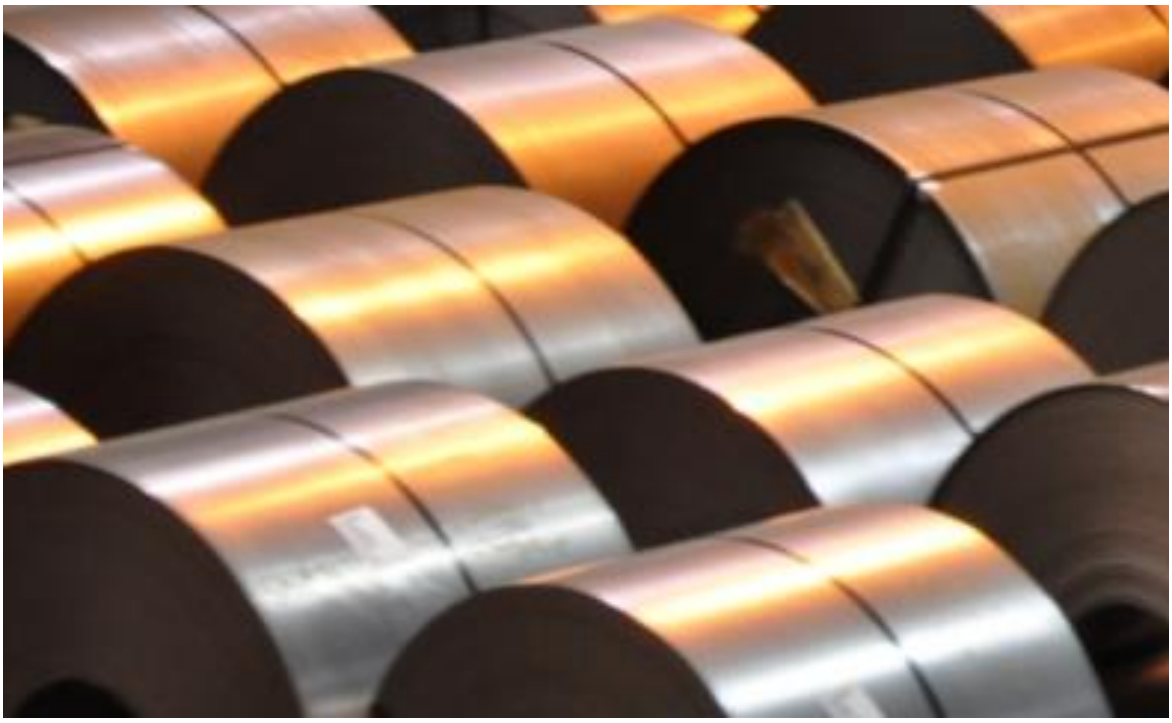
NLMK Indiana

Environmental Product Declaration



Environmental Product Declaration for various rolled steel sheet products produced by NLMK at their NLMK Farrell Facility in Farrell

ADMINISTRATIVE INFORMATION

International Certified Environmental Product Declaration

Declared Product:	This Environmental Product Declaration (EPD) covers rolled steel sheet products produced by NLMK. Declared Unit: one metric ton of steel
Declaration Owner:	NLMK
	15 Rormer Blvd
	Farrell, Pennsylvania
	https://us.nlmk.com/en
Program Operator:	Labeling Sustainability
	11670 W Sunset Blvd.
	Los Angeles, CA 90049
	www.labelingsustainability.com
Product Category Rule:	ISO 21930:2017 Sustainability in buildings and civil engineering works Core rules for environmental product declarations of construction products and services and Sub Product Category Rule part B: Designated Steel Construction Product EPD Requirements
	PCR Program Operator: UL
	PCR review was conducted by: Dr. Tom Gloria, Chair; Brandie Sebastian; James Littlefield
Independent LCA Reviewer and EPD Verifier:	This declaration was independently verified in accordance with ISO 14025:2006.
	Independent verification of the declaration, according to ISO 14025:2006
	Internal □; External □ X
	Third Party Verifier
	Geoffrey Guest, Certified 3rd Party Verifier under the Labeling Sustainability Program (www.labelingsustainability.com), CSA Group (www.csaregistries.ca),
Date of Issue:	20 October 2023
Period of Validity:	5 years; valid until 20 October 2028
EPD Number:	a87face8-d1ac-413c-9d4f-39b29cdfdd53

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COMPANY DESCRIPTION

NLMK Pennsylvania is the largest plant within NLMK USA. NLMK Pennsylvania operates as a conversion mill, turning slabs into hot-rolled and cold-rolled coils. NLMK Pennsylvania is a prime supplier of hot rolled, cold rolled, specialty high carbon and alloy products. NLMK Pennsylvania provides specialty alloy products including EAF and integrated melt materials in grades 1001 through 1095.

The Hot Strip Mill has the capacity to produce 2 million tons of rolled coil every year. The width of the coils can range from 35 inches, to 53 inches. The thickness can vary from 0.059 inches to 0.650 inches. The Pickle Line, equipped with four tanks is capable of processing up to 1 million tons of Hot Rolled Coils. The coils processed by the Pickle Line can have widths ranging from 29 inches, to 56 inches. Thicknesses varying between 0.060 inches and 0.187 inches.

STUDY GOAL

The intended application of this life cycle assessment (LCA) is to comply with the procedures for creating a Type III environmental product declaration (EPD) and publish the EPD for public review on the website, www.labelingsutainability.com. This level of study is in accordance with EPD Product Category Rule (PCR) for Rolled steel sheet published by; International Standards Organization (ISO) 14025:2006 Environmental labels and declarations, Type III environmental declarations-Principles and procedures; ISO 14044:2006 Environmental management, Life cycle assessment- Requirements and guidelines; and ISO 14040:2006 Environmental management, Life cycle assessment-Principles and framework. The performance of this study and its subsequent publishing is in alignment with the business-to-business (B2B) communication requirements for the environmental assessment of building products. The study does not intend to support comparative assertions and is intended to be disclosed to the public.

This project report was commissioned to differentiate NLMK from their competition for the following reasons: generate an advantage for the organization; offer customers information to help them make informed product decisions; improve the environmental performance of NLMK by continuously measuring, controlling and reducing the environmental impacts of their products; help project facilitators working on Leadership in Energy and Environmental Design (LEED) projects achieve their credit goal; and to strengthen NLMK's license to operate in the community. The intended audience for this LCA report is NLMK's employees, their suppliers, project specifiers of their products, architects, and engineers. The EPD report is also available for policy makers, government officials interested in sustainability, academic professors, and LCA professionals. This LCA report does not include product comparisons from other facilities.

DESCRIPTION OF PRODUCT AND SCOPE

Steel slabs are received from NLMK Group or other outside vendors. The slabs are heated and descaled, then pass through edger rolls to achieve the desired width. Before, reaching the finishing Mill the slabs passes through a 4-high reversible roughing mill, coil box and rotary crop shear. On passing through the 6-stand, 4-high finishing mill, the steel will be between 35 in. and 53 in. wide and 0.059 in. through 0.65 in. in gauge. The coils will then continue downstream or be shipped to the market as a Hot Rolled Coil.

The Cold- Mill receives the coils from the Hot-Mill after they pass through pickle line and get edge trimmed to final width. The coil is rolled to a desired thickness on tandem mill and can go to the market as cold rolled full hard or proceed to our coating lines for further processing. NLMK Pennsylvania produces cold rolled coil between 28 in. and 52 in. wide and 0.010 in. through 0.120 in. in gauge.

This LCA assumes the impacts from products manufactured in accordance with the standards outlined in this report. This LCA is a cradle-to-gate study, and therefore, stages extending beyond the plant gate are not included in this LCA. Excluded stages include transportation of the manufactured material to the construction site; on-site construction processes and components; building (infrastructure) use and maintenance; and "end-of-life" effects.

ROLLED STEEL SHEET DESIGN SUMMARY

The following tables provide a list of the rolled steel sheet products considered in this EPD along with key performance parameters.

Hot Rolled Steel

Table 1: **Declared products with hot rolled steel considered in this environmental product declaration**

Prod#	Unique name/ID	Short description	Product type	Unit	Density, dry kg/Unit	Product Group
1	Hot Rolled Steel	Sheet Metal product	Steel	tonne	1,000	hot rolled steel

Cold Rolled Steel

Table 2: **Declared products with cold rolled steel considered in this environmental product declaration**

Prod#	Unique name/ID	Short description	Product type	Unit	Density, dry kg/Unit	Product Group
2	Cold Rolled Steel	Sheet Metal product	Steel	tonne	1,000	cold rolled steel

ROLLED STEEL SHEET DESIGN COMPOSITION

The following figures provide mass breakdown (kg per functional unit) of the material composition of each rolled steel sheet design considered.

Hot Rolled Steel

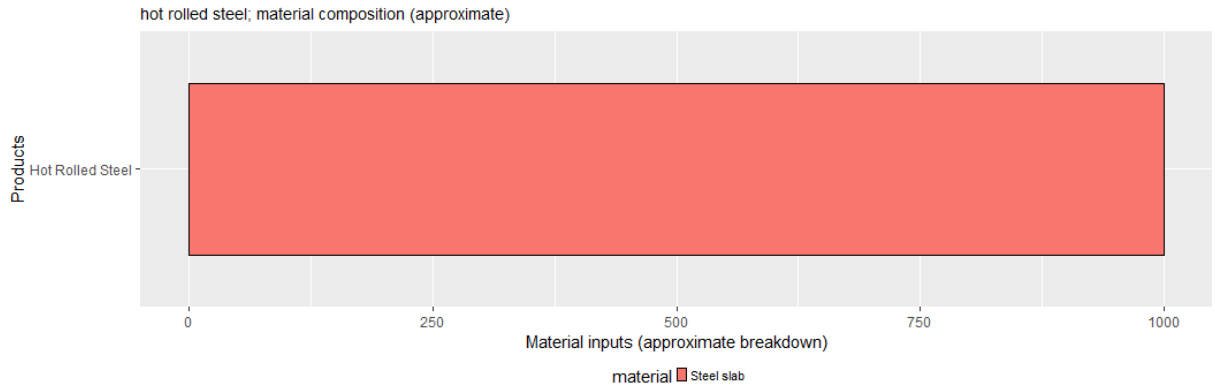

Figure 1: **Material composition – Hot rolled steel per One metric ton of steel**

Cold Rolled Steel

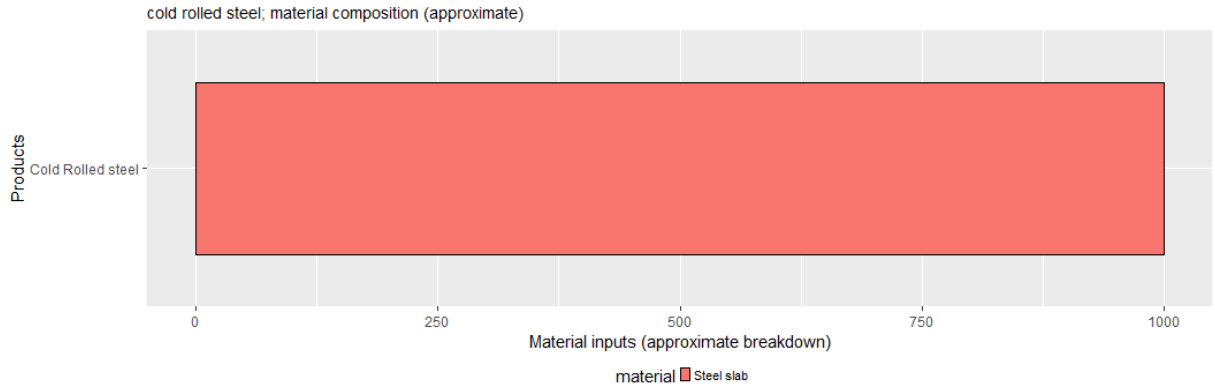

Figure 2: **Material composition – Cold rolled steel per One metric ton of steel**

A1 RAW MATERIAL RECYCLED CONTENT AND MATERIAL LOSSES –

The following table provides a list of the raw material inputs (module A1) across all products considered, their recyclability content and assumed material losses.

Table 3: **Module A1 raw material inputs, the recyclability content and assumed material losses (dry basis)**

product.name	mix.category	primary.content	post.industrial.content	post.consumer.content	material.losses
Raw Material Steel Slab	steel, low-alloyed	100%	0%	0%	5%

SYSTEM BOUNDARIES

The following figure depicts the cradle-to-gate system boundary considered in this study:

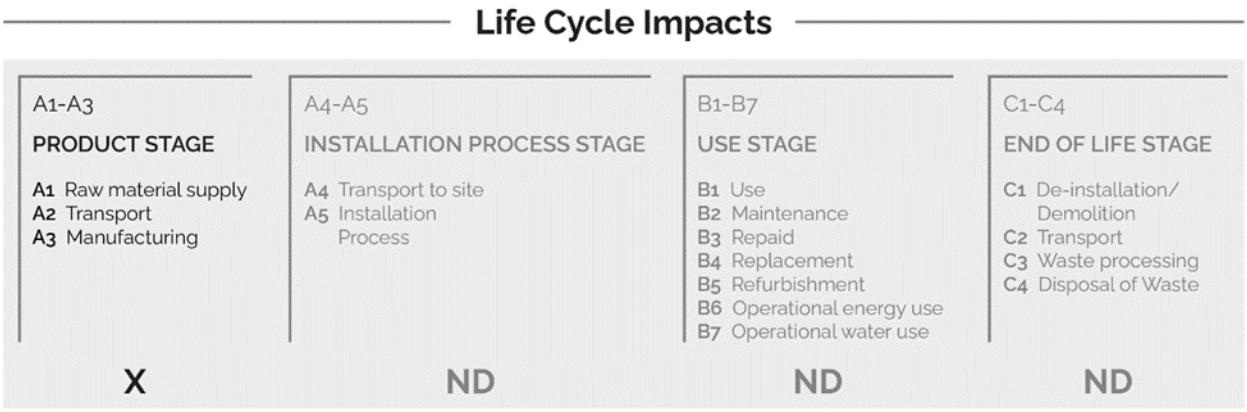

Figure 3: **General life cycle phases for consideration in a construction works system. (B stages are excluded)**

The following figure depicts the cradle-to-gate system boundary considered in this study:

This is a Cradle-to-gate life cycle assessment and the following life cycle stages are included in the study:

- A1: Raw material supply (upstream processes) - Extraction, handling, and processing of the materials used in manufacturing the declared products in this LCA.
- A2: Transportation - Transportation of A1 materials from the supplier to the "gate" of the manufacturing facility (i.e. A3).
- A3: Manufacturing (core processes)- The energy and other utility inputs used to store, move, and manufacturer the declared products and to operate the facility.

As according to the PCR, the following figure illustrates the general activities and input requirements for producing rolled steel sheet products and is not necessarily exhaustive.

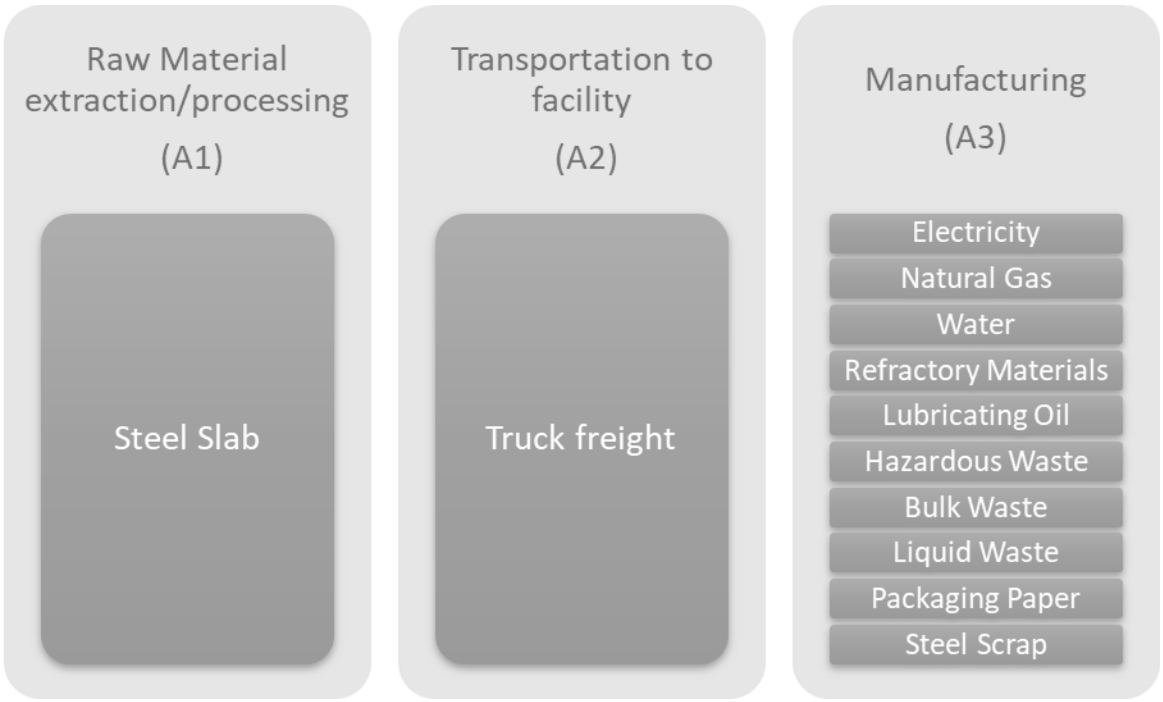

Figure 4: **General system inputs considered in the product system and categorized by modules in scope.**

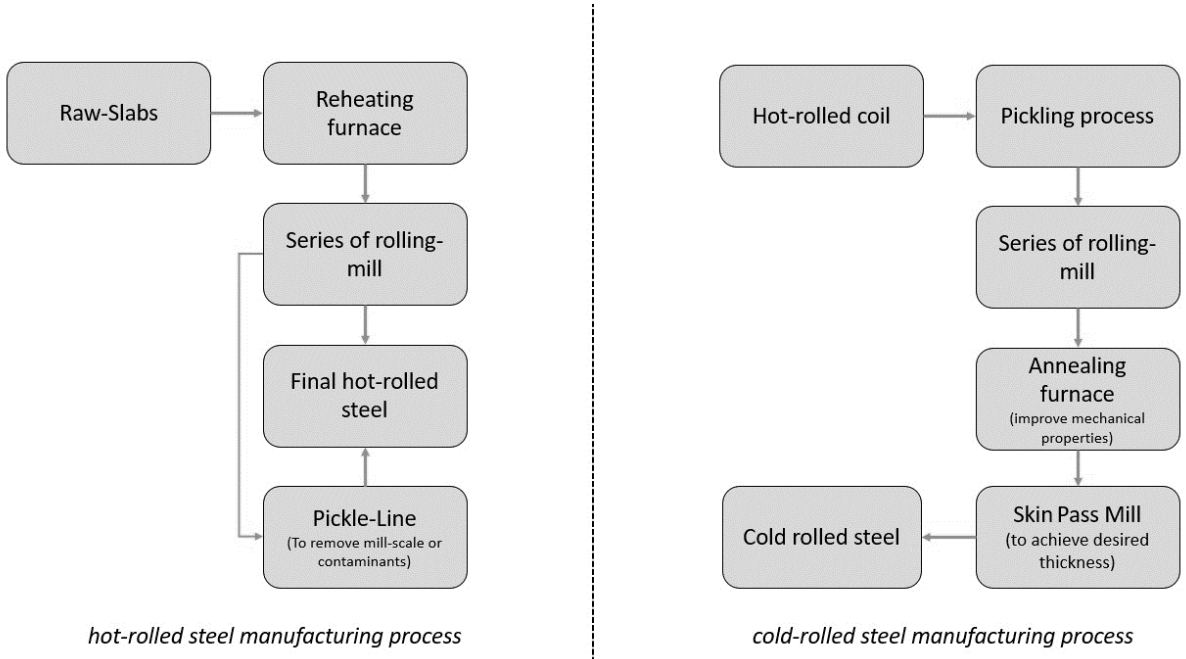

Figure 5: **Flow diagrams depicting the hot and cold rolled streel processing steps**

In addition, as according to the relevant PCR, the following requirements are excluded from this study:

- Production, manufacture and construction of A3 building/capital goods and infrastructure;
- Production and manufacture of steel production equipment, steel delivery vehicles, earth-moving equipment, and laboratory equipment;
- Personnel-related activities (travel, furniture, office supplies).
- Energy use related to company management and sales activities.

For this LCA the manufacturing plant, owned and operated by NLMK, is located at their NLMK Farrell facility in Farrell, Pennsylvania. All operating data is formulated using the actual data from NLMK's plant at the above location, including water, energy consumption and waste generation. All inputs for this system boundary are calculated for the plant.

This life cycle inventory was organized in a spreadsheet and was then input into an RStudio environment where pre-calculated LCIA results for relevant products/activities stemming from the ecoinvent v3.8 database and a local EPD database in combination with primary data from NLMK were utilized. Explanations of the contribution of each data source to this study are outlined in the section 'Data Sources and Quality'. Further LCI details for each declared product are provided in the sections 'Detailed LCI tables' and 'Transport tables' of the detailed LCA report. A parameter uncertainty analysis was also performed where key statistical results (e.g., min/mean/max etc.) are provided in the detailed LCA report.

No known flows are deliberately excluded from this EPD.

CUT-OFF CRITERIA

ISO 14044:2006 and the focus PCR requires the LCA model to contain a minimum of 95% of the total inflows (mass and energy) to the upstream and core modules be included in this study. The cut-off criteria were applied to all other processes unless otherwise noted above as follows. A 1% cut-off is considered for all renewable and non-renewable primary energy consumption and the total mass of inputs within a unit process where the total of the neglected inputs does not exceed 5%.

DATA SOURCES AND DATA QUALITY ASSESSMENT

No recovered on-site energy occurs at this facility.

Table 4: **Reused or recycled components/materials at the A3 facility site**

Component/material for re-use/recycling	Value	Units	Re-used/recycled on-site or off-site
Scrap steel	61,700,000	kg	Off-site

The following statements explain how the above facility requirements/generation were derived:

Raw material transport: Raw material transport is based on the actual distance from the manufacturer and market. All distances are calculated based on NMLK primary data. Materials arrive at the NMLK

facility via truck-freight. Product originates at a manufacturer within the United States and sold to different post-manufacturers.

This EPD only covers calculations related to the NMLK facility. However, the PCR allows for an average, the industry norm for EPDs in leaning towards facility-specific EPD. Since an EPD is valid for five years, the decision was made to make all NMLK EPDs facility specific; therefore, all transportation requirements are for the NMLK facility only.

Electricity: Primary electricity consumption was calculated for the NMLK facility from electricity bills. NMLK's fiscal year started in Jan 2022; twelve consecutive months were used, from January through December 2022. NMLK's utility provider's monthly usage was in kilowatt-hours (kWh), so no conversions were performed.

Process/space heating: The reported natural gas usage is based on the NLMK primary information from utility bills for the reporting period. The amount of natural gas used in the production of cold-rolled steel was determined by subtracting the natural gas consumed by each process line involved in the manufacturing of cold-rolled steel from the total natural gas usage. The remaining portion was then assigned to the production of hot-rolled steel.

Fuel required for machinery: All the waste calculations was calculated using primary information form NLMK's records or vendor bills, that includes bulk waste, hazardous and liquid waste only. No other waste is associated with the product because all the waste generated during the production process, as every single material is consumable and can be re-process. Transportation defaults were used because the driver's route and ultimate final destination are unknown. Therefore, the exact mileage could not be confirmed by the waste hauler.

Waste generation: No on-site energy is recovered on site

Recovered energy: All the scrap or waste generated during the manufacturing process at the facility is sold to the different post-manufacturers that is used as a constituent in another manufacturing process.

Recycled/reused material/components: Default material losses were used unless otherwise specified in the PCR. For instance, per the PCR, "It shall be assumed that there is a loss of 5%. This value was determined via industry consensus during the PCR development process and represents a conservative estimate."

Module A1 material losses: Direct emissions were modeled with best available ecoinvent processes.

Direct A3 emissions accounting: NA

The following tables depict a list of assumed life cycle inventory utilized in the LCA modeling to generate the impact results across the life cycle modules in scope. An assessment of the quality of each LCI activities utilized from various sources is also provided.

Table 5: **LCI inputs assumed for module A1 (i.e., raw material supply)**

Input	LCI.activity	Data.source	Geo	Year	Technology	Time	Geography	Reliability	Completeness
Raw Material Steel Slab	Hot rolled steel production, Steel, NLMK.Portage, NLMK.Indiana/Portage, RFC/one metric ton of steel	Progam Operator: Labeling Sustainability- EPD ID: 4c79e756-01f5-4a0a-b866-db104dd060e5	Mutilple cities	25 April 2023	2	3	2	3	3

Table 6: **LCI inputs assumed for module A2 (i.e. transport of A1 inputs)**

Input	LCI.activity	Data.source	Geo	Year	Technology	Time	Geography	Reliability	Completeness
Alkalis- freight transport via Truck	market for transport, freight, lorry 7.5-16 metric ton, EURO4/transport, freight, lorry 7.5-16 metric ton, EURO4/RER/tkm	ecoinvent v3.8	RER	v3.8 in 2021	2	3	1	3	3
Aluminium oxide- freight transport via Truck	market for transport, freight, lorry 7.5-16 metric ton, EURO4/transport, freight, lorry 7.5-16 metric ton, EURO4/RER/tkm	ecoinvent v3.8	RER	v3.8 in 2021	2	3	1	3	3
Aluminium phosphate- freight transport via Truck	market for transport, freight, lorry 7.5-16 metric ton, EURO4/transport, freight, lorry 7.5-16 metric ton, EURO4/RER/tkm	ecoinvent v3.8	RER	v3.8 in 2021	2	3	1	3	3
Aluminium sulfate- freight transport via Truck	market for transport, freight, lorry 7.5-16 metric ton, EURO4/transport,	ecoinvent v3.8	RER	v3.8 in 2021	2	3	1	3	3

	freight, lorry 7.5-16 metric ton, EURO4/RER/tkm								
Aluminosilicate (kyanite)- freight transport via Truck	market for transport, freight, lorry 7.5-16 metric ton, EURO4/transport, freight, lorry 7.5-16 metric ton, EURO4/RER/tkm	ecoinvent v3.8	RER	v3.8 in 2021	2	3	1	3	3
Aluminosilicate (mullite)- freight transport via Truck	market for transport, freight, lorry 7.5-16 metric ton, EURO4/transport, freight, lorry 7.5-16 metric ton, EURO4/RER/tkm	ecoinvent v3.8	RER	v3.8 in 2021	2	3	1	3	3
Amorphous silica- freight transport via Truck	market for transport, freight, lorry 7.5-16 metric ton, EURO4/transport, freight, lorry 7.5-16 metric ton, EURO4/RER/tkm	ecoinvent v3.8	RER	v3.8 in 2021	2	3	1	3	3
Bauxite- freight transport via Truck	market for transport, freight, lorry 7.5-16 metric ton, EURO4/transport, freight, lorry 7.5-16 metric ton, EURO4/RER/tkm	ecoinvent v3.8	RER	v3.8 in 2021	2	3	1	3	3
Bentonite- freight transport via Truck	market for transport, freight, lorry 7.5-16 metric ton, EURO4/transport, freight, lorry 7.5-16 metric ton, EURO4/RER/tkm	ecoinvent v3.8	RER	v3.8 in 2021	2	3	1	3	3
Bulk waste- freight transport via Truck	market for transport, freight, lorry 7.5-16 metric ton, EURO4/transport, freight, lorry 7.5-16 metric ton, EURO4/RER/tkm	ecoinvent v3.8	RER	v3.8 in 2021	2	3	1	3	3
Calcium aluminate- freight transport via Truck	market for transport, freight, lorry 7.5-16 metric ton, EURO4/transport, freight, lorry 7.5-16	ecoinvent v3.8	RER	v3.8 in 2021	2	3	1	3	3

	metric ton, EURO4/RER/tkm								
Clay- freight transport via Truck	market for transport, freight, lorry 7.5-16 metric ton, EURO4/transport, freight, lorry 7.5-16 metric ton, EURO4/RER/tkm	ecoinvent v3.8	RER	v3.8 in 2021	2	3	1	3	3
Coil paper- freight transport via Truck	market for transport, freight, lorry 7.5-16 metric ton, EURO4/transport, freight, lorry 7.5-16 metric ton, EURO4/RER/tkm	ecoinvent v3.8	RER	v3.8 in 2021	2	3	1	3	3
Cristobalite- freight transport via Truck	market for transport, freight, lorry 7.5-16 metric ton, EURO4/transport, freight, lorry 7.5-16 metric ton, EURO4/RER/tkm	ecoinvent v3.8	RER	v3.8 in 2021	2	3	1	3	3
Hazardous waste- freight transport via Truck	market for transport, freight, lorry 7.5-16 metric ton, EURO4/transport, freight, lorry 7.5-16 metric ton, EURO4/RER/tkm	ecoinvent v3.8	RER	v3.8 in 2021	2	3	1	3	3
Iron oxide- freight transport via Truck	market for transport, freight, lorry 7.5-16 metric ton, EURO4/transport, freight, lorry 7.5-16 metric ton, EURO4/RER/tkm	ecoinvent v3.8	RER	v3.8 in 2021	2	3	1	3	3
Liquid Waste- freight transport via Truck	market group for transport, freight, inland waterways, barge/transport, freight, inland waterways, barge/GLO/tkm	ecoinvent v3.8	GLO	v3.8 in 2021	2	3	1	3	3
Lubricating Oil- freight transport via Truck	market for transport, freight, lorry 7.5-16 metric ton, EURO4/transport, freight, lorry 7.5-16 metric ton, EURO4/RER/tkm	ecoinvent v3.8	RER	v3.8 in 2021	2	3	1	3	3

Quartz- freight transport via Truck	market for transport, freight, lorry 7.5-16 metric ton, EURO4/transport, freight, lorry 7.5-16 metric ton, EURO4/RER/tkm	ecoinvent v3.8	RER	v3.8 in 2021	2	3	1	3	3
Refractory Ceramic Fiber- freight transport via Truck	market for transport, freight, lorry 7.5-16 metric ton, EURO4/transport, freight, lorry 7.5-16 metric ton, EURO4/RER/tkm	ecoinvent v3.8	RER	v3.8 in 2021	2	3	1	3	3
Titanium dioxide- freight transport via Truck	market for transport, freight, lorry 7.5-16 metric ton, EURO4/transport, freight, lorry 7.5-16 metric ton, EURO4/RER/tkm	ecoinvent v3.8	RER	v3.8 in 2021	2	3	1	3	3

Table 7: **LCI inputs assumed for module A3**

Input	LCI.activity	Data.source	Geo	Year	Technology	Time	Geography	Reliability	Completeness
Alkalis	sodium oxide production/sodium oxide/RoW/kg	ecoinvent v3.8	Pennsylvania	v3.8 in 2021	2	3	1	3	3
Aluminium oxide	market for aluminium oxide, metallurgical/aluminium oxide, metallurgical/RoW/kg	ecoinvent v3.8	Pennsylvania	v3.8 in 2021	2	3	1	3	3
Aluminium phosphate	sodium phosphate production/sodium phosphate/RoW/kg	ecoinvent v3.8	Illinois	v3.8 in 2021	2	3	1	3	3
Aluminium sulfate	aluminium sulfate production, powder/aluminium sulfate, powder/RoW/kg	ecoinvent v3.8	Illinois	v3.8 in 2021	2	3	1	3	3
Aluminosilicate (kyanite)	chemical production, inorganic/chemical, inorganic/GLO/kg	ecoinvent v3.8	Illinois	v3.8 in 2021	2	3	1	3	3
Aluminosilicate (mullite)	chemical production, inorganic/chemical, inorganic/GLO/kg	ecoinvent v3.8	Illinois	v3.8 in 2021	2	3	1	3	3

Amorphous silica	silica sand production/silica sand/RoW/kg	ecoinvent v3.8	Pennsylvania	v3.8 in 2021	2	3	1	3	3
Bauxite	bauxite mine operation/bauxite/GLO/kg	ecoinvent v3.8	Illinois	v3.8 in 2021	2	3	1	3	3
Bentonite	bentonite quarry operation/bentonite/RoW/kg	ecoinvent v3.8	Illinois	v3.8 in 2021	2	3	1	3	3
Bulk waste	process-specific burdens, residual material landfill/process-specific burdens, residual material landfill/RoW/kg	ecoinvent v3.8	Multiple Regions	v3.8 in 2021	2	3	1	3	3
Calcium aluminate	chemical production, inorganic/chemical, inorganic/GLO/kg	ecoinvent v3.8	Illinois	v3.8 in 2021	2	3	1	3	3
Clay	clay pit operation/clay/RoW/kg	ecoinvent v3.8	Illinois	v3.8 in 2021	2	3	1	3	3
Coil paper	kraft paper production/kraft paper/RoW/kg	ecoinvent v3.8	Pennsylvania	v3.8 in 202	2	3	1	3	3
Cristobalite	silica sand production/silica sand/RoW/kg	ecoinvent v3.8	Multiple Regions	v3.8 in 2021	2	3	1	3	3
Electricity	market for electricity, medium voltage/electricity, medium voltage/US-RFC/kWh	ecoinvent v3.8	Multiple Regions	v3.8 in 2021	2	3	1	3	3
Hazardous waste	process-specific burdens, hazardous waste incineration plant/process-specific burdens, hazardous waste incineration plant/RoW/kg	ecoinvent v3.8	Multiple Regions	v3.8 in 2021	2	3	1	3	3
Iron oxide	magnetite production/magnetite/GLO/kg	ecoinvent v3.8	Pennsylvania	v3.8 in 2021	2	3	1	3	3
Liquid waste	treatment of waste mineral oil, hazardous waste incineration/waste mineral oil/RoW/kg	ecoinvent v3.8	Pennsylvania	v3.8 in 2021	2	3	1	3	3
Lubricating Oil	lubricating oil production/lubricating oil/RoW/kg	ecoinvent v3.8	Multiple Regions	v3.8 in 2021	2	3	1	3	3
Natural gas	market for heat, district or industrial, natural gas/heat, district or	ecoinvent v3.8	Multiple Regions	v3.8 in 2021	2	3	1	3	3

	industrial, natural gas/RoW/MJ								
Quartz	silica sand production/silica sand/RoW/kg	ecoinvent v3.8	Multiple Regions	v3.8 in 2021	2	3	1	3	3
Refractory ceramic fiber	refractory production, high aluminium oxide, packed/refractory, high aluminium oxide, packed/RoW/kg	ecoinvent v3.8	Pennsylvania	v3.8 in 2021	2	3	1	3	3
Titanium dioxide	titanium dioxide production, chloride process/titanium dioxide/RoW/kg	ecoinvent v3.8	Multiple Regions	v3.8 in 2021	2	3	1	3	3
Water	tap water production, conventional treatment/tap water/RoW/kg	ecoinvent v3.8	Pennsylvania	v3.8 in 2021	2	3	1	3	3

DATA QUALITY ASSESSMENT

Data quality/variability requirements, as specified in the PCR, are applied. This section describes the achieved data quality relative to the ISO 14044:2006 requirements. Data quality is judged based on its precision (measured, calculated or estimated), completeness (e.g., unreported emissions), consistency (degree of uniformity of the methodology applied within a study serving as a data source) and representativeness (geographical, temporal, and technological).

Precision: Through measurement and calculation, the manufacturers collected and provided primary data on their annual production. For accuracy, the LCA practitioner and 3rd Party Verifier validated the plant gate-to-gate data.

Completeness: All relevant specific processes, including inputs (raw materials, energy and ancillary materials) and outputs (emissions and production volume) were considered and modeled to represent the specified and declared products. The majority of relevant background materials and processes were taken from ecoinvent v3.8 LCI datasets where relatively recent region-specific electricity inputs were utilized. The most relevant EPDs requiring key A1 inputs were also utilized where readily available.

Consistency: To ensure consistency, the same modeling structure across the respective product systems was utilized for all inputs, which consisted of raw material inputs and ancillary material, energy flows, water resource inputs, product and co-products outputs, returned and recovered Calcium carbonate sand materials, emissions to air, water and soil, and waste recycling and treatment. The same background LCI datasets from the ecoinvent v3.8 database were used across all product systems. Crosschecks concerning the plausibility of mass and energy flows were continuously conducted. The LCA team conducted mass and energy balances at the plant and selected process level to maintain a high level of consistency.

Reproducibility: Internal reproducibility is possible since the data and the models are stored and available in a machine readable project file for all foreground and background processes, and in

Labeling Sustainability's proprietary Calcium carbonate sand LCA calculator* for all production facility and product-specific calculations. A considerable level of transparency is provided throughout the detailed LCA report as the specifications and material quantity make-up for the declared products are presented and key primary and secondary LCI data sources are summarized. The provision of more detailed publicly accessible data to allow full external reproducibility was not possible due to reasons of confidentiality.

*Labeling Sustainability has developed a proprietary tool that allows the calculation of PCR-compliant LCA results for Calcium carbonate sand product designs. The tool auto-calculates results by scaling base-unit technosphere inputs (i.e., 1 kg sand, 1 kWh electricity, etc.) to replicate the reference flow conversions that take place in any typical LCA software like openLCA or SimaPro. The tool was tested against several LCAs performed in openLCA and the tool generated identical results to those realized in openLCA across every impact category and inventory metric (where comparisons could be readily made).

Representativeness: The representativeness of the data is summarized as follows.

- Time related coverage of the manufacturing processes primary collected data from 2022-01-01 to 2022-12-31.
- Upstream (background) LCI data was either the PCR specified default (if applicable) or more appropriate LCI datasets as found in the country-adjusted ecoinvent v3.8 database.
- Geographical coverage for inputs required by the A3 facility(ies) is representative of its region of focus; other upstream and background processes are based on US, North American, or global average data and adjusted to regional electricity mixes when relevant.
- Technological coverage is typical or average and specific to the participating facilities for all primary data.

ENVIRONMENTAL INDICATORS AND INVENTORY METRICS

Per the PCR, this EPD supports the life cycle impact assessment indicators and inventory metrics as listed in the tables below. As specified in the PCR, the most recent US EPA Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI), impact categories were utilized as they provide a North American context for the mandatory category indicators to be included in the EPD. Additionally, the PCR requires a set of inventory metrics to be reported with the LCIA indicators (see tables below).

Table 8: **Life cycle impact categories and life cycle inventory metrics**

ID	LCIA.indicators	Abbreviations	Units
1	environmental impact: acidification	AP	moles of H+-Eq
2	environmental impact: eutrophication	EP	kg N
3	environmental impact: global warming	GWP	kg CO2-Eq
4	environmental impact: ozone depletion	ODP	kg CFC-11-Eq
5	environmental impact: photochemical oxidation	PCOP	kg NOx-Eq
6	material resources: metals/minerals: abiotic depletion potential (ADP): elements (ultimate reserves)	ADPe	kg Sb-Eq

7	energy resources: non-renewable: abiotic depletion potential (ADP): fossil fuels	ADPf	MJ, net calorific value
Inventory metrics			
8	Total primary energy	TPE	MJ-Eq
9	Renewable energy	RE	MJ-Eq
10	Non-renewable energy	NRE	MJ-Eq
11	Non-Renewable Resources	NRR	kg
12	Renewable Resources	RR	m^3
13	Water depletion: WDP	WDP	m^3
14	Land filling: bulk waste	LFW	kg waste
15	Land filling: hazardous waste	LFHW	kg waste

A summary description of each of the impact categories and inventory metrics is provided in the following table:

Table 9: **Definitions of life cycle impact categories and life cycle inventory metrics**

Midpoint impact categories	
Global Warming Potential (GWP) (units: kg CO2-eq)	Global Warming Potential or climate change can be defined as the change in global temperature caused by the greenhouse effect that the release of greenhouse gases by human activity creates. The Environmental Profiles characterization model is based on factors developed by the United Nations Intergovernmental Panel on Climate Change (IPCC). Factors are expressed as Global Warming Potential over the time horizon of different years, being the most common 100 years (GWP100), measured in the reference unit, kg CO2 equivalent.
Ozone Depletion Potential (ODP) (kg CFC-11-eq)	Ozone-depleting gases cause damage to stratospheric ozone or the ozone layer. CFCs, halons and HCFCs are the major causes of ozone depletion. The characterization model has been developed by the World Meteorological Organization (WMO) and defines the ozone depletion potential of different gases relative to the reference substance chlorofluorocarbon-11 (CFC-11), expressed in kg CFC-11 equivalent.
Acidification Potential (AP) (kg SO2-eq)	Acidic gases such as Sulphur dioxide (SO2) react with water in the atmosphere to form acid rain, a process known as acid deposition. Acidification potential is expressed using the reference unit, kg SO2 equivalent. The model does not take account of regional differences in terms of which areas are more or less susceptible to acidification. It accounts only for acidification caused by SO2 and NOx. This includes acidification due to fertilizer use, according to the method developed by the Intergovernmental Panel on Climate Change (IPCC). CML has based the characterization factor on the RAINS model developed by the University of Amsterdam.
Eutrophication Potential (EP) (PO4 3- -eq)	Eutrophication is the build-up of a concentration of chemical nutrients in an ecosystem which leads to abnormal productivity. This causes excessive plant growth like algae in rivers which causes severe reductions in water quality and animal populations. This category is based on the work of Heijungs, and is expressed using the reference unit, kg PO4 3- equivalents. Direct and indirect impacts of fertilizers are included in the method. The direct impacts are from production of the fertilizers and the indirect ones are calculated using the IPCC method to estimate emissions to water causing eutrophication.

Photochemical Ozone Creation/Smog Potential (POCP) (kg O3-eq)	Ozone is protective in the stratosphere, but on the ground-level, it is toxic to humans in high concentration. Photochemical ozone, also called ground-level ozone, is formed by the reaction of volatile organic compounds and nitrogen oxides in the presence of heat and sunlight. The impact category depends largely on the amounts of carbon monoxide (CO), Sulphur dioxide (SO2), nitrogen oxide (NO), ammonium and NMVOC (non-methane volatile organic compounds). Photochemical ozone creation potential (also known as summer smog) for emission of substances to air is calculated with the United Nations Economic Commission for 22 Europe (UNECE) trajectory model (including fate) and expressed using the reference unit, kg ethylene (C2H4) equivalent.
Abiotic Depletion Potential (ADPel and ADPff) (kg Sb-eq)	The main concern of this category is the health of humans and the ecosystem and how it is affected by the extraction of minerals and fossil fuels, which are inputs into the system. For each extraction of minerals and fossil fuels, the abiotic depletion factor is determined. This indicator is on a global scale and is based on the concentration reserves and rate of deaccumulation. The results are presented in units of the reference element strontium (i.e. Sb). For the purposes of this EPD, this impact category is split between mineral elements (i.e. ADPel) and fossil fuels (i.e. ADPff).
Inventory metrics	
Depletion of non-renewable material resources (NRM) (kg)	This indicator covers the cumulative life cycle consumption of non-renewable resources that are extracted from the ground but not including energy resources like coal, oil and natural gas. This indicator includes the consumption of metallic ores, aggregates, and other minerals. The units of measure are in terms of kilograms material extracted and utilized/wasted in the life cycle system considered.
Use of renewable material resources (RM) (kg)	This indicator covers the cumulative life cycle consumption of renewable resources that are extracted from nature like sustainably harvested biomass. The units of measure are in terms of kilograms material extracted and utilized/wasted in the life cycle system considered.
Depletion of non-renewable energy resources (NRE) (MJ HHV)	This indicator considers the cumulative life cycle consumption of non-renewable energy resources like oil, natural gas, and coal. The units of measure are in terms of Mega-Joules of energy resource extracted and utilized/wasted in the life cycle system considered.
Use of renewable primary energy (RE) (MJ HHV)	This indicator considers the cumulative life cycle extraction of renewable energy resources from nature like solar and wind energy as well as biomass for energy purposes. The units of measure are in terms of Mega-Joules of energy resource extracted and utilized/wasted in the life cycle system considered.
Total primary energy consumption (PEC) (MJ HHV)	This indicator is the summation of non-renewable and renewable energy extracted from nature, where the units of measure are in terms of Mega-Joules of energy resource extracted/utilized/wasted in the life cycle system considered.
Water Depletion Potential (WDP) (m^3)	This indicator considers the cumulative life cycle consumption of water required to produce the declared functional unit of a given product. The units of measure are in cubic meters of water consumed.

It should be noted that emerging LCA impact categories and inventory 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 any of the following categories.

- Renewable primary energy resources as energy (fuel);
- Renewable primary resources as material;
- Non-renewable primary resources as energy (fuel);
- Non-renewable primary resources as material;
- Secondary Materials;
- Renewable secondary fuels;
- Non-renewable secondary fuels;
- Recovered energy;
- Abiotic depletion potential for non-fossil mineral resources.
- Land use related impacts, for example on biodiversity and/or soil fertility;
- Toxicological aspects;
- Emissions from land use change [GWP 100 (land-use change)];
- Hazardous waste disposed;
- Non-hazardous waste disposed;
- High-level radioactive waste;
- Intermediate and low-level radioactive waste;
- Components for reuse;
- Materials for recycling;
- Materials for energy recovery;
- Recovered energy exported from the product system.

TOTAL IMPACT SUMMARY

The following table reports the total LCA results for each product produced at the given rolled steel sheet facility on a per One metric ton of steel basis.

Hot Rolled Steel:

Table 10: **Total life cycle (across modules in scope) impact results for hot rolled steel , assuming the geometric mean point values on a per 1 metric ton of steel basis**

a) Midpoint Impact Categories:

Indicator/LCI Metric	**AP**	**EP**	**GWP**	**ODP**	**PCOP**	**ADPe**	**ADPf**
Unit	**moles of H+-Eq**	**kg N**	**kg CO2-Eq**	**kg CFC-11-Eq**	**kg NOx-Eq**	**kg Sb-Eq**	**MJ, net calorific value**
Hot Rolled Steel	344	3.17	1580	0.000421	3.87	0.0135	29300

b) Inventory Metrics:

Indicator/LCI Metric	**TPE**	**RE**	**NRE**	**NRR**	**RR**	**WDP**	**LFW**	**LFHW**
Unit	**MJ-Eq**	**MJ-Eq**	**MJ-Eq**	**kg**	**m^3**	**m^3**	**kg waste**	**kg waste**
Hot Rolled Steel	31700	827	30900	1050	0.019	33.3	307	0.0758

Cold Rolled Steel:

Table 11: **Total life cycle (across modules in scope) impact results for hot rolled steel , assuming the geometric mean point values on a per 1 metric ton of steel basis**

a) Midpoint Impact Categories:

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf
Unit	**moles of H+-Eq**	**kg N**	**kg CO2-Eq**	**kg CFC-11-Eq**	**kg NOx-Eq**	**kg Sb-Eq**	**MJ, net calorific value**
Cold Rolled steel	285	3.13	1180	0.000364	3.2	0.0126	19900

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFHW
Unit	**MJ-Eq**	**MJ-Eq**	**MJ-Eq**	**kg**	**m^3**	**m^3**	**kg waste**	**kg waste**
Cold Rolled steel	21600	740	20900	822	0.017	31.3	290	0.0659

ADDITIONAL ENVIRONMENTAL INFO

No regulated substances of very high concern are utilized on site.

INTERPRETATION

Interpretation of Data for a Steel Facility Specializing in Hot and Cold Rolled Steel Production offers the following insights from the EPD report.

The Environmental Product Declaration (EPD) report provides a granular breakdown of the factors contributing to the Global Warming Potential (GWP) in the manufacturing processes of hot rolled steel at the Farrell facility.

For Hot Rolled Steel Production:

The major sources of GWP are identified in the modules pertaining to raw materials and energy consumption. Module A1, concerning the Raw Material Steel Slab, stands out significantly, accounting for 59.3% of the total GWP impact. Strategies to address impacts in this domain could range from the procurement of steel slabs with lower environmental footprints, to enhancing the efficiency of the steel production processes, and potentially exploring alternative materials.

Similarly, Module A3, which encompasses Natural Gas usage, is responsible for 23.6% of the GWP. To mitigate impacts here, a multifaceted approach could be beneficial, focusing on bolstering energy efficiency, transitioning towards renewable energy sources, and optimizing processes to curtail natural gas consumption.

Though various transportation activities for materials like aluminum oxide, silica sand, and titanium dioxide exhibit smaller individual contributions to GWP, their collective impact necessitates attention.

Strategies to ameliorate impacts in this area could include shortening transportation distances, enhancing the fuel efficiency of transport vehicles, or transitioning to more sustainable modes of transportation.

For Cold Rolled Steel Production:

The environmental impacts associated with the production of Cold Rolled steel, particularly in terms of GWP, are primarily dominated by the Raw Material Steel Slab, with the production process at NLMK Portage contributing an overwhelming 84.56% to the total GWP impact. This underscores the necessity to focus mitigation strategies at this production stage.

Conversely, transportation activities and minor inputs, including materials production and waste transport, have a minimal impact on the GWP, each contributing less than 0.05%.

Mitigation Recommendations include:

Prioritizing Optimization of Raw Material Usage: Given Module A1's substantial contribution to GWP, strategies should center around optimizing the use of raw material steel slabs. This may entail integrating recycled steel, enhancing process efficiency, or sourcing from suppliers with minimal environmental footprints.

Enhancing Energy Efficiency and Transitioning to Renewable Energy: The prominence of natural gas consumption in Module A3 calls for a concentrated effort in improving energy efficiency and investigating the potential integration of renewable energy sources.

In summary, addressing these specified areas, the GWP associated with the production of both Hot and Cold Rolled steel, can be reduced thus reducing its overall carbon footprint.

REFERENCES

ISO Standards:

- ISO 6707-1: 2014 Buildings and Civil Engineering Works - Vocabulary - Part 1: General Terms
- ISO 14021:1999 Environmental Labels and Declarations - Self-declared Environmental Claims (Type II Environmental Labeling)
- ISO 14025:2006 Environmental Labels and Declarations - Type III Environmental Declarations - Principles and Procedures
- ISO 14040:2006 Environmental Management - Life Cycle Assessment - Principles and Framework
- ISO 14044:2006 Environmental Management - Life Cycle Assessment - Requirements and Guidelines
- ISO 14067:2018 Greenhouse Gases – Carbon Footprint of Products – Requirements and Guidelines for Quantification
- ISO 14050:2009 Environmental Management - Vocabulary
- ISO 21930:2017 Sustainability in Building Construction - Environmental Declaration of Building Products

EN Standards:

- EN 16757 Sustainability of construction works - Environmental product declarations – Product Category Rules for concrete and cobiax elements
- EN 15804 Sustainability of construction works - Environmental product declarations -Core rules for the product category of construction products

Other References:

- USGBC LEED v4 for Building Design and Construction, 11 Jan 2019 available at https://www.usgbc.org/resources/pcr-committee-process-resources-part-b
- USGBC PCR Committee Process & Resources: Part B, USGBC, 7 July 2017 available at https://www.usgbc.org/resources/pcr-committee-process-resources-part-b.
- US EPA (2020) Advancing Sustainable Materials Management: 2018 Fact Sheet, https://www.epa.gov/sites/production/files/2021-01/documents/2018_ff_fact_sheet_dec_2020_fnl_508.pdf