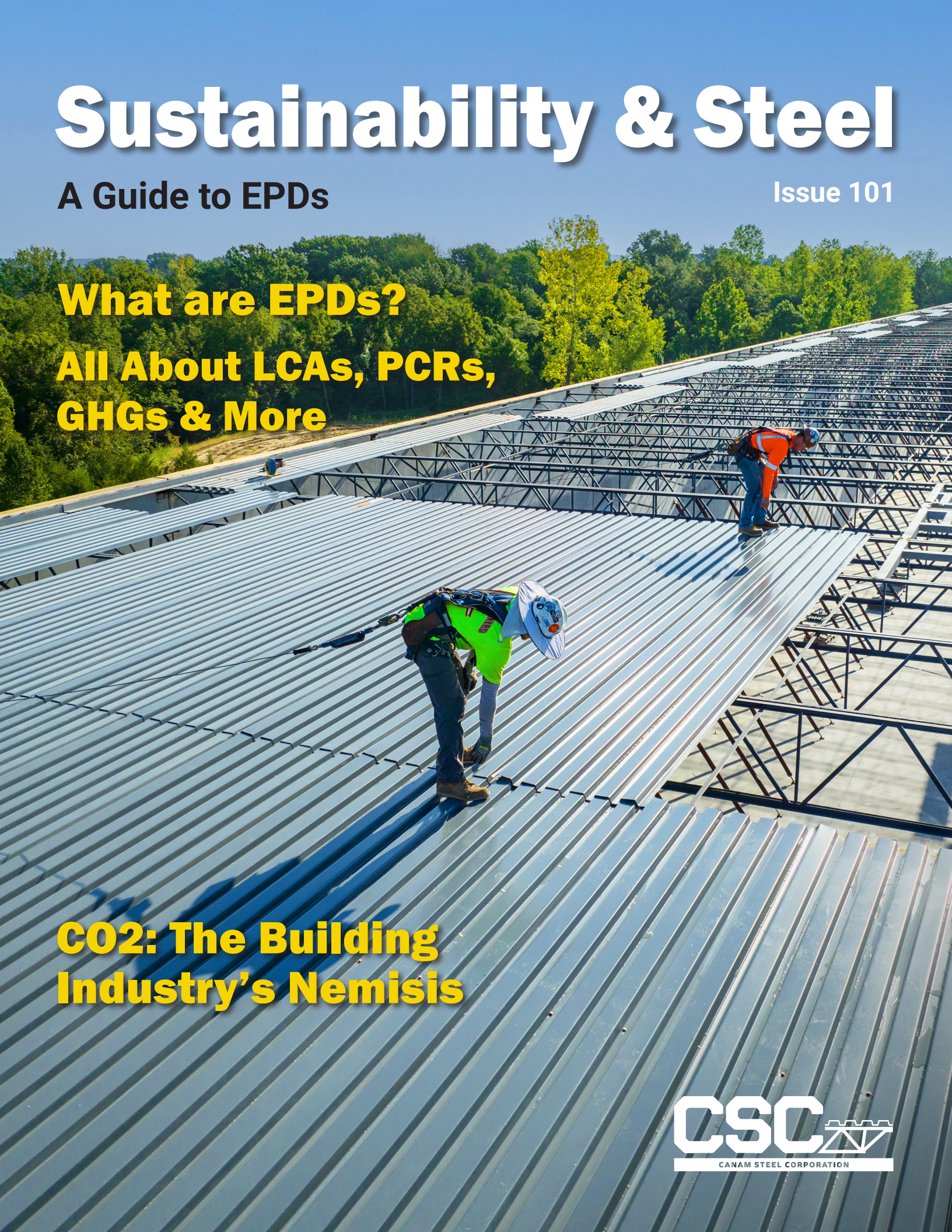
Sustainability & Steel

A Guide to EPDs

Issue 101



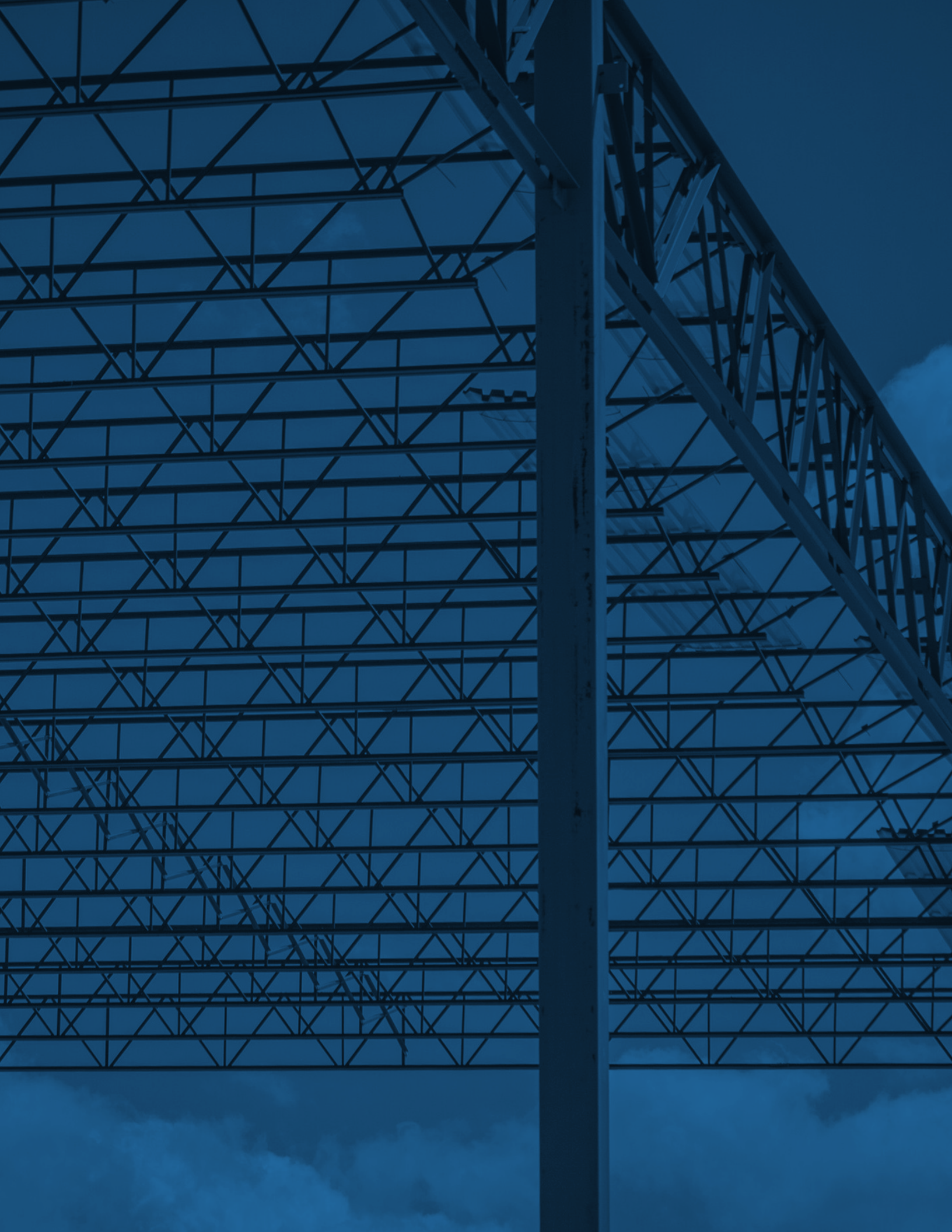
What are EPDs?

All About LCAs, PCRs, GHGs & More

CO2: The Building Industry's Nemisis

CSC

CANAM STEEL CORPORATION



CONTENT

CSC
CANAM STEEL CORPORATION

Striving for Environmental Balance

Steel producers and manufacturers, such as Canam Steel Corporation (CSC), are actively integrating climate action strategies to mitigate and prevent environmental damage.

As part of these efforts, CSC recently completed verified environmental reports, also known as, environmental product declarations (EPDs), across facilities. To aid in understanding and interpreting these reports, this guide explores concepts and terminology related to sustainability and EPDs.

Sustainable Construction

The phrase "**sustainable construction**" encapsulates the construction industry's efforts to incorporate beneficial design, materials, and processes that reduce impacts to the environment. Strategies include utilizing renewable and recyclable materials in building projects to minimize energy use and waste.

According to a 2023 United Nation's article, "the buildings and construction sector is by far the largest emitter of greenhouse gases, accounting for a staggering 37% of global emissions."[1] The industry's negative impacts stem from multiple stages within the construction life cycle, including:[2]

- the extraction of raw materials that may lead to water pollution,
- a reliance on heavy machinery and equipment typically using fossil fuel resources,
- the transportation and production of construction materials that further elevate carbon emissions,
- and poor waste management and disposal practices which can lead to additional pollution.

Sustainability: The balance between the environment, equity, and economy

All About Emissions

Emissions are gases and other particles that are released into the atmosphere due to human activities such as burning fuels from cars, generating power, or industrial processes. The two main types of emissions that "impact the environment, air quality, and human health" are **greenhouse gas (GHG) emissions** and **air pollutants**.[3] As of 2021, *steelmaking i*s estimated to be responsible for around 11% of carbon dioxide global emissions and around 7% of global GHG emissions.[4]

Greenhouse Gas Emissions

GHGs absorb infrared radiation, creating a layer of insulation that traps and holds heat in the Earth's atmosphere resulting in global warming—similar to the warm environment that a plant greenhouse generates.

The Earth's *natural* greenhouse effect has a beneficial function, warming the planet to sustain life. However, human activities, particularly since the Industrial Revolution have significantly increased the amount of greenhouse gas emissions in our atmosphere. The most damaging GHGs emitted by humans include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (NO_2), and fluorinated gases. These gases have "varying lifetimes and potencies that define their climate impacts".[5]

GHG Scope Categories

Within its Corporate Accounting Reporting Standard, the Greenhouse Gas Protocol developed categories dividing GHG emissions as Scopes 1, 2 and 3. These categories

established a worldwide framework for quantifying and managing greenhouse gas emissions across various organizations and industries as well as to aid in avoiding "double-counting" them within corporate reporting.[6] Descriptions of the categories are as follows:

Scope 1

GHG emissions stemming from sources controlled or owned by an organization (e.g., emissions associated with fuel combustion in boilers, furnaces, vehicles). Scope 1 also includes fugitive emissions from refrigerants.

Scope 2

Indirect GHG emissions associated with the purchase of electricity, steam, heat, or cooling.

Scope 3

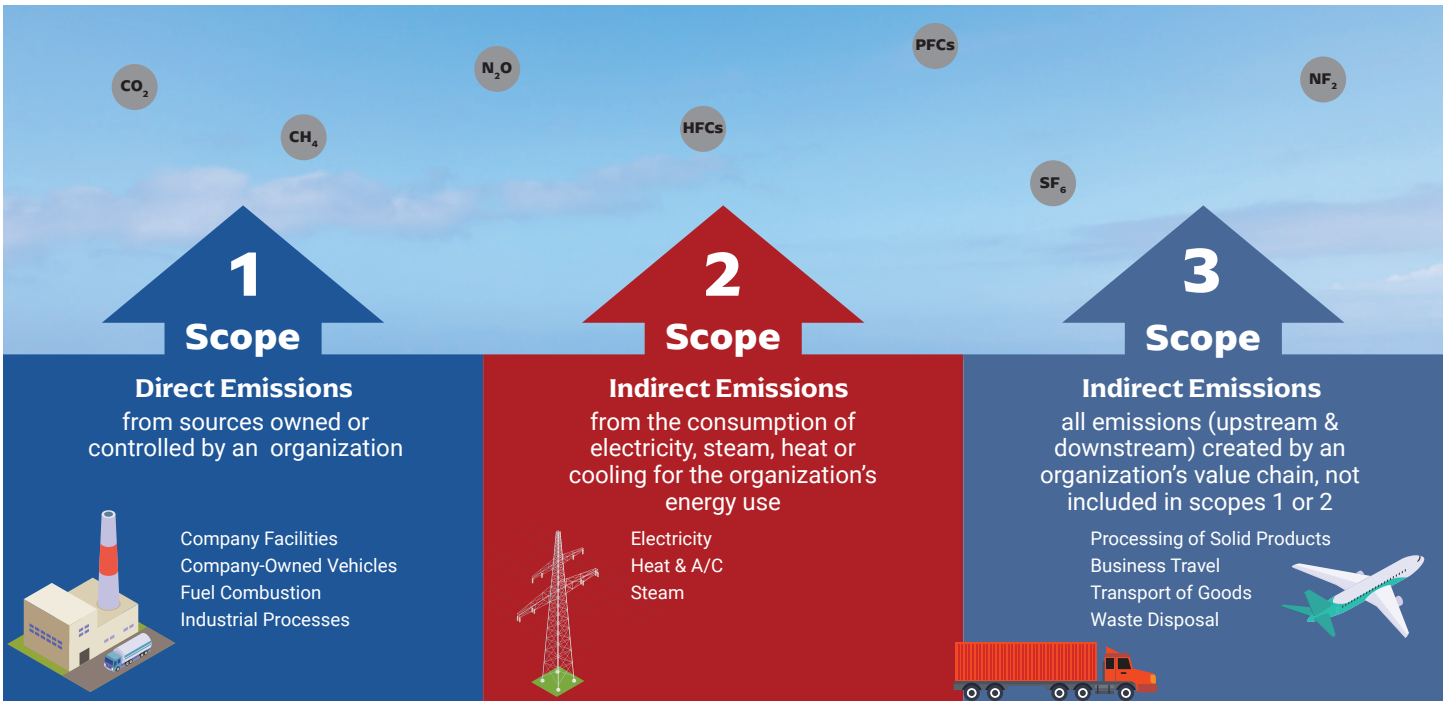
Indirect GHG emissions that are the result of activities from assets not owned or controlled by the reporting organization, which the organization indirectly affects through its value chain.

CSC's activities primarily fall under Scope 3.

Greenhouse Gas Protocol

The Greenhouse Gas Protocol (GHG Protocol) is a globally recognized framework that provides guidelines and tools for measuring, managing, and reporting greenhouse gas emissions. It was established in 1990 to provide a consistent way for organizations to report GHG emissions.

The GHG Protocol is used by companies, governments, cities, and other organizations to: 1) identify priorities for reducing emissions, 2) benchmark progress across industries, 3) understand emissions accounting gaps, 4) report carbon footprints, and 5) assess how well they're doing in the fight against climate change.



Carbon Emissions: The Building Industry's Primary Nemesis

The greenhouse gas, *carbon dioxide (CO_2)*, is released into the atmosphere through activities such as burning fossil fuels (i.e., coal, natural gas, and oil), incinerating solid waste, and the decomposition of trees and other organic matter. It is also emitted during certain chemical processes, like cement manufacturing. Conversely, CO_2 is taken out of the atmosphere, or "sequestered," when plants absorb it during the natural carbon cycle.

During steelmaking, GHG emissions, particularly CO_2, result from mining coal and iron ore, as well as through the refining and shipping of materials. As one of the most carbon emission intensive industries in the world, the steelmaking process emits on average about *1.85 metric tons of carbon dioxide for every 1 ton of steel.*[7]

Measuring GHG Emissions

GHG emissions are typically measured in metrics such as **carbon dioxide equivalent (CO_2E)** and **global warming potential (GWP)**. These metrics are then used in comparing and calculating pollutant emissions based on their impact to the global climate.

Global Warming Potential

Global warming potential measures the warming contributed by each gas to the greenhouse effect.[8]

Carbon Dioxide Equivalents (CO_2E)

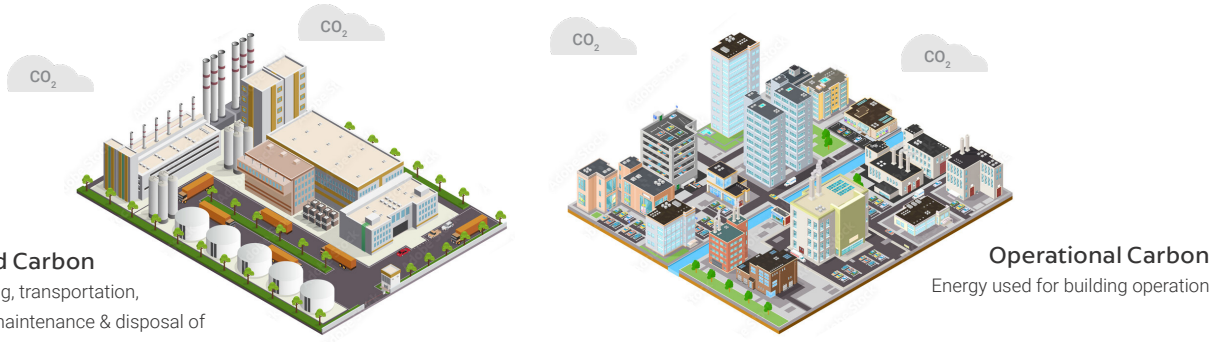
CO_2E represents either non-CO_2 climate pollutants or a sum of multiple climate pollutant emissions. CO_2E is calculated by multiplying the mass of a non-CO_2 climate pollutant by its GWP. This metric indicates the amount of CO_2 with an equivalent climate impact over a specified time horizon. When a time horizon is not specified, it typically is 100 years.

Life Cycle / Total Carbon

Globally, buildings generate approximately 40% of annual GHG emissions, which may be split into two categories: **operational carbon** and **embodied carbon**.

Embodied Carbon is the "upfront carbon" footprint of a building before it is built and encompasses the GHG emissions associated with the manufacturing, transportation, installation, maintenance, and disposal of construction materials. Embodied carbon is responsible for about 13% of global annual GHG emissions (from materials manufacturing as well as construction activities).

- If only 13% of emissions from buildings come from embodied carbon, why do we focus on it?
  Because embodied carbon is being released into the atmosphere now, not over the next 50 or more years. If we can reduce embodied carbon now, we can significantly decrease the effects of climate change more quickly.[9]



Embodied Carbon
Manufacturing, transportation, installation, maintenance & disposal of construction materials

Operational Carbon
Energy used for building operation

Embodied Carbon + Operational Carbon = **Total Carbon**

- Globally, the carbon "budget" between now and 2050 is 420 GT (gigatons).
  To meet the goals of the Paris Agreement, carbon emissions must stay below this amount over the next 26 years. Collectively, this budget is rapidly being spent at the rate of 53GT per year—and is expected to reach 1,325 GT by 2050. To decrease this spending rate, the focus must be on reducing current carbon emissions, *particularly embodied carbon.*

Operational Carbon refers to the carbon emissions associated with energy used to operate a building.

- Operational carbon is responsible for 27% of global annual GHG emissions.
- Operational carbon includes:
  - Lighting
  - Heating
  - Ventilation
  - Air conditioning, and
  - Overall power usage throughout a building

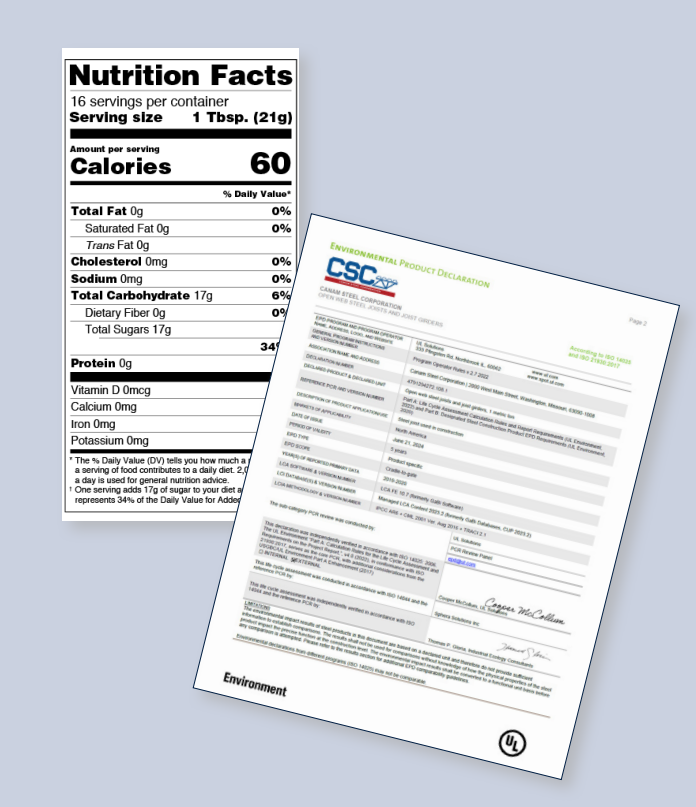
The sum of embodied carbon and operational carbon is known as **life cycle carbon** or **total carbon**.

Sustainability Tools

Frameworks and tools, such as product category rules (PCRs), life cycle assessments (LCAs) and environmental product declarations (EPDs), were developed to track, monitor and summarize the adverse impacts that specific activities and products may have on the environment.

What are EPDs?

In a nutshell, environmental product declarations (EPDs) are objective, third-party verified reports that document a product's environmental impact over its life cycle. Similar to nutrition labels for food, EPDs provide data detailing a product's environmental impact.



There are multiple types of EPDs: **Industry-Wide** and **Product-Specific (Manufacturer** or **Facility-Specific)**.

- **Industry-Wide EPDs (IW-EPDs)** produced by industry organizations, such as, the *American Institute of Steel Construction (AISC)* or the *Steel Deck Institute (SDI)*, provide GWP values representing a weighted average over a representative sample of suppliers for a given type of product.
- **Manufacturer EPDs** are produced by an individual supplier for products from a group of facilities in a region.
- **Facility-Specific EPDs** are produced by an individual supplier for a product from a specific facility.

To better understand EPDs, the following section explains a few more terms that apply to these documents.

Product Category Rules (PCRs)

PCRs outline rules and boundaries for the development of LCAs and EPDs. The PCR defines how the EPDs are created for a specific product, including how system boundaries are chosen, which impact categories should be included, and which methodologies should be used.

Life Cycle Assessments (LCAs)

Through a scientific process, an LCA assesses and quantifies the environmental and human health impacts of a product, materials or process in terms of severity, quality and extent throughout its **life cycle**—from extraction of raw materials to end-of-life disposal or recycling.[10] *An EPD is the vehicle for reporting the results of the LCA studies.*

Whole Building Life Cycle Assessments (WBLCAs)

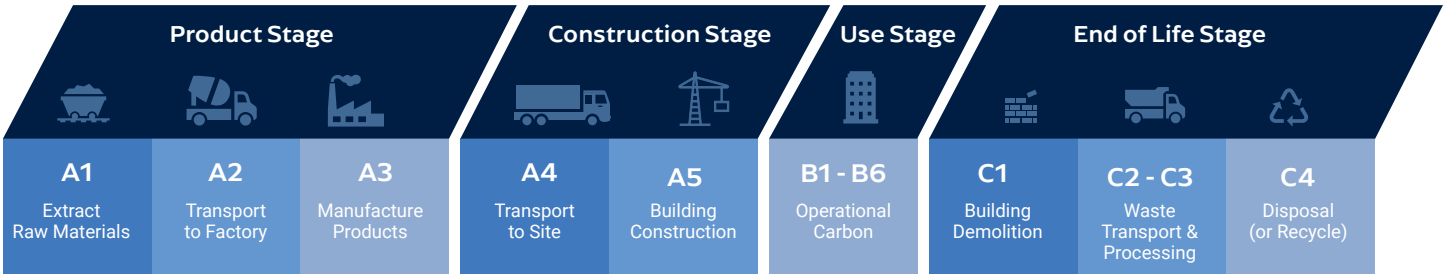
Specific to the building industry, a WBLCA looks at the GHG emissions a building produces throughout its life cycle. The typical stages of LCAs or WBLCAs are illustrated below.

LCA Goals & Scope

The scope and level of detail for a LCA depends on the subject and intended use. Common scope boundaries include:

- Cradle-to-steel mill gate
- Cradle-to-gate
- Cradle-to-cradle

Life Cycle Stages.



Stage A

Material production & construction (embodied carbon)

- Looks at all the materials needed for construction, includes items like wood, concrete, and steel.
- Identifies where materials come from and how they are made and tracked –following the product from the forest or mine to delivery to the construction site.
- Examines how the construction process affects the environment.
  - Involves looking at the energy used, the waste produced, and the emissions released during building construction.

Stage A & B

Building operation and use (operational carbon) & maintenance (embodied carbon)

- Examines how the building will be used *after* construction is complete.
  - For example, in a commercial building, how the HVAC is set up is evaluated to determine an estimate of lifetime energy usage.

Stage C & D

End of life (embodied carbon) & Stage D: Circularity

- Analyzes what happens when the building is no longer used or needs to be replaced.
  - Will it be demolished?
  - Can parts of it be recycled or reused?
- "Stage D" is often optional and can be beyond the boundary of a typical WBLCA.

Steel manufacturing EPDs typically fall under "cradle-to-gate", covering three main life cycle assessment stages:

- Raw material supply (Stage A1),
- Transportation (Stage A2), and
- Manufacturing (Stage A3).

Impact Assessment

The results of the LCA are expressed in terms of six primary impact category indicators. Out of these six impact category metrics, the **GWP** is the metric most used to represent the carbon footprint of a given product. The table below includes descriptions for the primary impact indicators, as well as additional impact categories that may be included.[11]

Where LCAs & EPDs are Used

LCAs, EPDs, and their corresponding data are used within numerous codes, standards and rating systems by: federal, state and local governments; organizations, including the IGCC and ASHRAE; as well as, rating programs, like LEED, Green Globes and the Living Building Challenge. EPDs specifically fall under the International Standards Organization's building standard, ISO 14025.

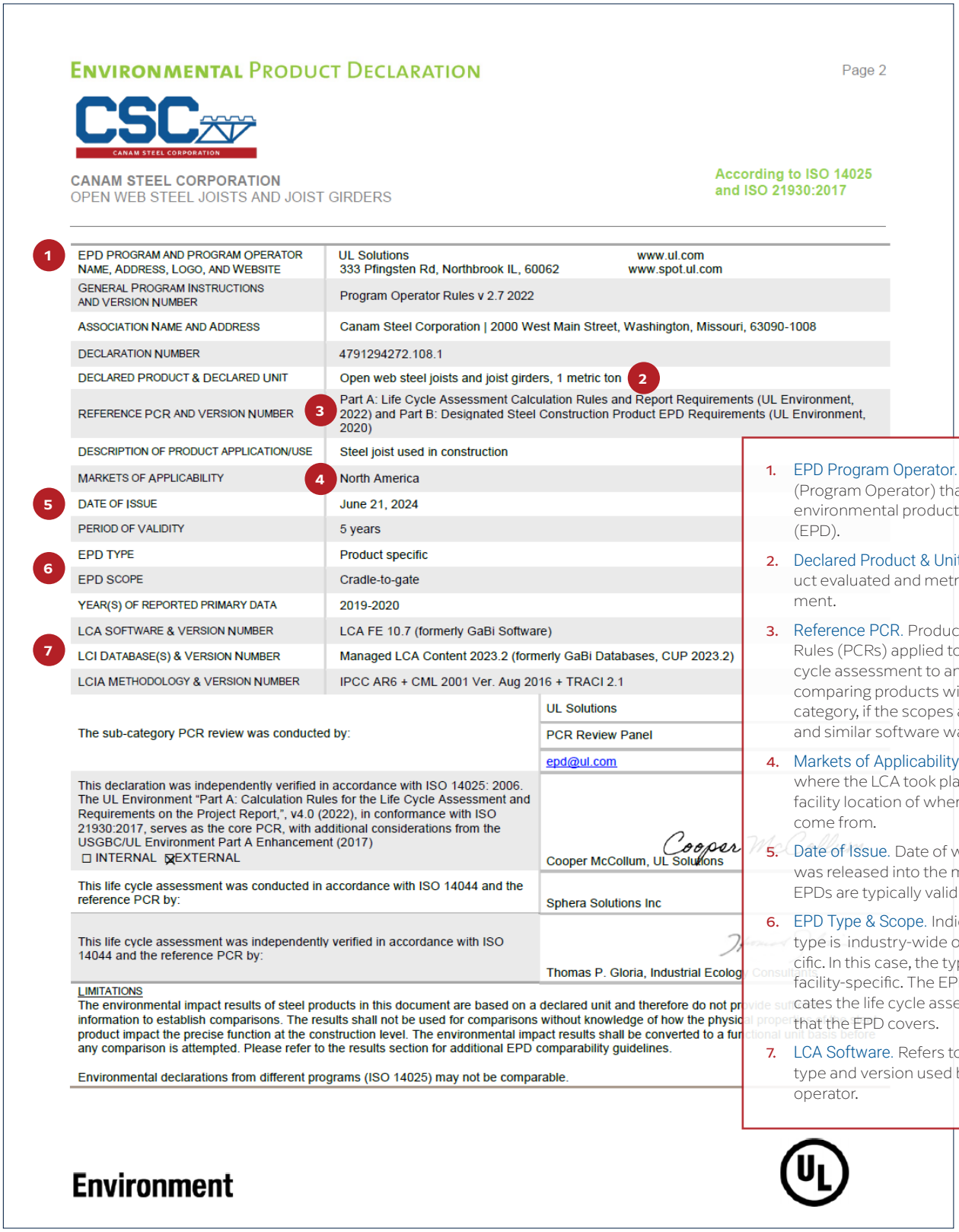
Reading an EPD

The following portion of our EPD Guide includes an example EPD from one of CSC's facilities, along with explanations and descriptions for specific sections of the report located on Pages 2, 4, 7, and 9. EPDs are useful for evaluating and comparing the environmental impacts incurred over the various life cycle stages of products.

Impact Category Indicators.

	Impact Category	Unit	Description
1.	**Global warming potential (GWP)**	kg CO2-eq	Measures the potential increase in average global temperatures as a result of greenhouse gases
2.	**Ozone depletion potential (ODP)**	kg CFC-11-eq	Measures the potential depletion of the stratospheric ozone layer
3.	**Acidification potential (AP)**	kg mol H+	Measures potential impact of emissions contributing to acidification in the air, water, and soil.
4.	**Eutrophication potential (EP)**	Kg N-eq	Measures the release of nitrogen or phosphorous compounds into ecosystems.
5.	**Smog formation potential (SFP)**	kg NMVOC-eq	Measures the potential impact of emissions contributing to photochemical ozone (or smog) formation.
6.	**Abiotic depletion potential (ADP)**	MJ, net calorific value	Measures the depletion of natural resources, such as fossil fuels or minerals.
7.	Human health toxicity	CTUh	Measures potential impacts from the environment on human health by absorbing substances from the air, water, and soil.
8.	Eco-toxicity	CTUe	Measures potential impacts on individual species within ecosystems.
9.	Land use change	Dimensionless	Measures impacts on soil quality properties.

EPD Excerpt - Page 2



ENVIRONMENTAL PRODUCT DECLARATION

Page 2

CANAM STEEL CORPORATION
OPEN WEB STEEL JOISTS AND JOIST GIRDERS

According to ISO 14025 and ISO 21930:2017

EPD PROGRAM AND PROGRAM OPERATOR NAME, ADDRESS, LOGO, AND WEBSITE	UL Solutions 333 Pfingsten Rd, Northbrook IL, 60062 www.ul.com www.spot.ul.com
GENERAL PROGRAM INSTRUCTIONS AND VERSION NUMBER	Program Operator Rules v 2.7 2022
ASSOCIATION NAME AND ADDRESS	Canam Steel Corporation | 2000 West Main Street, Washington, Missouri, 63090-1008
DECLARATION NUMBER	4791294272.108.1
DECLARED PRODUCT & DECLARED UNIT	Open web steel joists and joist girders, 1 metric ton
REFERENCE PCR AND VERSION NUMBER	Part A: Life Cycle Assessment Calculation Rules and Report Requirements (UL Environment, 2022) and Part B: Designated Steel Construction Product EPD Requirements (UL Environment, 2020)
DESCRIPTION OF PRODUCT APPLICATION/USE	Steel joist used in construction
MARKETS OF APPLICABILITY	North America
DATE OF ISSUE	June 21, 2024
PERIOD OF VALIDITY	5 years
EPD TYPE	Product specific
EPD SCOPE	Cradle-to-gate
YEAR(S) OF REPORTED PRIMARY DATA	2019-2020
LCA SOFTWARE & VERSION NUMBER	LCA FE 10.7 (formerly GaBi Software)
LCI DATABASE(S) & VERSION NUMBER	Managed LCA Content 2023.2 (formerly GaBi Databases, CUP 2023.2)
LCIA METHODOLOGY & VERSION NUMBER	IPCC AR6 + CML 2001 Ver. Aug 2016 + TRACI 2.1

The sub-category PCR review was conducted by:	UL Solutions PCR Review Panel epd@ul.com
This declaration was independently verified in accordance with ISO 14025: 2006. The UL Environment "Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report,", v4.0 (2022), in conformance with ISO 21930:2017, serves as the core PCR, with additional considerations from the USGBC/UL Environment Part A Enhancement (2017) ☐ INTERNAL ☒ EXTERNAL	Cooper McCollum, UL Solutions
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	Sphera Solutions Inc
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Thomas P. Gloria, Industrial Ecolog

LIMITATIONS

The environmental impact results of steel products in this document are based on a declared unit and therefore do not pr information to establish comparisons. The results shall not be used for comparisons without knowledge of how the physi product impact the precise function at the construction level. The environmental impact results shall be converted to a fu any comparison is attempted. Please refer to the results section for additional EPD comparability guidelines.

Environmental declarations from different programs (ISO 14025) may not be comparable.

Environment

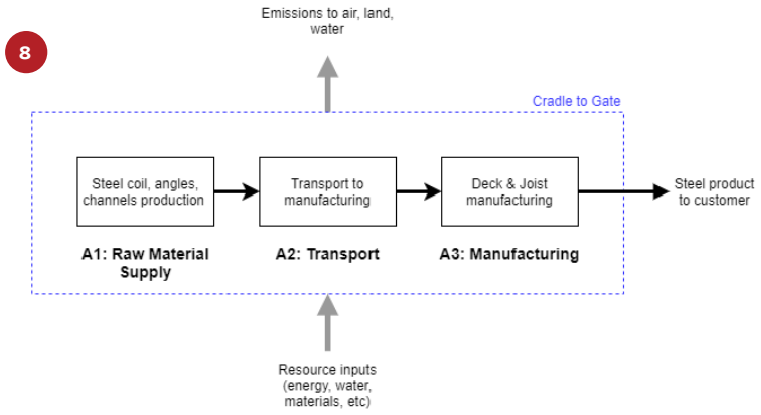
1. EPD Program Operator. Company (Program Operator) that verified the environmental product declaration (EPD).
2. Declared Product & Unit. Type of product evaluated and metric of measurement.
3. Reference PCR. Product Category Rules (PCRs) applied to move the life cycle assessment to an EPD. Aids in comparing products within the same category, if the scopes are the same and similar software was used.
4. Markets of Applicability. Indicates where the LCA took place, covering the facility location of where the products come from.
5. Date of Issue. Date of when the EPD was released into the marketplace. EPDs are typically valid for 5 years.
6. EPD Type & Scope. Indicates if the EPD type is industry-wide or product specific. In this case, the type is product/facility-specific. The EPD Scope indicates the life cycle assessment stages that the EPD covers.
7. LCA Software. Refers to the software type and version used by the program operator.

ENVIRONMENTAL PRODUCT DECLARATION

CANAM STEEL CORPORATION
OPEN WEB STEEL JOISTS AND JOIST GIRDERS

According to ISO 14025 and ISO 21930:2017

Flow Diagram



8. Flow Diagram. Illustrates the applicable life stages covered within the EPD, specific to the CSC facility.
9. Product Average. Identifies the specific facility location and the time period for the data collected.

Product Average

9 The data collected represents 2019 - 2020 production from CSC's Washington, MO plant.

Application

Steel joist products are used as structural supports for building applications.

Material Composition

Steel joist products are manufactured from welded structural steel, with a small amount of paint included. The products do not contain any hazardous substances according to the Resource Conservation and Recovery Act (RCRA), Subtitle 3. The products do not release dangerous substances to the environment, including indoor air emissions, gamma or ionizing radiation, or chemicals released into to air or leached to water or soil.

Methodological Framework

Declared Unit

The declared unit for this EPD is one metric ton of steel construction products. Note that comparison of EPD results on a mass basis alone is insufficient and should consider the technical performance of the product.

Environment

EPD Excerpt - Page 7

CANAM STEEL CORPORATION
OPEN WEB STEEL JOISTS AND JOIST GIRDERS

According to ISO 14025
and ISO 21930:2017

Use

Product use is outside the scope of this EPD.

10

Reuse, Recycling, and Energy Recovery

Product reuse, recycling, and incineration for energy recovery is outside the scope of this EPD.

Disposal

Product disposal is outside the scope of this EPD.

Environmental Indicators Derived from LCA

North American life cycle impact assessment (LCIA) results are declared using TRACI 2.1 (Bare, 2012; EPA, 2012) methodology, with the exception of GWP and ADP fossil. GWP is reported using the IPCC AR6 (IPCC, 2023) methodology, excluding biogenic carbon. ADP fossil is reported using CML 2001, Version 4.8, Aug 2016 (CML, 2001). Primary energy use represents the lower heating value (LHV) a.k.a. net calorific value (NCV).

LCIA results are relative expressions and do not predict actual impacts, the exceeding of thresholds, safety margins or risks. The result is given per the declared unit of 1 metric ton of steel joist product.

No biogenic carbon emission or removal was recorded from the product or packaging. There was no biogenic carbon emission from combustion of waste from renewable sources used in production processes as well. Accounting for the reaction of atmospheric carbon dioxide, it is not relevant for the product evaluated.

The six LCIA categories are globally deemed mature enough to be included in Type III environmental declarations. Other categories are being developed and defined and LCA should continue making advances in their development. However, the EPD users shall not use additional measures for comparative purposes.

Many of the LCI and waste indicators are considered as emerging LCA impact categories and inventory items. These items are still under development and can have high levels of uncertainty that preclude international acceptance pending further development. Use caution when interpreting data in these categories.

Table 1. LCIA results, per 1 metric ton

11

PARAMETER	UNIT	TOTAL	A1	A2	A3
GWP100, excl. biogenic carbon	kg CO_2 eq.	**1.26E+03**	1.05E+03	6.22E+01	1.40E+02
ODP*	kg CFC 11 eq.	**9.86E-12**	8.48E-12	1.60E-13	1.22E-12
AP	kg SO_2 eq.	**3.07E+00**	2.56E+00	3.08E-01	2.04E-01
EP	kg N eq.	**1.61E-01**	1.23E-01	2.68E-02	1.19E-02
SFP	kg O_3 eq.	**4.94E+01**	3.83E+01	7.12E+00	3.99E+00
ADP_{fossil}	MJ surplus	**1.53E+04**	1.26E+04	8.67E+02	1.77E+03

* ODP has limited relevance due to the absence of ozone-depleting emissions in the LCI, particularly in the foreground system.

10. Use, Reuse & Disposal. Within this EPD example, these stages are outside of the LCA boundaries.
11. Environmental Indicators. Shows data for the applicable impact categories. CO_2 emissions are represented within the GWP indicator on the first row.

    The figures under the "Total" column are given in scientific notation, to the nth power of ten. For example, the total GWP of 1.26E+03 = 1,260.

EPD Excerpt - Page 9

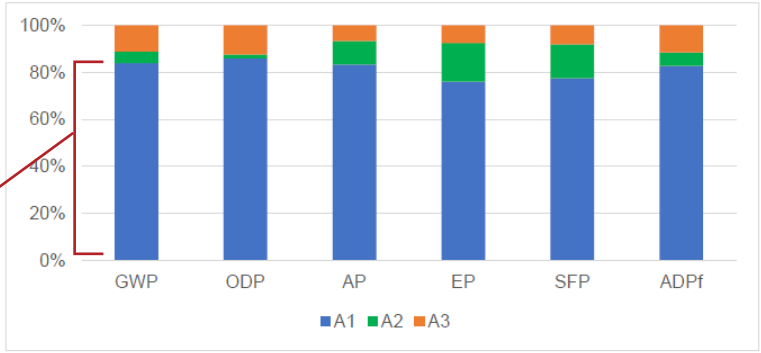
CANAM STEEL CORPORATION
OPEN WEB STEEL JOISTS AND JOIST GIRDERS

According to ISO 14025
and ISO 21930:2017

Visualization of Life Cycle Impact Assessment

The relative contribution of each life cycle stage to the overall cradle-to-gate impacts are presented in Figure-1.

12



Over 80% of the product's Global Warming Potential is attributed to Stage A1 or Raw Materials stage.

Figure 1: Relative contribution by life cycle stage for 1 metric ton of steel joist

Interpretation

13

The cradle-to-gate potential environmental impacts of steel joist products are primarily driven by upstream steel production (A1). Inbound transport to manufacturing (A2) and joist manufacturing (A3) contriubte to potential environmental impacts on a smaller order of magnitude.

Additional Environmental Information

Further Information

Further information can be found at:

- Canam Steel Corporation website: www.cscsteelusa.com
- Steel Joist Institute website: www.steeljoist.org

12. Visualization of LCA. Visual illustration of the facility's effects on each impact category over the related life cycle stages.
13. Interpretation. Provides a brief explanation of the EPD's findings.

Resources

1. *Building Materials and The Climate: Constructing a New Future*, 2023, https://www.unep.org/resources/report/building-materials-and-climate-constructing-new-future

2. Grace Ellis, *What is Sustainable Construction?*, 2024, https://www.autodesk.com/blogs/construction/sustainable-construction/

3. Understanding Emissions, https://www.greenvehicleguide.gov.au/pages/UnderstandingEmissions/VehicleEmissions

4. Ali Hasanbeigi, Ph.D., *Global Steel Industry's GHG Emissions*, 2022, https://www.globalefficiencyintel.com/new-blog/2021/global-steel-industrys-ghg-emissions

5. *Global Warming Potentials (GWPs)/CO2-Equivalent (CO2e) and the Importance of Time Horizons*, 2022, https://www.edf.org/sites/default/files/content/emission_equivalency_tool_documentation_methodology_23062022.pdf

6. *What is the Difference Between Scope 1, 2, and 3 Emissions?*, 2023, https://www.compareyourfootprint.com/difference-scope-1-2-3-emissions/

7. Alex Kamczyc, *World Steel Association Releases Paper on CO2 Emission Reduction*, 2021, https://www.recyclingtoday.com/news/worldsteel-co2-report/

8. *Greenhouse Gas Emissions Down*, 2019, https://www.cbs.nl/en-gb/news/2019/37/greenhouse-gas-emissions-down/co2-equivalents

9. *Embodied carbon vs. operational carbon*, https://oneclicklca.com/en/resources/articles/embodied-carbon-vs-operational-carbon

10. *Building Decarbonization*, https://sftool.gov/learn/about/657/building-decarbonization

11. Matthew Eckelman & Sarah Nunberg, *Life Cycle Assessment Explained*, https://stich.culturalheritage.org/life-cycle-assessment-explained/