus one-half of the pre-consumer recycled content is not less than - **percent***. The intent is that 90 percent** of the product tonnage meets this requirement.

*Percentage of material required to comply with recycled content limits is to be established by specifier.

**Recycled content limits are to be established by specifier.

RECYCLED CONTENT SAMPLE LANGUAGE, PART 2 - STEEL JOIST FRAMING

SECTION 05 12 00 STEEL JOIST FRAMING

PART 2 - PRODUCTS 2.0X MATERIALS

A. Recycled Content of Steel Joist Framing: Provide products with an average recycled content such that the post-consumer recycled content plus one-half of the pre-consumer recycled content is not less than – percent. The intent is that 90 percent* meets this requirement.

*Recycled content limits and material compliance limits are to be established by specifier.

RECYCLED CONTENT SAMPLE LANGUAGE, PART 2 - CONCRETE REINFORCING

SECTION 05 21 00 CONCRETE REINFORCING

PART 2 - PRODUCTS 2.0X MATERIALS

A. Recycled Content of Concrete Reinforcing Products: Provide products with an average recycled content such that the post-consumer recycled content plus one-half of the pre-consumer recycled content is not less than – percent. The intent is that 90 percent* of the product tonnage meets this requirement.

*Recycled content limits and material compliance limits are to be established by specifier.



APPENDIX



GENERAL NOTES SHEET
SS STRUCTURAL SHEET

ELEMENT	MIN. STRENGTH (KSI)		ASTM	EPD REQ'D	MAX. GWP (kgCO ₂ e/ton)		MIN. RECYCLED CONTENT %	COMMENTS
	Fy	Fu			UNFAB.	FAB.		
W and WT Shapes	50	65	A992	x				
W14x 90plf & Heavier	65	80	A913	x				
M & S Shapes	50	65	A992	x				
C & MC Shapes	50	65	A572	x				
Angle (L) Shapes	50	65	A572	x				
Square/Rect. & Round HSS	50	62	A500 Gr. C	x				
Plates	50	65	A572	x				

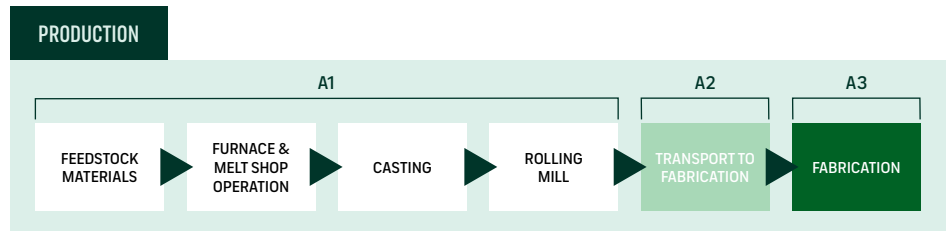
SAMPLE CALCULATION

FIND THE GWP OF AN UNFABRICATED PRODUCT WHEN FABRICATED PRODUCT EPD IS PROVIDED.

STEP 1

Read the introduction of the EPD.

Understand if the EPD is for a fabricated or unfabricated product. Find the EPD product flow chart and system boundary diagram to understand the product's life cycle. It can be determined that this is a fabricated product EPD.



STEP 2

Find the "Scrap-Rate."

The scrap-rate can typically be found in the "LCA Results" section, but documentation can vary between suppliers, so read carefully! The line below is extracted from Nucor's Fabricated Hot-Rolled Structural Steel Sections EPD.

"Fabrication requires 1.07 metric ton of structural sections per 1 metric ton of fabricated product. A1 includes production of all 1.07 metric ton of structural sections."

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE								END OF LIFE STAGE				BENEFITS & LOADS BEYOND THE SYSTEM BOUNDARY
RAW MATERIAL SUPPLY	TRANSPORT	MANUFACTURING	TRANSPORT FROM THE GATE TO SITE	ASSEMBLY/INSTALL	USE	MAINTENANCE	REPAIR	REPLACEMENT	REFURBISHMENT	BUILDING OPERATIONAL ENERGY USE DURING PRODUCT USE	BUILDING OPERATIONAL WATER USE DURING PRODUCT USE	DECONSTRUCTION	TRANSPORT	WASTE PROCESSING	DISPOSAL	REUSE, RECOVERY, RECYCLING POTENTIAL	
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D1	
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	

STEP 3

Locate the facility-specific GWP information, per 1 metric ton.

GWP [KG CO ₂ EQ.]	A1	A2	A3	TOTAL	CRADLE-TO-GATE, MILL PRODUCT
Nucor-Yamato Steel	8.75E+02	1.07E+01	1.10E+02	9.96E+02	8.16E+02

STEP 4

Calculate the unfabricated product GWP

A1 = unfabricated product GWP per 1.07 metric tons of steel (considering scrap rate)
 = 8.75E+02 kg CO₂e / 1.07 metric tons of steel
 = **8.16E+02 kg CO₂e / 1 metric ton of steel**

Note: Some producers explicitly state the unfabricated or mill product GWP values, so you don't have to!

BONUS STEP

Calculate embodied Carbon for 5,000 tons of steel beam

V = 5,000 tons
 GWP = 8.16E+02 kg
 CO₂e / MT (unfabricated)

EMBODIED CARBON = V x GWP = 4,080 kg CO₂e



RESOURCES

NUCOR RESOURCES



Environmental
Product
Declarations



Recycled
Content Letters



Sustainability
Page



Construction
Solutions Page



Two Ways
to Make Steel
Article



Spec Language

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