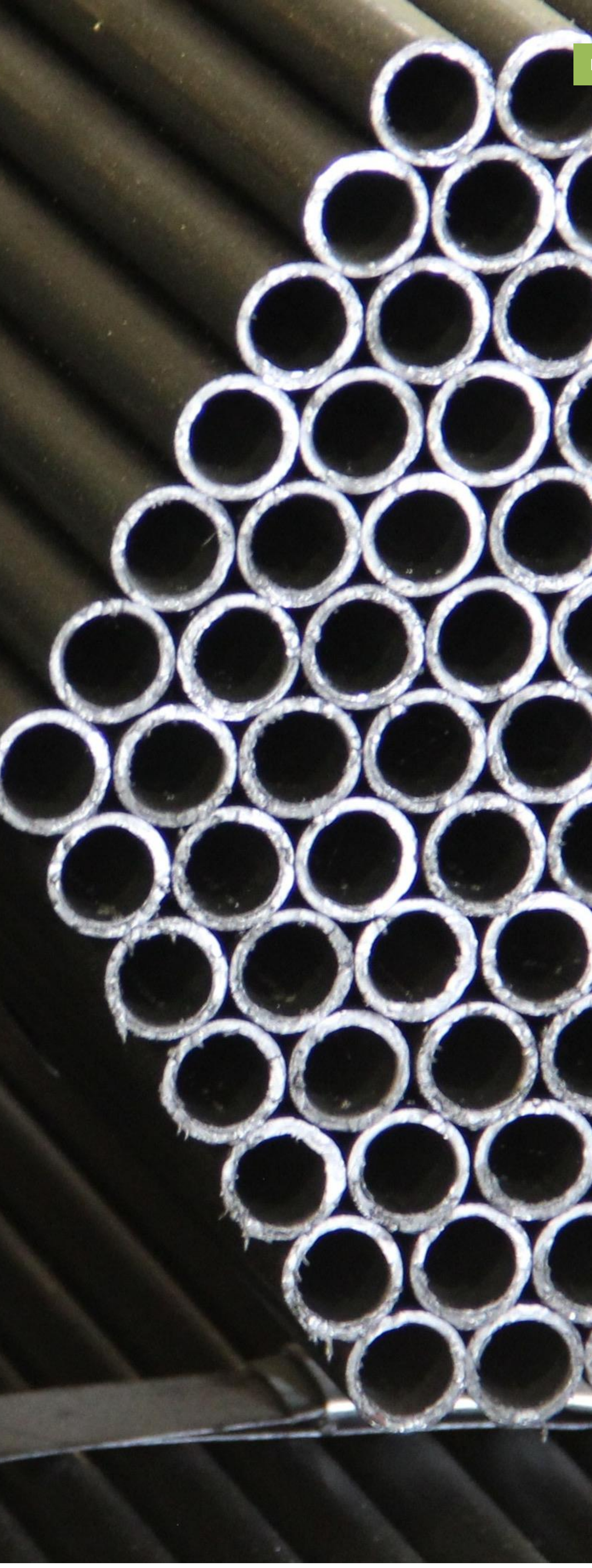


VERIFIED by SCS Global Services
ENVIRONMENTAL PRODUCT DECLARATION
BASED ON LCA

Declaration Owner

Bull Moose Tube

+1.888.227.5430 | www.bullmoosetube.com | techsupport@bullmoose.com

Burlington, ON
2170 Queensway Dr.
Burlington, Ontario L7R 3T1, Canada

Casa Grande, AZ
1001 North Jefferson Ave.
Casa Grande, AZ 8512

Chicago Heights; IL
555 E 16th St.
Chicago Heights, IL 60411

Elkhart, IN
29851 County Rd. 20 West
Elkhart, IN 46517

Gerald, MO
406 E Industrial Dr./Hwy. 50
Gerald, MO 63037

Masury, OH
1433 Standard Ave. SE
Masury, OH 44438

Sinton, TX
8534 Hwy 89
Sinton, TX 78387

Trenton, GA
195 North Industrial Dr.
Trenton, GA 30752

Product:

Steel Pipe and Tube

Declared Unit

The declared unit is one metric ton of steel tube and pipe

EPD Number and Period of Validity

SCS-EPD-07425

EPD Valid November 9, 2021 through November 8, 2026

Version Date: September 11, 2024

Product Category Rule

PCR Guidance for Version 3.2. UL Environment. Sept. 2018

PCR Guidance for Building-Related Products and Services. Part B: Designated Steel Construction Product EPD Requirements. UL Environment. August 2020.

Program Operator

SCS Global Services

2000 Powell Street, Ste. 600, Emeryville, CA 94608

+1.510.452.8000 | www.SCSglobalServices.com

Declaration owner:	Bull Moose Tube
Address:	See cover full list of facilities included in EPD
Declaration Number:	SCS-EPD-07425
Declaration Validity Period:	EPD Valid November 9, 2021 through November 8, 2026
Version Date:	September 11, 2024
Program Operator:	SCS Global Services
Declaration URL Link:	https://www.scsglobalservices.com/certified-green-products-guide
LCA Practitioner:	Tess Garvey, Ph.D., SCS Global Services
LCA Software and LCI database:	OpenLCA 1.10 and 2.0 software and the Ecoinvent v3.7.1 database
Product's Intended Application:	Steel Pipe and Tube
Product RSL:	n/a
Markets of Applicability:	Global
EPD Type:	Product-Specific
EPD Scope:	Cradle-to-Gate
LCIA Method and Version:	CML-IA and TRACI 2.1
Independent critical review of the LCA and data, according to ISO 14044 and ISO 14071	☐ internal ☒ external
LCA Reviewer:	Thomas Gloria, Ph.D., Industrial Ecology Consultants
Part A Product Category Rule:	PCR Guidance for Building-Related Products and Services Part A: Life Cycle Assessment Calculation Rules and Report Requirements. Version 3.2. UL Environment. Sept. 2018
Part A PCR Review conducted by:	Lindita Bushi, PhD (Chair); Hugues Imbeault-Tétreault, ing., M.Sc.A.; Jack Geibig
Part B Product Category Rule:	PCR Guidance for Building-Related Products and Services. Part B: Designated Steel Construction Product EPD Requirements. UL Environment. August 2020.
Part B PCR Review conducted by:	Thomas Gloria, PhD; Brandie Sebastian, James Littlefield
Independent verification of the declaration and data, according to ISO 14025 and the PCR	☐ internal ☒ external
EPD Verifier:	Thomas Gloria, Ph.D., Industrial Ecology Consultants
Declaration Contents:	

Disclaimers: *This EPD conforms to ISO 14025, 14040, 14044, and ISO 21930.*

Scope of Results Reported: *The PCR requirements limit the scope of the LCA metrics such that the results exclude environmental and social performance benchmarks and thresholds, and exclude impacts from the depletion of natural resources, land use ecological impacts, ocean impacts related to greenhouse gas emissions, risks from hazardous wastes and impacts linked to hazardous chemical emissions.*

Accuracy of Results: *Due to PCR constraints, this EPD provides estimations of potential impacts that are inherently limited in terms of accuracy.*

Comparability: *The PCR this EPD was based on was not written to support comparative assertions. EPDs based on different PCRs, or different calculation models, may not be comparable. When attempting to compare EPDs or life cycle impacts of products from different companies, the user should be aware of the uncertainty in the final results, due to and not limited to, the practitioner's assumptions, the source of the data used in the study, and the specifics of the product modeled.*

In accordance with ISO 21930:2017, EPDs are comparable only if they comply with the core PCR, use the same sub-category PCR where applicable, include all relevant information modules and are based on equivalent scenarios with respect to the context of construction works.

1. Bull Moose Tube

Bull Moose Tube is a division of Bull Moose Industries. Founded in 1962, Bull Moose Tube boast more than a half-century of steadfast commitment to serving customers requiring steel pipe and tube. Our products demonstrate our enduring commitment to quality, innovation and service.

One key contributor to our quality is our unique manufacturing method. Bull Moose Tube utilizes the direct form process to produce Hollow Structural Shapes (HSS), eliminating a parent round tube prior to forming a square or rectangle profile. This approach enables us to start with only the highest grade steel, reduce residual stresses, form sharper corners, craft the straightest tube, and make the most consistent welds. This EPD represents steel tubes produced by Bull Moose Tube Company at the following manufacturing sites: Burlington, ON; Casa Grande, AZ; Chicago Heights; IL; Elkhart, IN; Gerald, MO; Masury, OH; Trenton, GA; and their newest facility in Sinton, TX.

2. Products

2.1 PRODUCT DESCRIPTION

Steel Tubes covered under this declaration represent hollow structural sections, mechanical tube, and sprinkler pipe. These products can have circular, square, or rectangular cross sections, and are widely used in building, bridge and industrial projects. Bull Moose Tube produces tube in the range of 0.50” to 12”, with wall thickness of 0.0359” to 0.625”. Bull Moose Tube produces Pipe from 1” NPS to 4” NPS. The engineered wall thickness of Bull Moose pipe is Schedule 10 and Schedule 40.

Cradle-to-Gate TRACI 2.1 100 GWP for HSS

Table 1 below provides the TRACI 2.1 100-year GWP for one metric ton of steel pipe or tube manufacture (A1-A3), prior to downstream transport or tube or pipe fabrication.

Table 1. *100-year Global Warming Potential, based on TRACI 2.1, for one metric ton of steel produced (A1-A3)*

Cradle-to-Gate Hollow Structural Section (Unfabricated)		
Mill location	**Value**	**Unit**
Burlington	1.75	metric ton CO2e per 1 metric ton HSS
Casa Grande	1.91	metric ton CO2e per 1 metric ton HSS
Chicago Heights	1.68	metric ton CO2e per 1 metric ton HSS
Gerald	1.82	metric ton CO2e per 1 metric ton HSS
Elkhart	1.69	metric ton CO2e per 1 metric ton HSS
Masury	1.72	metric ton CO2e per 1 metric ton HSS
Sinton*	1.12	metric ton CO2e per 1 metric ton HSS
Trenton	1.75	metric ton CO2e per 1 metric ton HSS

*note Sinton only receives EAF steel

2.2 PRODUCT FLOW DIAGRAM

A flow diagram illustrating the production processes and life cycle phases included in the scope of the EPD is provided below.

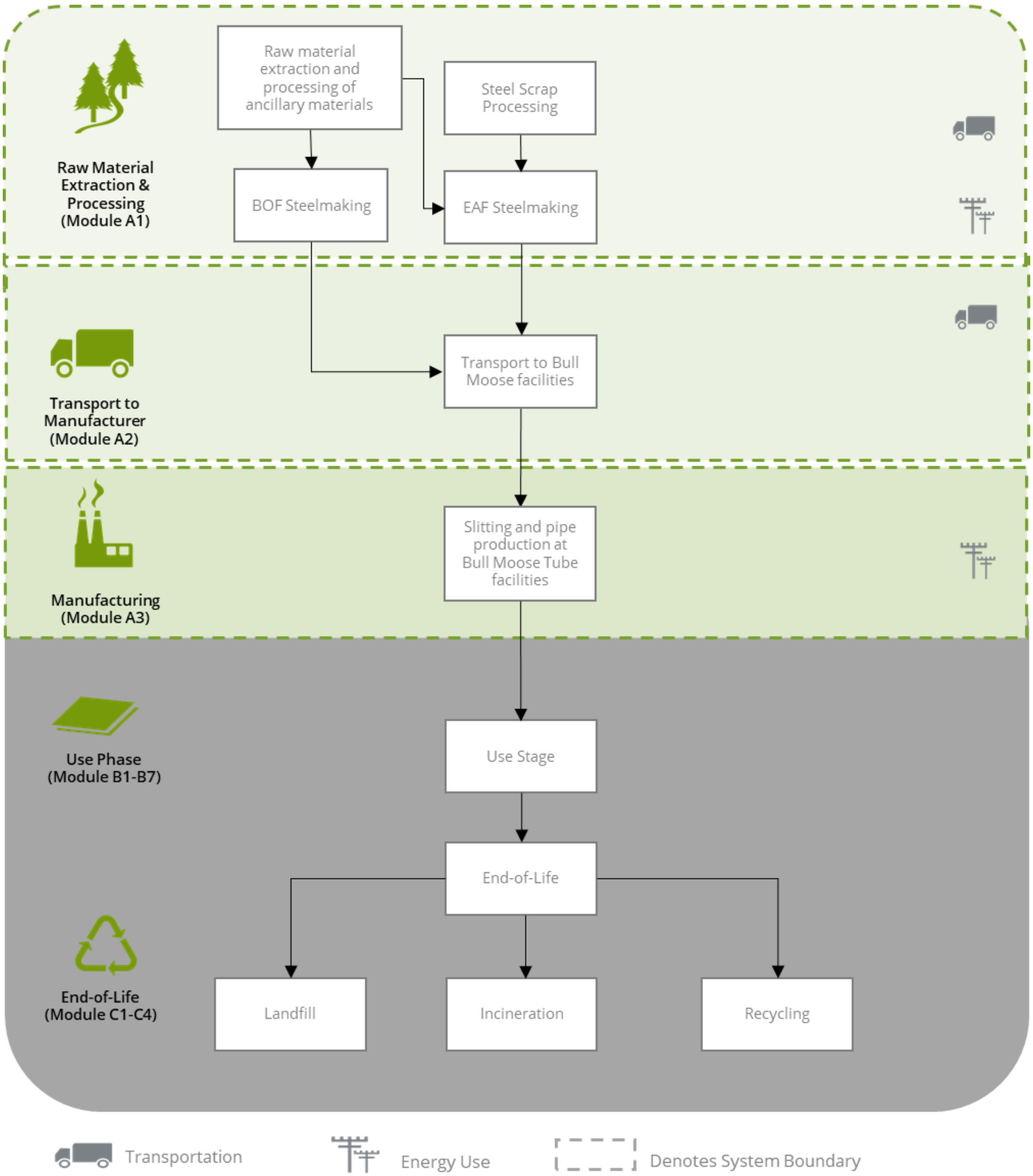


Figure 1. *Flow Diagram for the life cycle of the Bull Moose Tube steel pipe and tube.*

2.4 DECLARATION OF METHODOLOGICAL FRAMEWORK

The scope of the EPD is cradle-to-gate, including raw material extraction and processing, transportation, steel manufacture and rolling. The life cycle phases included in the product system boundary are shown below.

Table 2. *Life cycle phases included in the Bull Moose Tube steel pipe and tube product system boundary.*

Product			Construction Process		Use							End-of-life				Benefits and loads beyond the system boundary
A1	A2	A3	A4	A5	B1	B1	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Raw material extraction and processing	Transport to manufacturer	Manufacturing	Transport	Construction - installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction demolition	Transport	Waste processing	Disposal	Reuse, recovery and/or recycling potential
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

X = Module Included | MND = Module Not Declared

Cut-off and allocation procedures are described below and conform to the PCR and ISO standards.

2.5 TECHNICAL DATA

Steel Tubes produced by Bull Moose are defined by the following ASTM Standards:

ASTM A135 Standard Specification for Electric-Resistance-Welded Steel Pipe.

ASTM A252 Standard Specification for Welded and Seamless Steel Pipe Piles

ASTM A500 Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Tubing in Rounds and Shapes.

ASTM A513 Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing.

ASTM A787 Standard Specification for Electric-Resistance-Welded Metallic-Coated Carbon Steel Mechanical Tubing.

ASTM A795 Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.

ASTM A847 Standard Specification for Cold-Formed Welded and Seamless High-Strength, Low-Alloy Structural Tubing with Improved Atmospheric Corrosion Resistance.

ASTM A1076 Standard Specification for Cold-Formed Structural Steel Tubing from Metallic Precoated Steel Sheets.

ASTM A1085 Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS).

ASTM A1110 Standard Specification fpr Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes with 52KSI minimum yield strength and impact requirements.

ASTM A1112 Standard Specification for Cold-Formed Welded High Strength Carbon Steel or High Strength Low-Alloy Hollow Structural Sections (HSS) in Rounds and Shapes.

The CSI codes that products are classified under depend on the final use of the product.

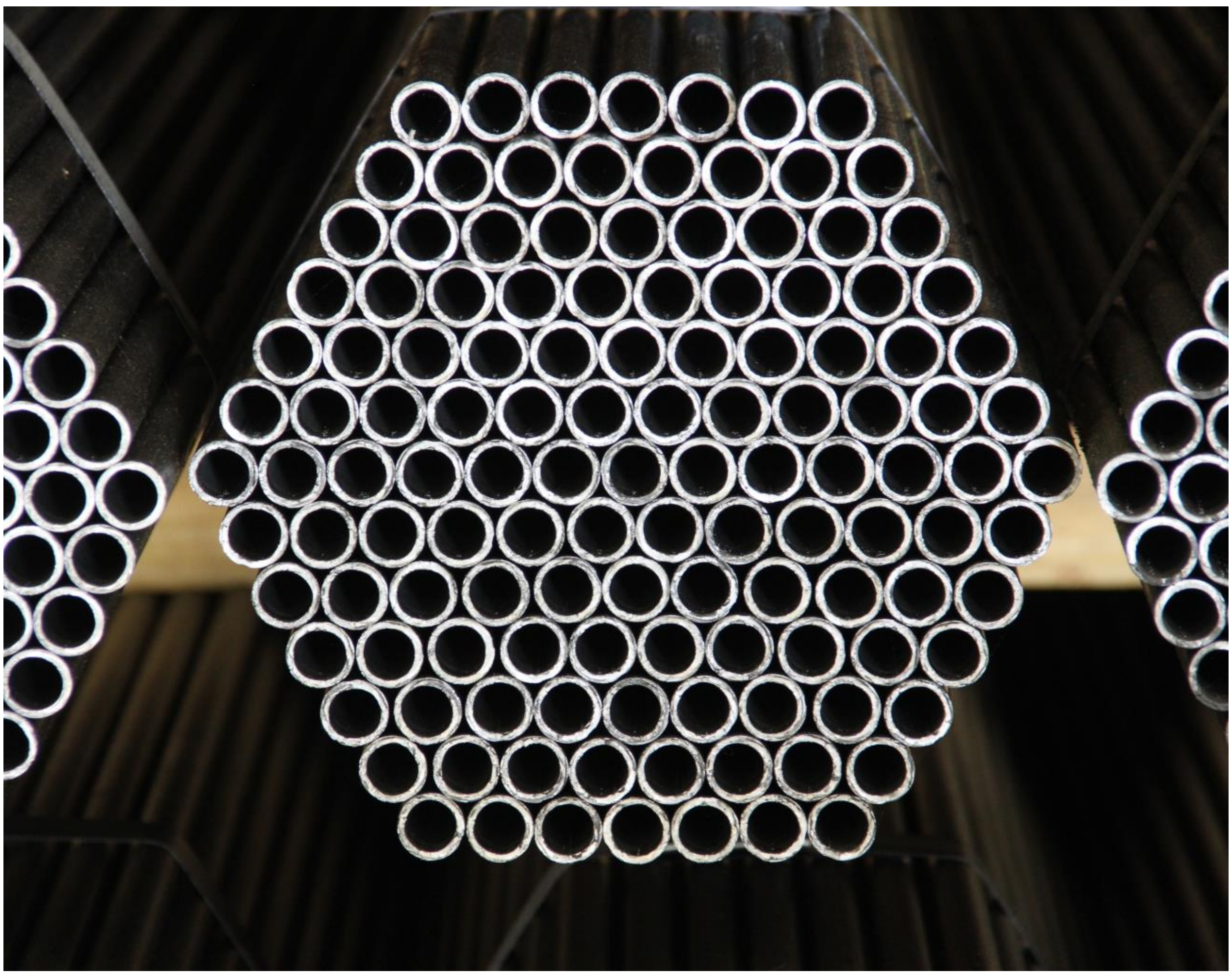
2.6 INTENDED APPLICATION

The intended application of the steel pipe and tube is for use in building, bridge and industrial projects and serve the primary function of conveying various substances.

2.7 MATERIAL COMPOSITION

The steel pipe and tube modeled in this study contain steel with an alloy content lower than 3%. In general, the reinforcing steel products will contain 97-99% iron, including ≤1.25% Manganese, ≤1.25% Carbon, <1% Silicon, <1% Aluminum, and other alloying elements, each less than 0.1% of the total.

Steel tube and pipe products under normal conditions do not present inhalation, ingestion, or contact health hazards. These products are used inside the building envelope, or other structures, and do not include materials or substances which have potential route of exposure to humans or flora/fauna in the environment.



2.8 PROPERTIES OF DECLARED PRODUCT AS DELIVERED

The steel pipe and tube is delivered as steel tube or pipe, in sizes meeting customer specifications. Bull Moose Tube produces tube in the dimensional range of 0.50" to 12", with wall thickness of 0.0359" to 0.625". Bull Moose Tube produces pipe from 1" NPS to 4" NPS. The wall thickness of Bull Moose pipe is Schedule 10 and Schedule 40, and special engineered design wall thicknesses.

2.9 MANUFACTURING

The steel pipe and tube in this study is manufactured at various sites including Burlington, ON; Casa Grande, AZ; Chicago Heights; IL, Elkhart; IN, Gerald, MO; Masury, OH; Sinton, TX; and Trenton, GA.

2.10 PACKAGING

Packaging consists of metal banding, lumber and wood for dunnage, plastic film and plastic tarps, depending upon the mill.

2.11 FURTHER INFORMATION

Further information on the product can be found on the manufacturers' website at www.bullmoosetube.com.

3. LCA: Calculation Rules

3.1 DECLARED UNIT

The declared unit used in the study is defined as one (1) metric ton of bar, consistent with the PCR.

Table 3. *The modules and unit processes included in the scope for the Bull Moose Tube steel pipe and tube.*

Module	Module Description	Unit Processes Included in Scope
A1	Extraction and processing of raw materials; any reuse of products or materials from previous product systems; processing of secondary materials; generation of electricity from primary energy resources; energy, or other, recovery processes from secondary fuels	Raw material extraction and processing, including all activities necessary for the reprocessing steel scrap, including but not limited to the recovery or extraction and processing of feedstock materials. Steelmaking at North American EAF and BOF Steel mills.
A2	Transport (to the manufacturer)	Transportation from steel mills to Bull Moose facilities throughout North America
A3	Manufacturing, including ancillary material production	Manufacture of steel tube including slitting and tube/pipe mill
A4	Transport (to the building site)	Module Not Declared
A5	Construction-installation process	Module Not Declared
B1	Product use	Module Not Declared
B2	Product maintenance	Module Not Declared
B3	Product repair	Module Not Declared
B4	Product replacement	Module Not Declared
B5	Product refurbishment	Module Not Declared
B6	Operational energy use by technical building systems	Module Not Declared
B7	Operational water uses by technical building systems	Module Not Declared
C1	Deconstruction, demolition	Module Not Declared
C2	Transport (to waste processing)	Module Not Declared
C3	Waste processing for reuse, recovery and/or recycling	Module Not Declared
C4	Disposal	Module Not Declared
D	Reuse-recovery-recycling potential	Module Not Declared

3.4 UNITS

All data and results are presented using SI units.

3.5 ESTIMATES AND ASSUMPTIONS

- Representative inventory data were used to reflect the energy mix for electricity use. Supply mixes were modeled based on U.S. EPA eGRID subregions AZNM for Casa Grande, AZ, RFCW for Chicago Heights, IL, Elkhart, IN and Masury, OH, SRSO for Trenton, GA, SRMW for Gerald, MO, in which the Bull Moose Tube facilities are located.
- The production of steel was modeled with secondary data using representative rates of EAF/BOF steelmaking in North America. The datasets utilized for steel production are provided in Section 4.4
- The same process is performed for the Sinton, TX facility using the eGRID 2022 data and ERCT subregion. The HBI dataset is updated to reflect the use of natural gas as the primary fuel in direct reduction, as is common in the US. The ecoinvent dataset for steelmaking uses HBI in proportion with the supplier's stated usage.
- Representative inventory data for raw materials and ancillary materials were modeled with unit process data taken from Ecoinvent.
- Disposal of manufacturing waste is modeled based for solid and hazardous waste generation and disposal in the United States, as specified in the PCR. Specifically, 80% of non-hazardous wastes are disposed in landfill and 20% incinerated. Transportation for end-of-life scenarios was modeled using the EPA WARM model assumption of 20 miles (~32 km), from the point of product use to a landfill, material recovery center, or waste incinerator. Ecoinvent datasets are used to model the impacts associated with incineration and landfilling, which does not include energy recovery from landfill gas.

The PCR requires the results for several inventory flows related to construction products to be reported including energy and resource use and waste and outflows. These are aggregated inventory flows, and do not characterize any potential impact; results should be interpreted considering this limitation.

3.6 CUT-OFF RULES

According to the PCR, processes contributing greater than 1% of the total environmental impact indicator for each impact are included in the inventory. No data gaps were allowed which were expected to significantly affect the outcome of the indicator results. No known flows are deliberately excluded from this EPD.

3.7 DATA SOURCES

Primary data were provided by Bull Moose Tube for their manufacturing facility. The sources of secondary LCI data are the Ecoinvent database.

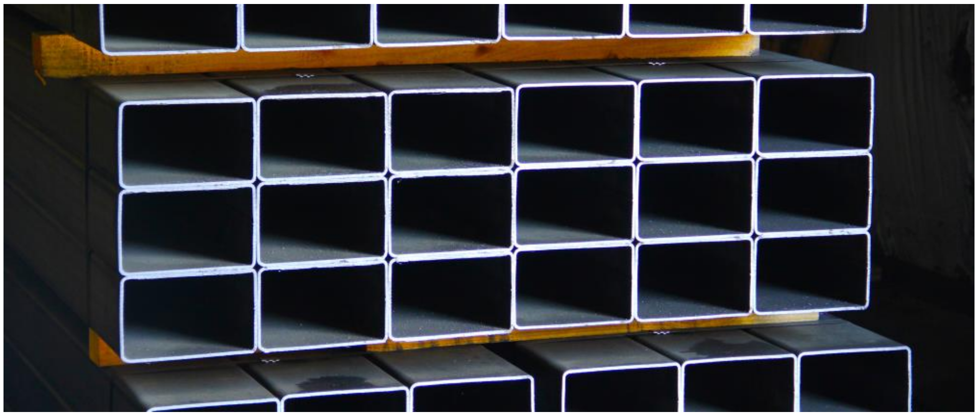


Table 4. *Data sources for the Bull Moose Tube steel pipe and tube.*

Flow	Dataset	Data Source	Publication Date
Raw Materials			
Hot rolled coil	steel production, converter, low-alloyed | steel, low-alloyed | Cutoff, U – RoW steel production, electric, low-alloyed | steel, low-alloyed | Cutoff, U - RoW* *modified sponge iron dataset to reflect production in the US in Sinton update hot rolling, steel | hot rolling, steel | Cutoff, U | BullMoose - RoW	Ecoinvent 3.7.1	2020
Cold rolling	LCI taken from "Life Cycle Inventories of North American Steel Products"	Sphera for AISI	2020
Pickling	LCI taken from "Life Cycle Inventories of North American Steel Products" market for hydrochloric acid, without water, in 30% solution state | hydrochloric acid, without water, in 30% solution state | Cutoff, U - RoW	Sphera for AISI Ecoinvent 3.7.1	2020 2020
Galvanization	LCI taken from "Life Cycle Inventories of North American Steel Products" market for zinc | zinc | Cutoff, U - GLO	Sphera for AISI Ecoinvent 3.7.1	2020 2020
Water	market for tap water | tap water | Cutoff, U - RoW	Ecoinvent 3.7.1	2020
Lubricant	lubricating oil production | lubricating oil | Cutoff, U - RoW	Ecoinvent 3.7.1	2020
Electricity/Heat			
Electricity	electricity voltage transformation from high to medium voltage | electricity, medium voltage | Cutoff, U - CA-ON electricity voltage transformation from high to medium voltage | electricity, medium voltage | Cutoff- US (Various) modified for egrid 2019 production mixes	Ecoinvent 3.7.1 Ecoinvent 3.7.1 eGRID 2019	2020 2020 2021
Propane	market for propane | propane | Cutoff, U - GLO	Ecoinvent 3.7.1	2020
Natural gas	market for heat, district or industrial, natural gas | heat, district or industrial, natural gas | Cutoff, U – RoW market group for natural gas, high pressure | natural gas, high pressure | Cutoff, U - CA	Ecoinvent 3.7.1	2020
Acetylene	acetylene production | acetylene | Cutoff, U - RoW	Ecoinvent 3.7.1	2020
Oxygen	Oxygen, liquid, at plant - RNA	US LCI	2012
Diesel	market for diesel | diesel | Cutoff, U - RoW	Ecoinvent 3.7.1	2020
Heavy fuel oil	market for heavy fuel oil | heavy fuel oil | Cutoff, U - RoW	Ecoinvent 3.7.1	2020
Light fuel oil	market for light fuel oil | light fuel oil | Cutoff, U - RoW	Ecoinvent 3.7.1	2020
Carbon dioxide	carbon dioxide production, liquid | carbon dioxide, liquid | Cutoff, U - RoW	Ecoinvent 3.7.1	2020
Transportation			
Road	market for transport, freight, lorry 16-32 metric ton, EURO4 | transport, freight, lorry 16-32 metric ton, EURO4 | Cutoff, U - RoW	Ecoinvent 3.7.1	2020
Packaging			
Wood packaging and dunnage	EUR-flat pallet production | EUR-flat pallet | Cutoff, U - RoW	Ecoinvent 3.7.1	2020
Metal banding	market for steel, low-alloyed | steel, low-alloyed | Cutoff, U - GLO	Ecoinvent 3.7.1	2020
Plastic film	packaging film production, low density polyethylene | packaging film, low density polyethylene | Cutoff, U - RoW	Ecoinvent 3.7.1	2020

3.8 DATA QUALITY

The data quality assessment addressed the following parameters: time-related coverage, geographical coverage, technological coverage, precision, completeness, representativeness, consistency, reproducibility, sources of data, and uncertainty.

Table 5. *Data quality assessment for the Bull Moose Tube steel pipe and tube product system.*

Data Quality Parameter	Data Quality Discussion
Time-Related Coverage: Age of data and the minimum length of time over which data is collected	The most recent available data are used, based on other considerations such as data quality and similarity to the actual operations. Typically, these data are less than 10 years old (typically 2015 or more recent). All of the data used represented an average of one year's worth of data collection. Manufacturer-supplied data (primary data) are based on annual production for 2020. Primary data for Sinton manufacturer consisted of three months of data from January – March of 2024, as this is a new facility and not able to provide a full year as yet. The ecoinvent 3.7.1 database was used for consistency with the previous model.
Geographical Coverage: Geographical area from which data for unit processes is collected to satisfy the goal of the study	The data used in the analysis provide the best possible representation available with current data. Actual processes for upstream operations are primarily North American. Surrogate data used in the assessment are representative of North American operations. Data representative of European operations are considered sufficiently similar to actual processes. Data representing product disposal are based on regional statistics.
Technology Coverage: Specific technology or technology mix	For the most part, data are representative of the actual technologies used for processing, transportation, and manufacturing operations.
Precision: Measure of the variability of the data values for each data expressed	Precision of results are not quantified due to a lack of data. Data collected for operations were typically averaged for one or more years and over multiple operations, which is expected to reduce the variability of results.
Completeness: Percentage of flow that is measured or estimated	The LCA model included all known mass and energy flows for production of pipe and tube. In some instances, surrogate data used to represent upstream and downstream operations may be missing some data which is propagated in the model. No known processes or activities contributing to more than 1% of the total environmental impact for each indicator are excluded.
Representativeness: Qualitative assessment of the degree to which the data set reflects the true population of interest	Data used in the assessment represent typical or average processes as currently reported from multiple data sources and are therefore generally representative of the range of actual processes and technologies for production of these materials. Considerable deviation may exist among actual processes on a site-specific basis; however, such a determination would require detailed data collection throughout the supply chain back to resource extraction.
Consistency: Qualitative assessment of whether the study methodology is applied uniformly to the various components of the analysis	The consistency of the assessment is considered to be high. Data sources of similar quality and age are used with a bias towards Ecoinvent v3.7.1 data where available. Different portions of the product life cycle are equally considered; however, it must be noted that final disposition of the product is based on assumptions of current average practices in Europe and the United States. Some updates to the model for inclusion of the Sinton facility have been noted, including the fuel source for HBI, eGRID and openLCA versions, which are inconsistent with previous model, but are required for improved accuracy.
Reproducibility: Qualitative assessment of the extent to which information about the methodology and data values would allow an independent practitioner to reproduce the results reported in the study	Based on the description of data and assumptions used, this assessment would be reproducible by other practitioners. All assumptions, models, and data sources are documented.
Sources of the Data: Description of all primary and secondary data sources	Data representing energy use at the Bull Moose Tube manufacturing facilities represent an annual average and are considered of high quality due to the length of time over which these data are collected, as compared to a snapshot that may not accurately reflect fluctuations in production. The Ecoinvent database is used for secondary LCI datasets.
Uncertainty of the Information: Uncertainty related to data, models, and assumptions	Uncertainty related to materials in the steel products is low. Actual supplier data for upstream operations was not available for all suppliers and the study relied upon the use of existing representative datasets. These datasets contained relatively recent data (<10 years) but lacked geographical representativeness. Uncertainty related to the impact assessment methods used in the study are high. The impact assessment method required by the PCR includes impact potentials, which lack characterization of providing and receiving environments or tipping points.

3.9 PERIOD UNDER REVIEW

The period of review is January 01, 2020 through December 31, 2020 for the five facilities Burlington, Ontario (Canada), Casa Grande, AZ, Chicago Heights, IL, Elkhart, IN, Gerald, MO, Masury, OH, and Trenton, GA. The facility in Sinton, TX was opened in 2022, and as such the period of review for this facility is January 1 through March 31 of 2024.

3.10 ALLOCATION

With respect to the steel scrap, the 100-0 recycled content approach is used in which the recycled material bears only the burden of any processing from waste material.

Mass allocation was deemed the most accurate and reproducible way of calculating the energy and material requirements for the manufacture of the steel and steel products. Primary data for resource use (e.g., electricity, natural gas, water), waste/co-products, and emissions released, are allocated on a mass-basis as a fraction of total annual production.

The transportation from primary producer of material components (e.g., steel coil) to the Bull Moose Tube facilities is based on primary data provided by Bull Moose Tube, including modes, distances, and amount of steel transported. Transportation was allocated on the basis of the mass and distance the material was transported.

3.11 COMPARABILITY

The PCR this EPD was based on was not written to support comparative assertions. EPDs based on different PCRs, or different calculation models, may not be comparable. When attempting to compare EPDs or life cycle impacts of products from different companies, the user should be aware of the uncertainty in the final results, due to and not limited to, the practitioner's assumptions, the source of the data used in the study, and the specifics of the product modeled.

4. LCA: Scenarios and Additional Technical Information

Manufacturing

The steel products included in this study are manufactured from hot rolled coil, produced using an average mix of EAF and BOF steelmaking in North America, and formed into pipe or tube at the Bull Moose Tube facilities. A small amount of tubes manufactured in the Burlington, Ontario mill is produced from either pickled and oiled steel or hot dip galvanized steel. The transport of materials from upstream steelmaking and other materials production to Bull Moose Tube mills is based on primary data of the transport distance and mode of transport.

At the Bull Moose Tube facilities, the master coil is received and then slit into smaller, slit coils for each tube mill located in the plant. The slit coils are loaded into the tube mills and are formed into tubes and welded using electric resistance welding (ERW) and cut to length on the tube mill. The tubes are then packaged (bundled) and placed into the warehouse for shipment to customers. Packaging consists of metal banding, lumber and wood for dunnage, plastic film and plastic tarps, depending upon the mill.

The Bull Moose Tube mills are located in Burlington, Ontario (Canada), Casa Grande, AZ, Chicago Heights, IL, Elkhart, IN, Gerald, MO, Masury, OH, Sinton, TX and Trenton, GA. The electricity supply mixes for each facility are modeled using ecoinvent electricity grids and modified for the appropriate eGRID 2019 subregions, with the exception of the Canadian mill and the Sinton, TX mill, which uses eGRID 2022. Electricity and resource use at the manufacturing facilities is allocated to the steel products based on product mass.

5. LCA: Results

Results of the Life Cycle Assessment are presented below. It is noted that LCA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.

The following environmental impact category indicators are reported using characterization factors based on the U.S. EPA's Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts – TRACI 2.1 and CML-IA.

CMLI-A Impact Category	Unit	TRACI 2.1 Impact Category	Unit
Global Warming Potential **(GWP)**	kg CO_2 eq	Global Warming Potential **(GWP)**	kg CO_2 eq
Depletion potential of the stratospheric ozone layer **(ODP)**	kg CFC 11 eq	Ozone Depletion Potential **(ODP)**	kg CFC 11 eq
Acidification Potential of soil and water **(AP)**	kg SO_2 eq	Acidification Potential **(AP)**	kg SO_2 eq
Eutrophication Potential **(EP)**	kg PO_4^{3-} eq	Eutrophication Potential **(EP)**	kg N eq
Photochemical Oxidant Creation Potential **(POCP)**	kg C_2H_4 eq	Smog Formation Potential **(SFP)**	kg O_3 eq
Abiotic depletion potential **(ADP-elements)** for non-fossil resources	kg Sb eq	Fossil Fuel Depletion Potential **(FFD)**	MJ Surplus, LHV
Abiotic depletion potential **(ADP-fossil fuels)** for fossil resources	MJ, LHV	-	-

These impact 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.

The following inventory parameters, specified by the PCR, are also reported.

Resources	Unit	Waste and Outflows	Unit
RPR_E: Renewable primary resources used as energy carrier (fuel)	MJ, LHV	**HWD:** Hazardous waste disposed	kg
RPR_M: Renewable primary resources with energy content used as material	MJ, LHV	**NHWD:** Non-hazardous waste disposed	kg
$NRPR_E$: Non-renewable primary resources used as an energy carrier (fuel)	MJ, LHV	**HLRW:** High-level radioactive waste, conditioned, to final repository	kg
$NRPR_M$: Non-renewable primary resources with energy content used as material	MJ, LHV	**ILLRW:** Intermediate- and low-level radioactive waste, conditioned, to final repository	kg
SM: Secondary materials	metric ton	**CRU:** Components for re-use	kg
RSF: Renewable secondary fuels	MJ, LHV	**MR:** Materials for recycling	kg
NRSF: Non-renewable secondary fuels	MJ, LHV	**MER:** Materials for energy recovery	kg
RE: Recovered energy	MJ, LHV	**EE:** Recovered energy exported from the product system	MJ, LHV
FW: Use of net freshwater resources	m^3	-	-

Table 6. *Life Cycle Impact Assessment (LCIA) results for Bull Moose Tube steel pipe and tube at Burlington, ON. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.*

Impact Category	Life cycle stage			
	A1	A2	A3	Total (A1-A3)
TRACI 2.1				
GWP (kg CO_2 eq)	1,650	5.61	95.2	1,750
	94.23%	0.3%	5.5%	100%
AP (kg SO_2 eq)	6.39	0.0254	0.258	6.67
	95.8%	0.4%	3.9%	100%
EP (kg N eq)	6.99	0.00624	0.426	7.42
	94%	0.1%	5.7%	100%
SFP (kg O_3 eq)	91.8	0.616	5.12	11.3
	100%	100%	100%	100%
ODP (kg CFC-11 eq)	1.71×10^{-4}	1.31×10^{-6}	7.00×10^{-6}	1.79×10^{-4}
	95%	0.73%	3.91%	100%
FFD (MJ Surplus)	1,700	11.9	82.1	1,800
	95%	0.66%	4.56%	100%
CML-IA				
GWP (kg CO_2 eq)	1,670	5.63	95.6	1,770
	94%	0.32%	5.41%	100%
AP (kg SO_2 eq)	6.16	0.0217	0.226	6.41
	96%	0%	4%	100%
EP (kg $(PO_4)^{3-}$ eq)	3.31	0.00512	0.181	3.50
	95%	0.15%	5.17%	100%
POCP (kg C_2H_4 eq)	0.629	7.24×10^{-4}	0.0109	0.641
	98%	0.11%	1.70%	100%
ODP (kg CFC-11 eq)	1.34×10^{-4}	9.81×10^{-7}	5.33×10^{-6}	1.40×10^{-4}
	95.5%	0.7%	3.8%	100%
ADPE (kg Sb eq)	3.67×10^{-4}	4.94×10^{-8}	2.72×10^{-6}	3.69×10^{-4}
	99%	0.01%	0.74%	100%
ADPF (MJ)	20,200	83.1	675	21,000
	96%	0.40%	3.22%	100%

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Table7. *Resource use and waste flows for Bull Moose Tube steel pipe and tube at Burlington, ON. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.*

Parameter	Life cycle stage			
	A1	A2	A3	Total (A1-A3)
Resources				
RPR_E (MJ)	1,320	0.937	366	1,680
	78%	0.1%	22%	100%
RPR_M (MJ)	0.00	0.00	89.0	89.0
	0%	0.0%	100%	100%
$NRPR_E$ (MJ)	18,600	79.1	1,110	19,800
	94%	0%	6%	100%
$NRPR_M$ (MJ)	0.00	0.00	0.69	0.691
	0%	0%	100%	100%
SM (MT)	0.764	0.00	0.00	0.764
	100%	0.00%	0.00%	100%
RSF/NRSF (MJ)	0.0	0.0	0.0	0.0
RE (MJ)	0.0	0.0	0.0	0.0
FW (m^3)	17.9	0.0284	7.20	25.2
	71.3%	0.113%	28.6%	100%
Wastes				
HWD (kg)	0.0932	2.21×10^{-4}	9.95×10^{-4}	0.0944
	99%	0.234%	1.05%	100%
NHWD (kg)	809	3.99	448	1,260
	64.2%	0.316%	35.5%	100%
HLRW (kg)	4.84×10^{-3}	4.41×10^{-6}	0.0129	0.0178
	27.2%	0.025%	72.7%	100%
ILLRW (kg)	0.0642	5.50×10^{-4}	6.44×10^{-3}	0.0712
	90.2%	0.77%	9.05%	100%
CRU (kg)	0.00	0.00	0.00	0.00
MR (kg)	0.0	0.0	24.2	24.2
	0%	0%	100%	100%
MER (kg)	0	0	0	0
EE (MJ)	Neg.	Neg.	Neg.	Neg.

Neg = negligible

Table 8. *Life Cycle Impact Assessment (LCIA) results for Bull Moose Tube steel pipe and tube at Casa Grande, AZ. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.*

Impact Category	Life cycle stage			
	A1	A2	A3	Total (A1-A3)
TRACI 2.1				
GWP (kg CO_2 eq)	1,750	112	50.0	1,910
	91.5%	5.9%	2.619%	100%
AP (kg SO_2 eq)	6.50	1.11	0.0991	7.70
	84.4%	14.4%	1.286%	100%
EP (kg N eq)	7.59	0.195	0.334	8.12
	93%	2.4%	4.112%	100%
SFP (kg O_3 eq)	95.4	32.9	1.51	130
	73.5%	25.3%	1.160%	100%
ODP (kg CFC-11 eq)	1.10×10^{-4}	2.12×10^{-5}	4.00×10^{-6}	1.35×10^{-4}
	81%	15.71%	2.96%	100%
FFD (MJ Surplus)	1,170	194	60.5	1,420
	82%	13.61%	4.25%	100%
CML-IA				
GWP (kg CO_2 eq)	1,770	112	50.5	1,930
	92%	5.81%	2.61%	100%
AP (kg SO_2 eq)	6.22	0.869	0.0932	7.18
	87%	12%	1%	100%
EP (kg $(PO_4)^{3-}$ eq)	3.59	0.226	0.147	3.97
	91%	5.69%	3.71%	100%
POCP (kg C_2H_4 eq)	0.667	0.0239	5.59×10^{-3}	0.696
	96%	3.43%	0.80%	100%
ODP (kg CFC-11 eq)	8.84×10^{-5}	1.59×10^{-5}	3.01×10^{-6}	1.07×10^{-4}
	82.4%	14.8%	2.8%	100%
ADPE (kg Sb eq)	4.06×10^{-4}	2.05×10^{-6}	8.29×10^{-7}	4.09×10^{-4}
	99%	0.50%	0.20%	100%
ADPF (MJ)	17,600	1,440	609	19,700
	90%	7.30%	3.10%	100%

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Table 9. *Resource use and waste flows for Bull Moose Tube steel pipe and tube at Casa Grande, AZ. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.*
Neg = negligible

Parameter	Life cycle stage			
	A1	A2	A3	Total (A1-A3)
Resources				
RPR_E (MJ)	1,450	36.6	57.5	1,540
	94%	2.4%	4%	100%
RPR_M (MJ)	0.00	0.00	1,340	1,340
	0.0%	0.0%	100%	100%
$NRPR_E$ (MJ)	16,200	1,380	634	18,200
	89%	8%	3%	100%
$NRPR_M$ (MJ)	0.0	0.0	0.00	0.00
SM (MT)	0.850	0.000	0.000	0.850
	100%	0.00%	0.00%	100%
RSF/NRSF (MJ)	0	0	0	0
RE (MJ)	0	0	0	0
FW (m^3)	19.3	1.03	0.0692	20.4
	94.6%	5.06%	0.340%	100%
Wastes				
HWD (kg)	0.0926	3.87×10^{-3}	1.70×10^{-4}	0.0966
	96%	4.0%	0.18%	100%
NHWD (kg)	893	17.5	2.35	913
	98%	1.9%	0.26%	100%
HLRW (kg)	5.29×10^{-3}	1.64×10^{-4}	7.53×10^{-4}	6.21×10^{-3}
	85.2%	2.64%	12.1%	100%
ILLRW (kg)	0.0384	9.03×10^{-3}	3.39×10^{-3}	0.0508
	75.5%	17.8%	6.67%	100%
CRU (kg)	0	0	0	0
MR (kg)	0	0	140	140
	0%	0%	100%	100%
MER (kg)	0	0	0	0
EE (MJ)	Neg.	Neg.	Neg.	Neg.

Neg = negligible

The PCR require the calculation of carbon emissions and removals, all of which are negligible due to the fact that no biogenic carbon is included in the product and any packaging is negligible.

Table 10. *Life Cycle Impact Assessment (LCIA) results for Bull Moose Tube steel pipe and tube at Chicago Heights, IL. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.*

Impact Category	Life cycle stage			
	A1	A2	A3	Total (A1-A3)
TRACI 2.1				
GWP (kg CO_2 eq)	1,580	48.3	53.7	1,680
	93.94%	2.9%	3.2%	100%
AP (kg SO_2 eq)	5.88	0.219	0.174	6.27
	93.7%	3.5%	2.8%	100%
EP (kg N eq)	6.87	0.0538	0.196	7.12
	96%	0.76%	2.76%	100%
SFP (kg O_3 eq)	86.3	5.31	1.78	93.4
	92.4%	5.68%	1.91%	100%
ODP (kg CFC-11 eq)	9.87×10^{-5}	1.13×10^{-5}	3.57×10^{-6}	1.14×10^{-4}
	87%	9.92%	3.14%	100%
FFD (MJ surplus)	1,050	102	51.7	1,210
	87%	8.47%	4.28%	100%
CML-IA				
GWP (kg CO_2 eq)	1,600	48.5	54.2	1,710
	94%	2.84%	3.18%	100%
AP (kg SO_2 eq)	5.62	0.187	0.174	5.98
	94%	3.12%	2.90%	100%
EP (kg $(PO_4)^{3-}$ eq)	3.25	0.0441	0.0910	3.39
	96%	1.30%	2.69%	100%
POCP (kg C_2H_4 eq)	0.603	6.23×10^{-3}	8.25×10^{-3}	0.618
	98%	1.01%	1.34%	100%
ODP (kg CFC-11 eq)	7.96×10^{-5}	8.45×10^{-6}	2.44×10^{-6}	9.05×10^{-5}
	88.0%	9.3%	2.7%	100%
ADPE (kg Sb eq)	3.68×10^{-4}	4.25×10^{-7}	3.08×10^{-7}	3.68×10^{-4}
	100%	0.12%	0.08%	100%
ADPF (MJ)	15,900	716	591	17,200
	92%	4.16%	3.43%	100%

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Table 11. *Resource use and waste flows for Bull Moose Tube steel pipe and tube at Chicago Heights, IL. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.*

Parameter	Life cycle stage			
	A1	A2	A3	Total (A1-A3)
Resources				
RPR_E (MJ)	1,310	8.08	120	1,440
	91%	0.6%	8%	100%
RPR_M (MJ)	0.00	0.00	6.77	6.77
	0%	0.0%	100%	100%
$NRPR_E$ (MJ)	14,600	681	406	15,700
	93%	4%	3%	100%
$NRPR_M$ (MJ)	0.0	0.0	0.00	0.00
SM (MT)	0.776	0.000	0.000	0.776
	100%	0.00%	0.00%	100%
RSF/NRSF (MJ)	0.0	0.0	0.0	0.0
RE (MJ)	0.0	0.0	0.0	0.0
FW (m^3)	17.4	0.245	0.361	18.0
	96.6%	1.36%	2.00%	100%
Wastes				
HWD (kg)	0.0837	0.00190	3.32×10^{-4}	0.0859
	97%	2.216%	0.39%	100%
NHWD (kg)	808	34.4	5.31	848
	95.3%	4.052%	0.6%	100%
HLRW (kg)	4.79×10^{-3}	3.80×10^{-5}	3.56×10^{-5}	4.86×10^{-3}
	98.5%	0.781%	0.73%	100%
ILLRW (kg)	0.0345	4.74×10^{-3}	4.98×10^{-4}	0.0397
	86.8%	11.9%	1.25%	100%
CRU (kg)	0.0	0.0	0.0	0.0
MR (kg)	0.0	0.0	496	496
	0%	0%	100%	100%
MER (kg)	0.0	0.0	0.0	0.0
EE (MJ)	Neg.	Neg.	Neg.	Neg.

Neg = negligible

The PCR require the calculation of carbon emissions and removals, all of which are negligible due to the fact that no biogenic carbon is included in the product and any packaging is negligible.

Table 12. *Life Cycle Impact Assessment (LCIA) results for Bull Moose Tube steel pipe and tube at Elkhart, IN. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.*

Impact Category	Life cycle stage			
	A1	A2	A3	Total (A1-A3)
TRACI 2.1				
GWP (kg CO_2 eq)	1,640	18.5	31.3	1,690
	97.05%	1.1%	1.9%	100%
AP (kg SO_2 eq)	6.09	0.0839	0.101	6.28
	97.1%	1.3%	1.6%	100%
EP (kg N eq)	7.12	0.0206	0.118	7.26
	98%	0.28%	1.62%	100%
SFP (kg O_3 eq)	89.5	2.03	0.986	92.6
	97%	2.19%	1.07%	100%
ODP (kg CFC-11 eq)	1.03×10^{-4}	4.31×10^{-6}	1.94×10^{-6}	1.09×10^{-4}
	94%	3.96%	1.78%	100%
FFD (MJ surplus)	1,090	39.1	27.5	1,160
	94%	3.37%	2.37%	100%
CML-IA				
GWP (kg CO_2 eq)	1,660	18.5	31.6	1,710
	97%	1.08%	1.85%	100%
AP (kg SO_2 eq)	5.83	0.0715	0.101	6.01
	97%	1.19%	1.69%	100%
EP (kg $(PO_4)^{3-}$ eq)	3.37	0.0169	0.0542	3.44
	98%	0.49%	1.57%	100%
POCP (kg C_2H_4 eq)	0.626	2.38×10^{-3}	4.72×10^{-3}	0.633
	99%	0.38%	0.75%	100%
ODP (kg CFC-11 eq)	8.27×10^{-5}	3.23×10^{-6}	1.31×10^{-6}	8.72×10^{-5}
	94.8%	3.7%	1.5%	100%
ADPE (kg Sb eq)	3.81×10^{-4}	1.63×10^{-7}	1.29×10^{-7}	3.82×10^{-4}
	100%	0.04%	0.03%	100%
ADPF (MJ)	16,500	274	333	17,100
	96%	1.60%	1.95%	100%

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Table 13. *Resource use and waste flows for Bull Moose Tube steel pipe and tube at Elkhart, IN. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.*

Parameter	Life cycle stage			
	A1	A2	A3	Total (A1-A3)
Resources				
RPR_E (MJ)	1,360	3.09	61.2	1,420
	95%	0.2%	4%	100%
RPR_M (MJ)	0.00	0.00	48.1	48.1
	0%	0.0%	100%	100%
$NRPR_E$ (MJ)	15,200	261	235	15,700
	97%	2%	1%	100%
$NRPR_M$ (MJ)	0.0	0.0	1.94	1.94
	0%	0%	100%	100%
SM (MT)	0.798	0.000	0.000	0.798
	100%	0.00%	0.00%	100%
RSF/NRSF (MJ)	0	0	0	0
RE (MJ)	0	0	0	0
FW (m^3)	18.1	0.0937	0.164	18.3
	98.6%	0.51%	0.89%	100%
Wastes				
HWD (kg)	0.0868	7.29×10^{-4}	1.53×10^{-4}	0.0877
	99%	0.831%	0.17%	100%
NHWD (kg)	838	13.1	2.25	854
	98.2%	1.540%	0.263%	100%
HLRW (kg)	4.97×10^{-3}	1.45×10^{-5}	2.01×10^{-5}	5.00×10^{-3}
	99.3%	0.290%	0.403%	100%
ILLRW (kg)	0.0358	1.81×10^{-3}	2.49×10^{-4}	0.0379
	94.6%	4.78%	0.66%	100%
CRU (kg)	0.0	0.0	0.0	0.0
MR (kg)	0.0	0.0	168	168
	0%	0%	100%	100%
MER (kg)	0.0	0.0	0.0	0.0
EE (MJ)	Neg.	Neg.	Neg.	Neg.

Neg = negligible

Table 14. *Life Cycle Impact Assessment (LCIA) results for Bull Moose Tube steel pipe and tube at Gerald, MO. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.*

Impact Category	Life cycle stage			
	A1	A2	A3	Total (A1-A3)
TRACI 2.1				
GWP (kg CO_2 eq)	1,630	101	87.4	1,820
	89.6%	5.6%	4.8%	100%
AP (kg SO_2 eq)	6.06	0.455	0.235	6.75
	89.8%	6.7%	3.5%	100%
EP (kg N eq)	7.06	0.106	0.554	7.72
	91%	1.38%	7.17%	100%
SFP (kg O_3 eq)	89.0	11.3	2.09	102
	87%	11.02%	2.04%	100%
ODP (kg CFC-11 eq)	1.05×10^{-4}	2.47×10^{-5}	2.15×10^{-6}	1.32×10^{-4}
	80%	18.7%	1.63%	100%
FFD (MJ surplus)	1,120	224	23.3	1,360
	82%	16.40%	1.71%	100%
CML-IA				
GWP (kg CO_2 eq)	1,650	102	87.9	1,840
	90%	5.53%	4.78%	100%
AP (kg SO_2 eq)	5.81	0.388	0.235	6.43
	90%	6.03%	3.66%	100%
EP (kg $(PO_4)^{3-}$ eq)	3.34	0.0902	0.243	3.68
	91%	2.45%	6.61%	100%
POCP (kg C_2H_4 eq)	0.621	0.0129	9.46×10^{-3}	0.644
	97%	2.00%	1.47%	100%
ODP (kg CFC-11 eq)	8.46×10^{-5}	1.86×10^{-5}	1.06×10^{-6}	1.04×10^{-4}
	81.2%	17.8%	1.0%	100%
ADPE (kg Sb eq)	3.78×10^{-4}	9.26×10^{-7}	2.17×10^{-7}	3.79×10^{-4}
	100%	0.24%	0.06%	100%
ADPF (MJ)	16,600	1,530	744	18,900
	88%	8.10%	3.94%	100%

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Table 15. *Resource use and waste flows for Bull Moose Tube steel pipe and tube at Gerald, MO. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.*

Parameter	Life cycle stage			
	A1	A2	A3	Total (A1-A3)
Resources				
RPR_E (MJ)	1,340	20.6	74.9	1,440
	93%	1.4%	5.2%	100%
RPR_M (MJ)	0.00	0.00	256	256
	0%	0.0%	100%	100%
$NRPR_E$ (MJ)	15,300	1,470	695	17,400
	88%	8%	4%	100%
$NRPR_M$ (MJ)	0.0	0.0	0.00	0.00
SM (MT)	0.791	0.000	0.000	0.791
	100%	0.00%	0.00%	100%
RSF/NRSF (MJ)	0	0	0	0
RE (MJ)	0	0	0	0
FW (m^3)	17.9	0.965	0.0446	18.9
	94.7%	5.10%	0.235%	100%
Wastes				
HWD (kg)	0.0864	4.07×10^{-3}	8.62×10^{-5}	0.0906
	95%	4.492%	0.10%	100%
NHWD (kg)	831	74.8	2.90	909
	91.4%	8.233%	0.3%	100%
HLRW (kg)	4.92×10^{-3}	1.18×10^{-4}	2.16×10^{-5}	5.06×10^{-3}
	97.2%	2.339%	0.4%	100%
ILLRW (kg)	0.0370	0.0106	1.99×10^{-4}	0.0478
	77.4%	22.14%	0.42%	100%
CRU (kg)	0	0	0	0
MR (kg)	0	0	2.53	2.53
	0%	0%	100%	100%
MER (kg)	0	0	0	0
EE (MJ)	Neg.	Neg.	Neg.	Neg.

Neg = negligible

The PCR require the calculation of carbon emissions and removals, all of which are negligible due to the fact that no biogenic carbon is included in the product and any packaging is negligible.

Table 16. *Life Cycle Impact Assessment (LCIA) results for Bull Moose Tube steel pipe and tube at Masury, OH. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.*

Impact Category	Life cycle stage			
	A1	A2	A3	Total (A1-A3)
TRACI 2.1				
GWP (kg CO_2 eq)	1,630	9.85	81.8	1,720
	94.68%	0.6%	4.8%	100%
AP (kg SO_2 eq)	6.06	0.0442	0.385	6.49
	93.4%	0.7%	5.9%	100%
EP (kg N eq)	7.08	0.0103	1.31	8.40
	84%	0.12%	15.6%	100%
SFP (kg O_3 eq)	89.0	1.10	4.3	94.4
	94%	1.16%	5%	100%
ODP (kg CFC-11 eq)	$1.02x10^{-4}$	$2.40x10^{-6}$	$5.42x10^{-6}$	$1.10x10^{-4}$
	93%	2.19%	4.94%	100%
FFD (MJ Surplus)	1,090	21.7	71.4	1,180
	92%	1.84%	6.05%	100%
CML-IA				
GWP (kg CO_2 eq)	1,650	9.87	82.6	1,740
	95%	0.57%	4.74%	100%
AP (kg SO_2 eq)	5.80	0.0376	0.367	6.20
	93%	0.61%	5.92%	100%
EP (kg $(PO_4)^{3-}$ eq)	3.35	$8.76x10^{-3}$	0.573	3.93
	85%	0.22%	14.55%	100%
POCP (kg C_2H_4 eq)	0.622	$1.25x10^{-3}$	0.0192	0.642
	97%	0.19%	3.00%	100%
ODP (kg CFC-11 eq)	$8.21x10^{-5}$	$1.80x10^{-6}$	$3.97x10^{-6}$	$8.79x10^{-5}$
	93.4%	2.1%	4.5%	100%
ADPE (kg Sb eq)	$3.79x10^{-4}$	$8.99x10^{-8}$	$5.14x10^{-6}$	$3.84x10^{-4}$
	99%	0.02%	1.34%	100%
ADPF (MJ)	16,400	148	872	17,500
	94%	0.85%	5.00%	100%

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Table 17. *Resource use and waste flows for Bull Moose Tube steel pipe and tube at Masury, OH. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.*

Parameter	Life cycle stage			
	A1	A2	A3	Total (A1-A3)
Resources				
RPR_E (MJ)	1,350	2.00	292	1,640
	82%	0.1%	18%	100%
RPR_M (MJ)	0.00	0.00	59.6	59.6
	0%	0.0%	100%	100%
$NRPR_E$ (MJ)	15,100	142	693	15,900
	95%	1%	4%	100%
$NRPR_M$ (MJ)	0.0	0.0	2.72	2.72
	0%	0%	100%	100%
SM (MT)	0.791	0.000	0.000	0.791
	100%	0.00%	0.00%	100%
RSF/NRSF (MJ)	0	0	0	0
RE (MJ)	0	0	0	0
FW (m^3)	18.0	0.0937	1.02	19.1
	94.2%	0.49%	5.35%	100%
Wastes				
HWD (kg)	0.0863	3.95×10^{-4}	5.27×10^{-3}	0.0920
	94%	0.430%	5.73%	100%
NHWD (kg)	834	7.26	91.8	933
	89.4%	0.779%	9.8%	100%
HLRW (kg)	4.94×10^{-3}	1.15×10^{-5}	1.78×10^{-4}	5.13×10^{-3}
	96.3%	0.224%	3.5%	100%
ILLRW (kg)	0.0356	1.03×10^{-3}	1.27×10^{-3}	0.0379
	93.9%	2.71%	3.36%	100%
CRU (kg)	0	0	0	0
MR (kg)	0	0	64.4	64.4
	0%	0%	100%	100%
MER (kg)	0	0	0	0
EE (MJ)	Neg.	Neg.	Neg.	Neg.

Neg = negligible

Table 18. *Life Cycle Impact Assessment (LCIA) results for Bull Moose Tube steel pipe and tube at Trenton, GA. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.*

Impact Category	Life cycle stage			
	A1	A2	A3	Total (A1-A3)
TRACI 2.1				
GWP (kg CO_2 eq)	1,630	72.5	48.0	1,750
	93.10%	4.2%	2.7%	100%
AP (kg SO_2 eq)	6.04	0.325	0.110	6.47
	93.3%	5.0%	1.7%	100%
EP (kg N eq)	7.06	0.0760	0.191	7.32
	96%	1.04%	2.61%	100%
SFP (kg O_3 eq)	88.7	8.07	1.20	98.0
	91%	8.23%	1%	100%
ODP (kg CFC-11 eq)	1.01×10^{-4}	1.77×10^{-5}	3.86×10^{-6}	1.23×10^{-4}
	82%	14.36%	3.14%	100%
FFD (MJ Surplus)	1,080	160	62.5	1,300
	83%	12.25%	4.79%	100%
CML-IA				
GWP (kg CO_2 eq)	1,650	72.7	48.5	1,770
	93%	4.11%	2.75%	100%
AP (kg SO_2 eq)	5.78	0.277	0.109	6.16
	94%	4.49%	1.78%	100%
EP (kg $(PO_4)^{3-}$ eq)	3.34	0.0645	0.0865	3.49
	96%	1.85%	2.48%	100%
POCP (kg C_2H_4 eq)	0.620	0.00922	0.00672	0.636
	97%	1.45%	1.06%	100%
ODP (kg CFC-11 eq)	8.18×10^{-5}	1.33×10^{-5}	2.82×10^{-6}	9.79×10^{-5}
	83.6%	13.6%	2.9%	100%
ADPE (kg Sb eq)	3.78×10^{-4}	6.62×10^{-7}	1.07×10^{-7}	3.79×10^{-4}
	100%	0.17%	0.03%	100%
ADPF (MJ)	16,400	1,090	582	18,000
	91%	6.05%	3.22%	100%

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Table 19. *Resource use and waste flows for Bull Moose Tube steel pipe and tube at Trenton, GA. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.*

Parameter	Life cycle stage			
	A1	A2	A3	Total (A1-A3)
Resources				
RPR_E (MJ)	1,340	14.8	123	1,481
	91%	1.0%	8.3%	100%
RPR_M (MJ)	0.00	0.00	36.9	36.9
	0%	0.0%	100%	100%
$NRPR_E$ (MJ)	15,100	1,050	307	16,400
	92%	6%	2%	100%
$NRPR_M$ (MJ)	0.0	0.0	0.0	0.0
SM (MT)	0.791	0	0	0.791
	100%	0.00%	0.00%	100%
RSF/NRSF (MJ)	0	0	0	0
RE (MJ)	0	0	0	0
FW (m^3)	17.9	0.690	0.0801	18.7
	95.9%	3.70%	0.4294%	100%
Wastes				
HWD (kg)	0.0860	2.91×10^{-3}	8.75×10^{-5}	0.0890
	97%	3.268%	0.10%	100%
NHWD (kg)	831	53.5	1.44	885
	93.8%	6.04%	0.2%	100%
HLRW (kg)	4.92×10^{-3}	8.47×10^{-5}	1.03×10^{-5}	0.00501
	98.1%	1.69%	0.16%	100%
ILLRW (kg)	0.0355	7.56×10^{-3}	1.17×10^{-4}	0.0432
	82.2%	17.52%	0.27%	100%
CRU (kg)	0	0	0	0
MR (kg)	0	0	9.39	9.39
	0%	0%	100%	100%
MER (kg)	0	0	0	0
EE (MJ)	Neg.	Neg.	Neg.	Neg.

Neg = negligible

The PCR require the calculation of carbon emissions and removals, all of which are negligible due to the fact that no biogenic carbon is included in the product and any packaging is negligible.

Table 20. *Life Cycle Impact Assessment (LCIA) results for Bull Moose Tube steel pipe and tube at Sinton, TX. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.*

Impact Category	Life cycle stage			
	A1	A2	A3	Total (A1-A3)
TRACI 2.1				
GWP (kg CO_2 eq)	1,070	3.23	51.2	1,120
	95.1%	0.29%	4.56%	100%
AP (kg SO_2 eq)	4.25	0.0216	0.117	4.38
	96.84%	0.49%	2.67%	100%
EP (kg N eq)	4.50	8.66×10^{-3}	0.396	4.91
	92%	0.18%	8.06%	100%
SFP (kg O_3 eq)	61.1	0.506	1.11	62.7
	97.42%	0.81%	1.77%	100%
ODP (kg CFC-11 eq)	1.21×10^{-4}	4.49×10^{-7}	4.24×10^{-6}	1.26×10^{-4}
	96.27%	0.36%	3.37%	100%
FFD (MJ surplus)	1,290	4.38	70.5	1,370
	95%	0.32%	5.16%	100%
CML-IA				
GWP (kg CO_2 eq)	1,080	3.26	51.7	1,135
	95%	0.29%	4.55%	100%
AP (kg SO_2 eq)	4.10	1.85×10^{-2}	0.123	4.24
	97%	0.44%	2.90%	100%
EP (kg $(PO_4)^{3-}$ eq)	2.13	5.77×10^{-3}	0.171	2.31
	92%	0.25%	7.43%	100%
POCP (kg C_2H_4 eq)	0.335	1.04×10^{-3}	0.00769	0.343
	97%	0.30%	2.24%	100%
ODP (kg CFC-11 eq)	9.59×10^{-5}	3.38×10^{-7}	3.31×10^{-6}	9.96×10^{-5}
	96%	0.34%	3.32%	100%
ADPE (kg Sb eq)	2.74×10^{-4}	1.25×10^{-7}	7.70×10^{-7}	2.75×10^{-4}
	100%	0.05%	0.28%	100%
ADPF (MJ)	12,400	38.8	618	13,000
	95%	0.30%	4.74%	100%

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Table 21. *Resource use and waste flows for Bull Moose Tube steel pipe and tube at Sinton, TX. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.*

Parameter	Life cycle stage			
	A1	A2	A3	Total (A1-A3)
Resources				
RPR_E (MJ)	965	4.36	134	1,100
	87%	0%	12%	100%
RPR_M (MJ)	0.0	0.0	0.0	0.0
	n/a	n/a	n/a	n/a
$NRPR_E$ (MJ)	9,490	36.4	474	10,000
	95%	0%	5%	100%
$NRPR_M$ (MJ)	0.00	0.00	0.00	0.00
SM (MT)	1,360	0.0	0.0	1,360
	100%	0%	0%	100%
RSF/NRSF (MJ)	0.0	0.0	0.0	0.0
RE (MJ)	0.0	0.0	0.0	0.0
FW (m^3)	13.2	0.0500	0.0889	13.3
	99%	0.4%	0.7%	100%
Wastes				
HWD (kg)	0.0405	1.60×10^{-4}	3.40×10^{-4}	0.0410
	99%	0.4%	0.8%	100%
NHWD (kg)	678	0.554	2.92	682
	99%	0.1%	0.4%	100%
HLRW (kg)	3.09×10^{-3}	5.643×10^{-6}	4.20×10^{-4}	3.52×10^{-3}
	88%	0.2%	11.9%	100%
ILLRW (kg)	0.0314	1.90×10^{-4}	1.97×10^{-3}	0.0335
	94%	0.6%	5.9%	100%
CRU (kg)	0.0	0.0	0.0	0.0
MR (kg)	0.0910	0.0	0.123	0.214
	42%	0.0%	57.6%	100%
MER (kg)	0.0	0.0	0.0	0.0
EE (MJ)	Neg.	Neg.	Neg.	Neg.

Neg = negligible

The PCR require the calculation of carbon emissions and removals, all of which are negligible due to the fact that no biogenic carbon is included in the product and any packaging is negligible.

6. LCA: Interpretation

The contributions to total impact indicator results are dominated by the steelmaking phase (A1), followed by either the tube mill (A3) or transportation of unfabricated tube to the pipe mill (A2), depending upon the indicator. For the Burlington, ON and the Masury, OH mills, the tube mill (A3) impacts are smaller than the transportation (A2) impacts across all indicators.

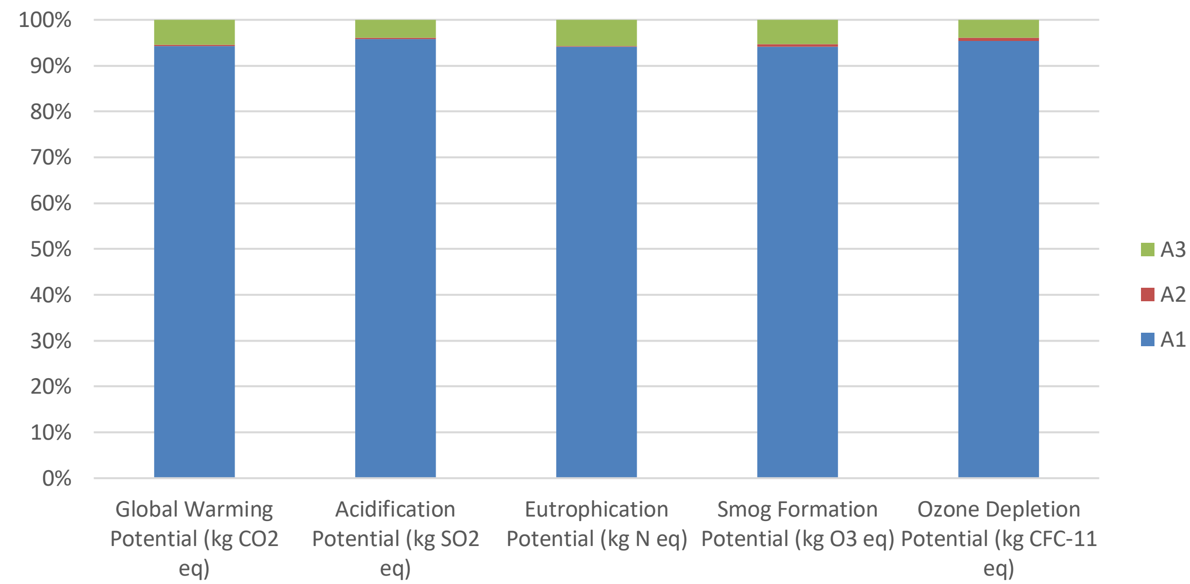

Figure 2. *Contribution analysis for the Bull Moose Tube steel pipe and tube at the Burlington, ON facility, using TRACI 2.1.*

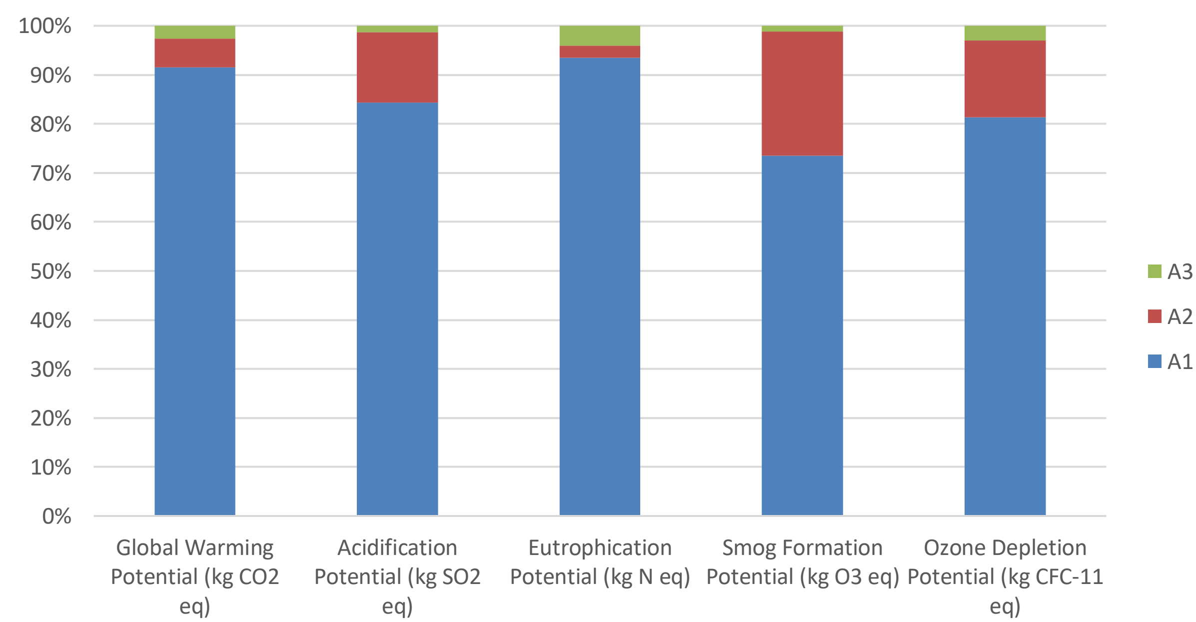

Figure 3. *Contribution analysis for the Bull Moose Tube steel pipe and tube at the Casa Grande, AZ facility, using TRACI 2.1.*

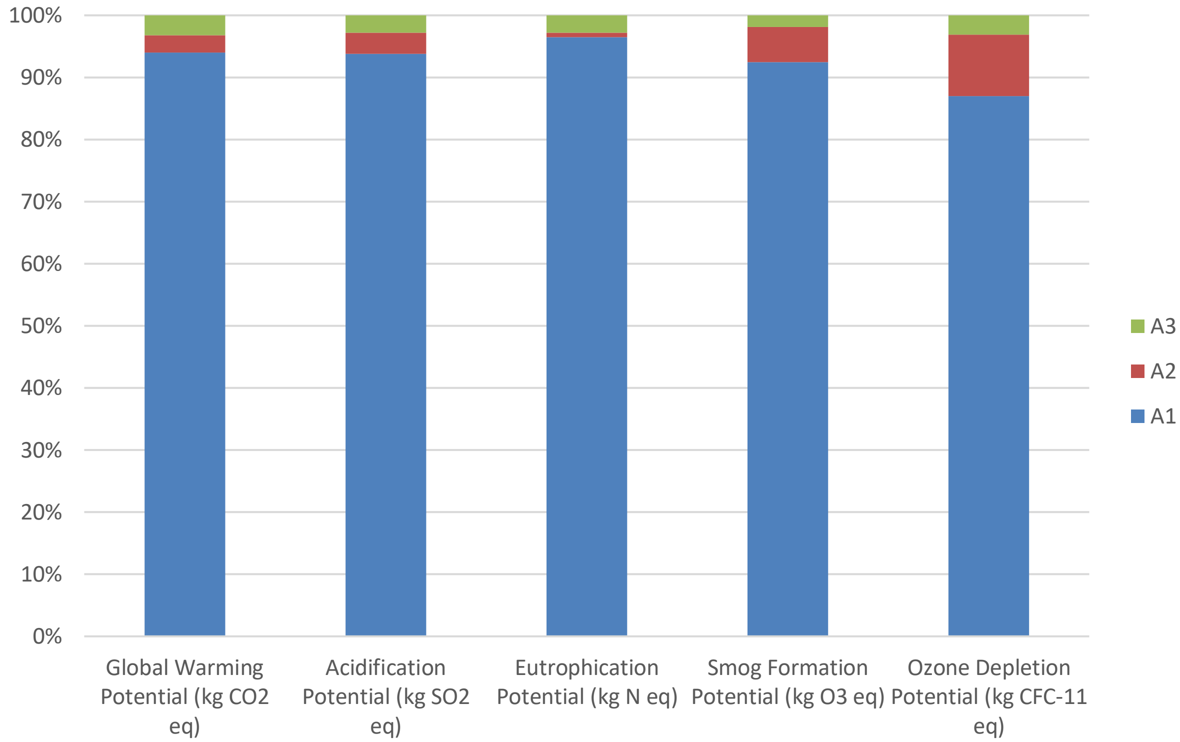

Figure 4. *Contribution analysis for Bull Moose tube produced at the Chicago Heights, IL facility, using TRACI 2.1*

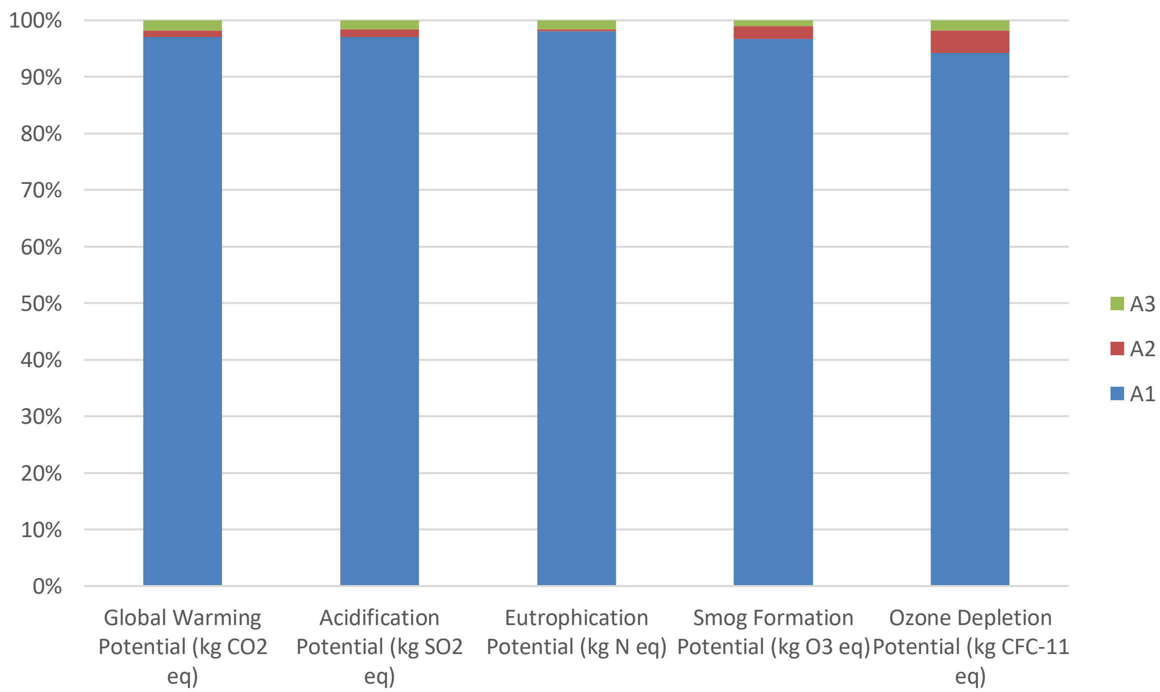

Figure 5. *Contribution analysis for Bull Moose tube produced at the Elkhart, IN facility, using TRACI 2.1.*

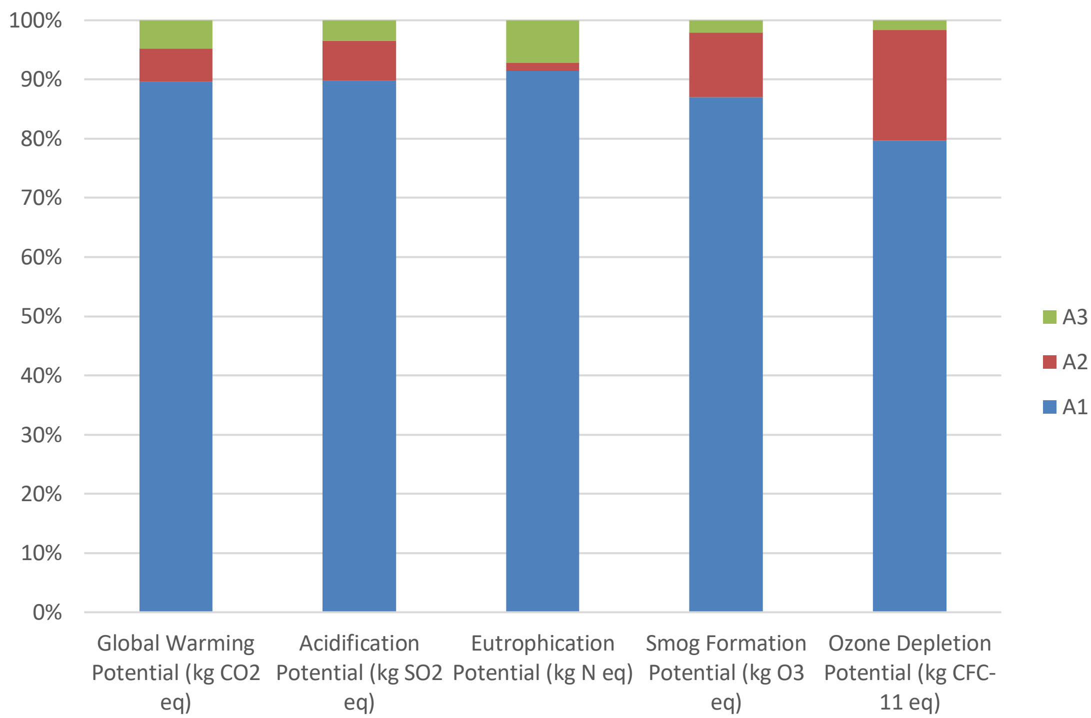

Figure 6. *Contribution analysis for Bull Moose tube produced at the Gerald, MO facility, using TRACI 2.1.*

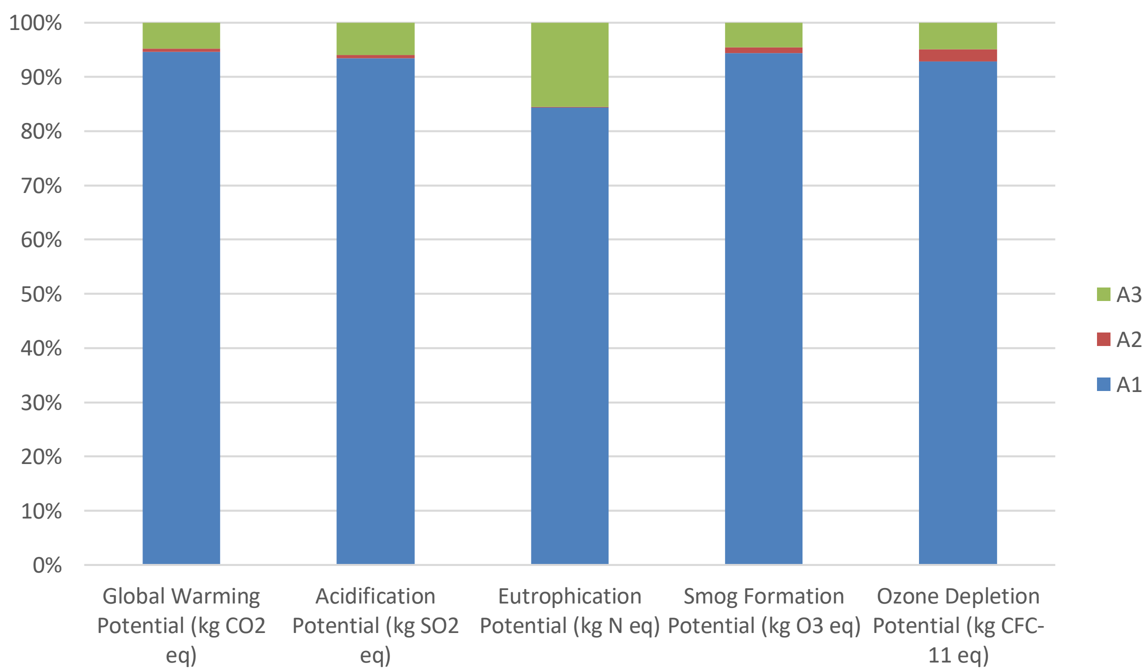

Figure 7. *Contribution analysis for Bull Moose tube produced at the Masury, OH facility, using TRACI 2.1.*

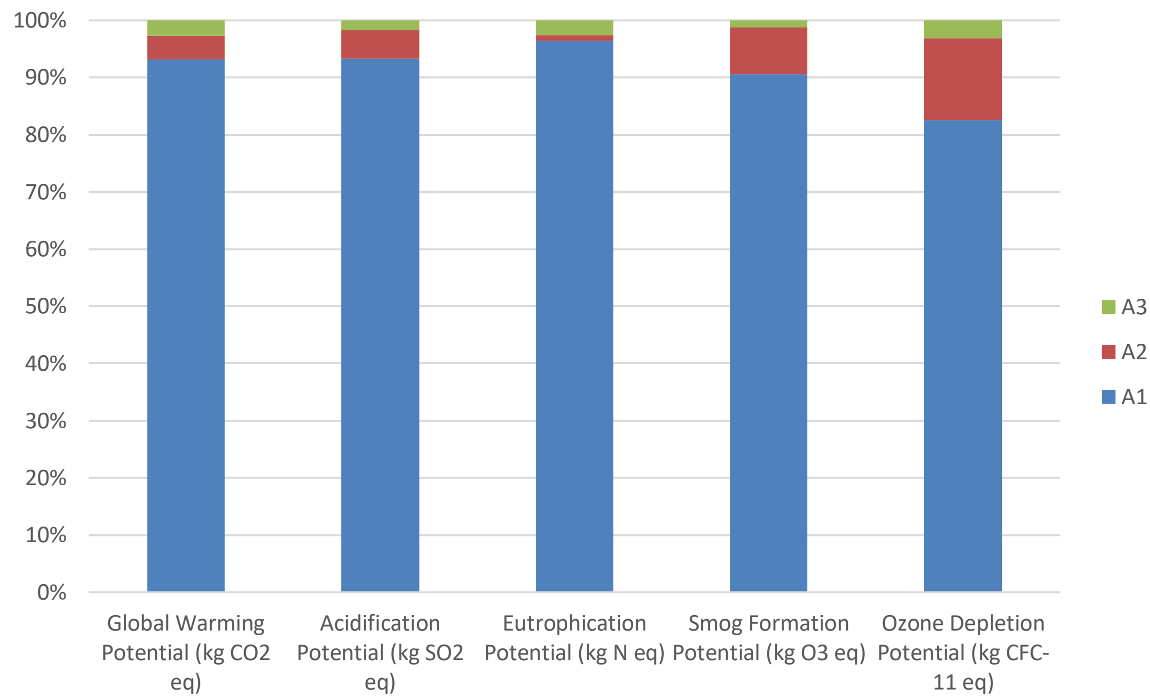

Figure 8. *Contribution analysis for Bull Moose tube produced at the Trenton, GA facility, using TRACI 2.1.*

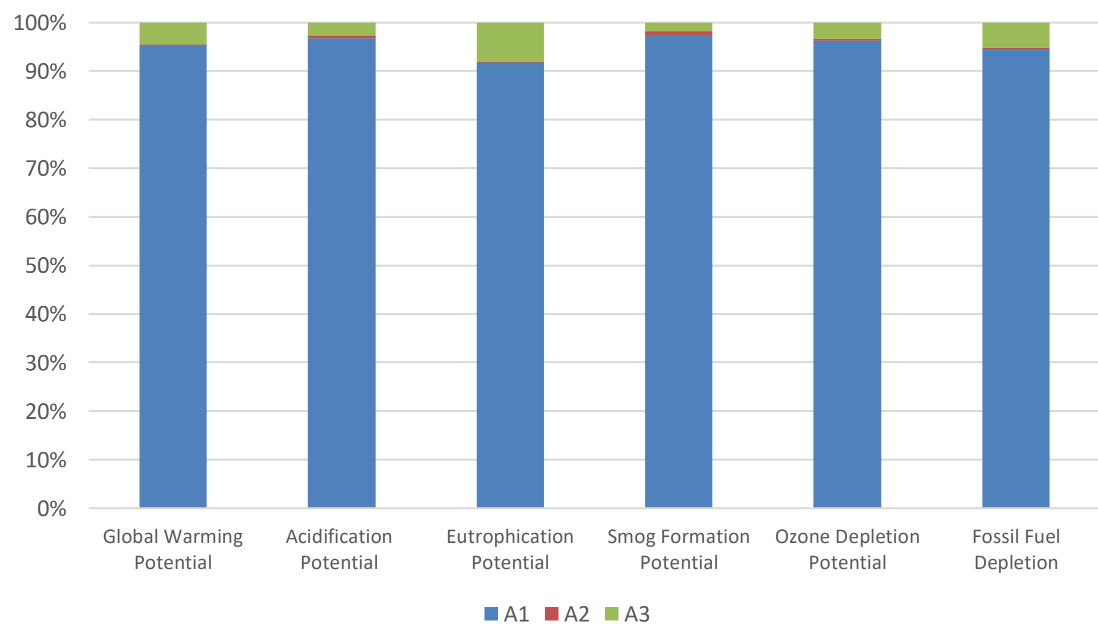

Figure 9. *Contribution analysis for Bull Moose tube produced at the Sinton, TX facility, using TRACI 2.1.*

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