ENVIRONMENTAL PRODUCT DECLARATION

OPEN WEB STEEL JOISTS

STEEL JOIST INSTITUTE

Open Web Steel Joists and Joist Girders being installed on a jobsite.

Steel is one of the world's most recycled products, lending itself to positive environmental contributions as well as sustainable construction. This publication represents Steel Joist Institute's membership: Acero Technologia SA de CV; Canam; ESJ; Gooder-Henrichsen Co.; Joist Structural Systems; New Millennium Building Systems; Seyco Joist Company; Valley Joist, Inc.; and Vulcraft Division Nucor Corp.

The Steel Joist Institute and its members have undertaken the development of this Environmental Product Declaration to show the construction industry the merits of steel joist construction from a sustainability point of view.

Green building professionals have known for decades that the steel used in the manufacture of our products is highly recycled; more than 85% of the steel used in production of steel joist product in North America comes through recycling. And when the service life of the building is over, steel joists can be recycled and the material used to build another building, create an automobile or become a home appliance.

This publication, based on rigorous LCA research and broad sampling of our industry, provides scientific backup for what we already knew: Steel has always been the leading material for safe, sustainable construction and will continue to be a leader in green buildings.

UL CERTIFIED ENVIRONMENTAL PRODUCT DECLARATION UL.COM/EPD

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According to ISO 14025

This declaration is an environmental product declaration (EPD) in accordance with ISO 14025. EPDs rely on Life Cycle Assessment (LCA) to provide information on a number of environmental impacts of products over their life cycle. Exclusions: EPDs do not indicate that any environmental or social performance benchmarks are met, and there may be impacts that they do not encompass. LCAs do not typically address the site-specific environmental impacts of raw material extraction, nor are they meant to assess human health toxicity. EPDs can complement but cannot replace tools and certifications that are designed to address these impacts and/or set performance thresholds – e.g. Type 1 certifications, health assessments and declarations, environmental impact assessments, etc. Accuracy of Results: EPDs regularly rely on estimations of impacts, and the level of accuracy in estimation of effect differs for any particular product line and reported impact. Comparability: EPDs are not comparative assertions and are either not comparable or have limited comparability when they cover different life cycle stages, are based on different product category rules or are missing relevant environmental impacts. EPDs from different programs may not be comparable.

PROGRAM OPERATOR	UL Provided
DECLARATION HOLDER	UL Provided
DECLARATION NUMBER	UL Provided
DECLARED PRODUCT	
REFERENCE PCR	UL Provided
DATE OF ISSUE	UL Provided
PERIOD OF VALIDITY	UL Provided
CONTENTS OF THE DECLARATION	Product definition and information about building physics Information about basic material and the material's origin Description of the product's manufacture Indication of product processing Information about the in-use conditions Life cycle assessment results Testing results and verifications
The PCR review was conducted by:	UL Provided UL Provided UL Provided
This declaration was independently verified in accordance with ISO 14025 by Underwriters Laboratories ☐ INTERNAL ☒ EXTERNAL	 UL Provided
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	 UL Provided

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Product Definition

Association Description

The Steel Joist Institute (SJI), a nonprofit organization of active joist manufacturers and other organizations and companies connected to the industry, was founded in 1928 to address the need for uniform joist standards within the industry.

Today, the Institute continues to maintain the standards for steel joist construction. In addition, the SJI provides educational opportunities for construction professionals utilizing a library of printed publications and both live and recorded webinars. We also offer assistance in identifying existing joists in buildings undergoing retrofit.

Participating Members

Three manufacturers contributed data for EPD development, including Canam (United States, Canada), New Millennium Building Systems (United States and Mexico), and the Vulcraft Division of Nucor Corp. (United States). Collectively, these manufacturers represent over 85% of North American membership production. Other SJI members contributed to EPD development and are represented in this publication. These members include Acero Technologia SA de CV; East Coast Steel, Inc.; ESJ; Gooder-Henrichsen Co.; Joist Structural Systems; Seyco Joist Company; and Valley Joist, Inc.

Product Description

Steel joists are welded steel products that are used to frame a building and support the deck (which, in turn, supports a building's roof and floors). They are custom engineered to suit the design of each building. Joists in this EPD represent product manufactured in North America from steel produced in North America.

Delivered Product Configurations

Open Web Steel Joists, which are secondary framing members, range from 10" to 120" deep, and up to 240' long.

Joist Girders, which are primary framing members, range from 20" to 120" deep and up to 120' long

Composite Steel Joists are open web products that are used in the construction of concrete roofs and floors allowing composite action between the joist and the concrete.

Application and Codes of Practice

American National Standard SJI-100 (for Open Web Steel Joists and Joist Girders)

American National Standard SJI-200 (for Composite Steel Joists)

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Life Cycle Stages

Raw Materials

Steel joists are manufactured almost entirely from welded structural steel. Background datasets for steel production include hot-rolled structural sections, plate, hot-rolled coil manufactured in North America, as well as a dataset representing the global average of wire rod.

Inbound Transportation

Inbound transportation distances and modes for steel were collected from each manufacturer. Some manufacturers also provided distances and modes for ancillary manufacturing materials (e.g. lubricants and welding electrodes) and packaging. These materials, however, represent a small portion of product mass; therefore, their inbound transportation impact falls under cut-off criteria.

Manufacturing

Steel joists are made of five main components: top chord, bottom chord, end web and interior web members and bearing seats. These components are cut, bent and assembled to create the steel joist. The major input to the manufacturing process is steel; however small amounts of process materials are needed, such as lubricants for the machines and electrodes and gases for welding. Energy is also needed to perform the manufacturing and move the materials.

Requirements for Underlying Life Cycle Assessment

A “cradle-to-gate” analysis using life cycle assessment (LCA) methodology was conducted for this EPD. The analysis was done according to the product category rule (PCR) for Designated Steel Construction Products and followed LCA principles, requirements and guidelines laid out in the ISO 14040/14044 standards. As such, EPDs of construction products may not be comparable if they do not comply with the same PCR. While the intent of the PCR is to increase comparability, there may still be differences among EPDs that comply with the same PCR (e.g., due to differences in system boundaries, background data, etc.).

Declared unit

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

Name	Required Unit	Optional Unit
Declared Unit	metric ton	short ton
Density	7,800 kg / m^3	487 lbs. / $ft.^3$

System Boundaries

The “cradle-to-gate” life cycle stages represent the product stage (information modules A1-A3) and include

- A1: all extraction and processing of raw materials; any reuse of products or materials from a previous product

system; processing of secondary materials; generation of electricity from primary energy resources, including upstream processes; and any energy recovery or other recovery processes from secondary fuels;
- A2: all transportation to the factory gate and all internal transport;
- A3: production of all ancillary materials, pre-products, products, and co-products, including any packaging.

Product Stage			Construction Stage		Use Stage					End-of-Life Stage			
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4
EXCLUDED FROM THIS STUDY													
Raw materials supply	Transport	Manufacturing	Transport	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	De-construction	Transport	Waste processing	Disposal

Time coverage: Primary data were collected on production within calendar year 2012. Background data for upstream and downstream processes (i.e., raw materials, energy resources, transportation and ancillary materials) were obtained from the GaBi 2014 databases.

Technology coverage: Data were collected for the production of steel joist by SJI members.

Geographical coverage: SJI members manufacture steel joist products at their North American facilities. As such, the geographical coverage for this study is based on United States system boundaries for all processes and products. Whenever US background data were not readily available, European data or global data were used as proxies.

Assumptions

No significant assumptions have been made. All of the raw materials and energy inputs have been modeled using processes and flows that closely follow actual production raw materials and processes. All of the material and energy flows have been accounted.

Allocation

No multi-output (i.e., co-product) allocation was performed in this study. Allocation of background data (energy and materials) taken from the GaBi 2014 databases is documented online at http://documentation.gabi-software.com/.

Cut-off Criteria

The cut-off criteria for including or excluding materials, energy and emissions data of the study are as follows:

- Mass: If a flow is less than 1% of the cumulative mass of the model it may be excluded, providing its environmental relevance is not a concern.
- Energy: If a flow is less than 1% of the cumulative energy of the model it may be excluded, providing its environmental relevance is not a concern.
- Environmental relevance: If a flow meets the above criteria for exclusion, yet is thought to potentially have a significant environmental impact, it was included.

Only inbound transportation of ancillary manufacturing materials and packaging was excluded. Additionally, capital items for the production processes (machines, buildings, etc.) were not taken into consideration.

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Life Cycle Assessment Results and Analysis

Use of Energy and Material Resources

Primary Energy (PE) Demand	Unit	Magnitude
Use of renewable PE excluding renewable PE resources used as raw materials	MJ, net calorific value	750
Use of renewable PE resources used as raw materials	MJ, net calorific value	0
Total use of renewable PE resources (PE and PE resources used as raw materials)	MJ, net calorific value	750
Use of non-renewable PE excluding non-renewable PE resources used as raw materials	MJ, net calorific value	17,400
Use of non-renewable PE resources used as raw materials	MJ, net calorific value	145
Total use of non-renewable PE resources (PE and PE resources used as raw materials)	MJ, net calorific value	17,500

Material Resource Use	Unit	Magnitude
Use of secondary material	metric ton	0.870
Use of renewable secondary fuels	MJ, net calorific value	0
Use of non-renewable secondary fuels	MJ, net calorific value	0
Net use of fresh water	m^3	6.09

Life Cycle Impact Assessment

Parameter	Unit	Magnitude
Impact Assessment Method: TRACI 2.1		
Global warming potential (GWP)	metric ton CO_2 eq	1.38
Depletion potential of the stratospheric ozone layer (ODP)	metric ton CFC-11 eq	4.91E-09
Acidification potential of soil and water (AP)	metric ton SO_2 eq	4.27E-03
Eutrophication potential (EP)	metric ton N eq	2.01E-04
Formation potential of tropospheric ozone (POCP)	metric ton O_3 eq	5.27E-02
Impact Assessment Method: CML		
Abiotic depletion potential (ADP-elements)*	metric ton Sb eq	-1.04E-05
Abiotic depletion potential (ADP-fossil)	MJ, net calorific value	15,900

* This indicator is based on assumptions regarding current reserves estimates. Users should use caution when interpreting results because there is insufficient information on which indicator is best for assessing the depletion of abiotic resources.

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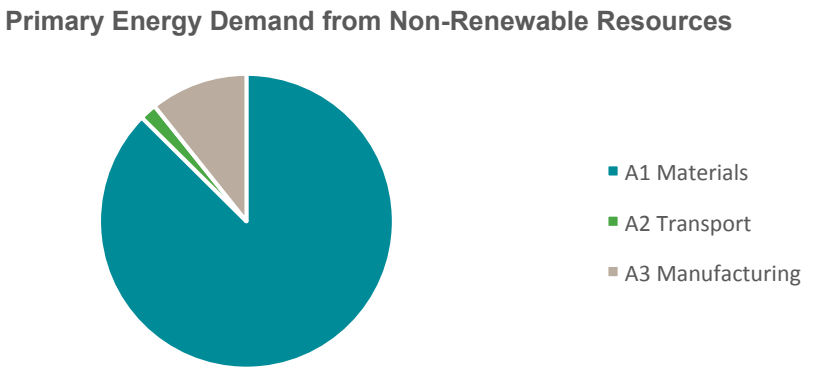
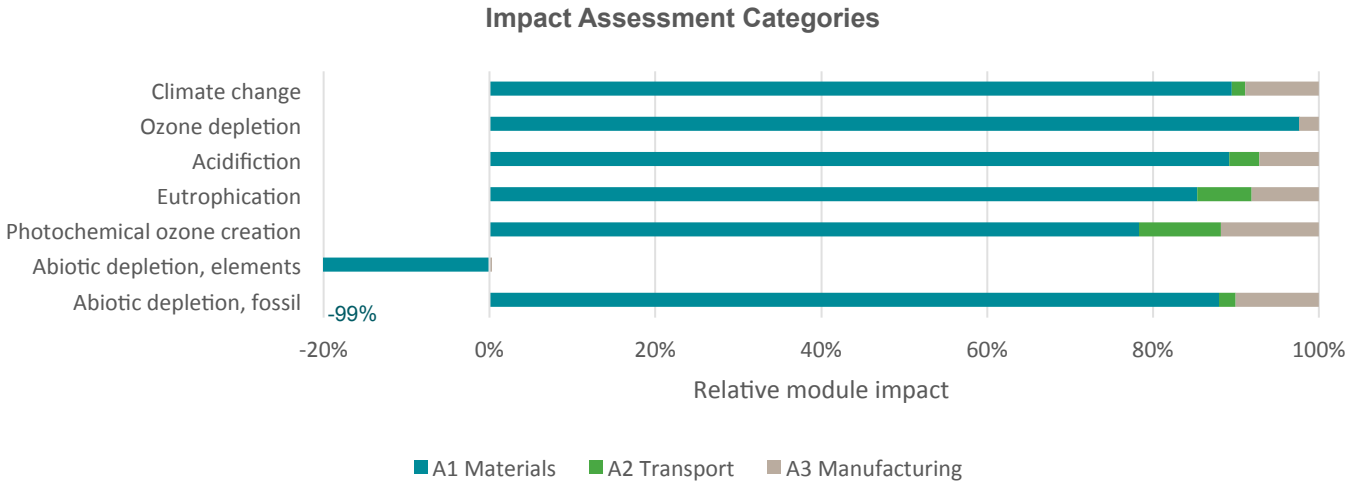
Other Environmental Information

Parameter	Unit	Magnitude
Hazardous waste disposed	metric ton	2.61E-06
Non-hazardous waste disposed	metric ton	1.01E-02
Radioactive waste disposed	metric ton	6.41E-04
Components for re-use	metric ton	0
Materials for recycling	metric ton	0
Materials for energy recovery	metric ton	0
Exported energy	MJ per energy carrier	0

Visualization of Life Cycle Impact Assessment

The diagrams below illustrate the degree to which the modules drive the major impact categories.





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Data Quality Assessment

Temporal representativeness: All primary data were collected for the year 2012. All secondary data come from the GaBi 2014 databases and are representative of the years 2007-2013. Therefore, temporal representativeness is warranted. **Geographical representativeness:** All primary and secondary data were collected specific to the countries or regions under study. Where country-specific or region-specific data were unavailable, proxy data were used. Geographical representativeness is considered to be high. **Technological representativeness:** All primary and secondary data were modeled to be specific to the technologies or technology mixes under study. Where technology-specific data were unavailable, proxy data were used. Technological representativeness is considered to be high. **Precision:** As the majority of the relevant foreground data are measured data or calculated based on primary information sources of the owner of the technology, precision is considered to be high. All background data are sourced from GaBi databases with the documented precision.

Disclaimer: This Environmental Product Declaration (EPD) conforms to ISO 14025, ISO 14040, ISO 14044, and ISO 21930.

Scope of Results Reported: The PCR requires the reporting of a limited set of LCA metrics; therefore, there may be relevant environmental impacts beyond those disclosed by this EPD. The EPD does not indicate that any environmental or social performance benchmarks are met nor thresholds exceeded.

Accuracy of Results: This EPD has been developed in accordance with the PCR applicable for the identified product following the principles, requirements and guidelines of the ISO 14040, ISO 14044, ISO 14025 and ISO 21930 standards. The results in this EPD are estimations of potential impacts. The accuracy of results in different EPDs may vary as a result of value choices, background data assumptions and quality of data collected.

Comparability: EPDs are not comparative assertions and are either not comparable or have limited comparability when they cover different life cycle stages, are based on different product category rules or are missing relevant environmental impacts. Such comparisons can be inaccurate, and could lead to the erroneous selection of materials or products which are higher-impact, at least in some impact categories. Any comparison of EPDs shall be subject to the requirements of ISO 21930. For comparison of EPDs which report different module scopes, such that one EPD includes Module D and the other does not, the comparison shall only be made on the basis of Modules A1, A2 and A3. Additionally, when Module D is included in the EPDs being compared, all EPDs must use the same methodology for calculation of Module D values.

LCA Practitioner

The EPD and underlying LCA model were developed by thinkstep, Inc. on behalf of the Steel Joist Institute.

thinkstep

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