Statement of Verification

BREG EN EPD No.: 000379 Issue 03

This is to verify that the

Environmental Product Declaration

provided by:

NatSteel Holdings Pte Ltd

is in accordance with the requirements of:

EN 15804:2012+A1:2013

and

BRE Global Scheme Document SD207

This declaration is for:

1 tonne steel reinforcing bar/coil

Company Address

NatSteel Holdings Pte Ltd
22 Tanjong Kling Road
Gate 1
Singapore
628048

Signed for BRE Global Ltd	Emma Baker Operator	05 October 2023 Date of this Issue
25 October 2021 Date of First Issue		24 October 2026 Expiry Date

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Environmental Product Declaration

EPD Number: 000379

General Information

EPD Programme Operator	Applicable Product Category Rules
BRE Global Watford, Herts WD25 9XX United Kingdom	BRE Environmental Profiles 2013 Product Category Rules for Type III environmental product declaration of construction products to EN 15804:2012+A1:2013
Commissioner of LCA study	**LCA consultant/Tool**
NatSteel Holdings Pte Ltd 22 Tanjong Kling Road Gate 1 Singapore 628048	LCA consultant: Roger Connick Tool: BRE LINA v2.0
Declared Unit	**Applicability/Coverage**
1 tonne steel reinforcing bar/coil	Manufacturer specific product
EPD Type	**Background database**
Cradle to Gate with options	ecoinvent v3.2

Demonstration of Verification
CEN standard EN 15804 serves as the core PCR [a]
Independent verification of the declaration and data according to EN ISO 14025:2010 ☐Internal ☒ External
(Where appropriate [b]) Third party verifier: Nigel Jones
a: Product category rules b: Optional for business-to-business communication; mandatory for business-to-consumer communication (see EN ISO 14025:2010, 9.4)

Comparability
Environmental product declarations from different programmes may not be comparable if not compliant with EN 15804:2012+A1:2013. Comparability is further dependent on the specific product category rules, system boundaries and allocations, and background data sources. See Clause 5.3 of EN 15804:2012+A1:2013 for further guidance

Information modules covered

Product			Construction		Use stage							End-of-life					Benefits and loads beyond the system boundary
					Related to the building fabric					Related to the building							
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4		D
Raw materials supply	Transport	Manufacturing	Transport to site	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
☑	☑	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☑		☑

Note: Ticks indicate the Information Modules declared.

Manufacturing site

NatSteel Holdings Pte Ltd
22 Tanjong Kling Road
Gate 1
Singapore
628048

Construction Product

Product Description

Reinforcement Bars

Reinforcement Bars are deformed steel bars produced to provide a solid foundation for buildings that can withstand the test of time of up to 300 years, providing tensile load enhancement to concrete's material weakness in tension.

There are several uses for Reinforcement Bars, they can be divided into Primary and Secondary Reinforcement. Primary Reinforcement refers to the employment of steel to guarantee resistance to support design loads, whereas Secondary Reinforcement refers to the employment of steel to provide localised resistance to limit cracking and resistance stress from temperature changes and shrinkage.

In addition to Primary and Secondary Reinforcement, Reinforcement Bars are employed to confer resistance to concentrated loads by providing localised resistance and stiffness to allow the load to spread through a wider area, and to hold other steel bars in its position to accommodate their loads.

With the characteristics of Reinforcement Bars, you will typically find them in structural elements such as Bored Piles, Pile Caps, Columns, Beams, Slab, and Walls.

NatSteel produce two variants of Reinforcement Bars; Grade 500 and Grade 600. The former provides a yield strength of 500 Mpa, and the latter provides a yield strength of 600 Mpa. With Grade 600 Reinforcement Bars, contractors benefit from an overall cost and time reduction from material reduction, manpower reduction, and construction time, whilst generating a lower carbon footprint compared to the same work carried out with Grade 500 Reinforcement Bars.

Wire Rod

Wire Rod is semi-finished plain bar in coil form of diameter ranging from 5.5-13mm. It is used to fabricate welded wire mesh for reinforcing monolithic structures of concrete floors and screeds, as well as ligatures for reinforcement steel cages.

Deformed Bar in Coil (DBIC)

Deformed Bar in Coil (DBIC) is produced via the same process as Wire Rod and hence is similar in terms of being in coil form, but its surface finishing is deformed and diameter ranges from 8-16mm. It carries the same specifications and usage applications as reinforcement bars.

DBIC is used to fabricate Cut-And-Bend (CAB) products as well as linkages for Bore Pile Cages. DBIC provides benefits of reduced material wastage in the fabrication process due to the continuous length nature of the coiled bar.

Technical Information

The below table covers the basic technical properties of the reinforcing steel products:

Property	Value, Unit
Production Route	EAF
Density[1]	7.85 g/cm^3
Weldability	Yes
Yield Strength[2]	250-700 Mpa
Tensile Strength[2]	400-800 Mpa
Surface Geometry	Plain bar and ribbed bar in round bar form
Elongation[2]	15-40%
Re-bond test	n/a
Recycled Content[3]	95%

1 Standard density for mild steel as listed in Singapore Steel standard SS 560:2016 (note 6 of clause no. 7.3).
2 Mill certificates provided confirm samples fall within the tolerances for Yield Strength, Tensile Strength and Elongation.
3 Recycled content calculated from inputs listed in the Rebar, Wire Rod and Hot-Rolled DBIC data collection form.

NatSteel's steel reinforcing bar/coil product (incorporating rebar, wire rod and hot-rolled DBIC) conforms to the following standards:

- Singapore Standards Council SS 560:2016 – Specification for steel for the reinforcement of concrete – Weldable reinforcing steel – Bar, coil and decoiled product.
- Malaysian Standard MS 146:2014 – Steel for the reinforcement of concrete – Weldable reinforcing steel – Bar, coil and decoiled product – Specification.
- Indian Standard IS 1786:2008 – High strength deformed steel bars and wires for concrete reinforcement – specification.
- Australian/New Zealand Standard AS/NZS 4671:2019 – Steel for the reinforcement of concrete.

Main Product Contents

Material/Chemical Input	Mass (%)
Iron	96-98%
Other additives	2-4%

Manufacturing Process

Preparation of Scrap
Steel production begins with categorising scrap according to its size, density and other considerations. An overhead crane is used to handle scrap, the scrap bucket is designed like a clam-shell to release scrap hydraulically.

Charging of Scrap into the Furnace
Cold scrap is charged by introducing scrap directly into the furnace by an overhead crane, the scrap is placed on the top of shaft to be integrated with the Electric Arc Furnace (EAF). For each heat, three rectangular buckets of scrap are charged into the furnace to obtain the proper heat size. The EAF technology employed by NatSteel allows the first charge of scrap of each cycle to be preheated by off-gases of the prior cycle while scrap is held in the shaft.

Melting
During the melting stage, electrical energy is supplied by graphite electrode which maintains an electric arc between the electrode, scrap, and the furnace bottom anode.

Anthracite and diesel, together with oxygen, are introduced through six oxy-fuel jet burners to induce rapid melt-down. Jet burners are directed at the cold spots of the scrap where arcing is not efficient. When scrap is being charged through the shaft, the electrode is then lifted, allowing the scrap to drop into the furnace through the shaft. When the scrap has liquefied in the furnace, metallurgical tests are performed on the liquid steel, and the appropriate alloying elements or compounds are injected thereafter.

Refining
Refining begins when impurities in the molten steel are oxidised to obtain the required steel chemistry, oxygen is introduced through oxygen lances and alloys are added; Phosphorus, manganese, carbon, and iron are oxidised.

Calcium Oxide is added to remove sulphur while enhancing oxidation. During the process, undesirable materials within the bath are oxidised, which will transit into the slag phase. During the slag foaming process, carbon is injected into the slag to reduce Ferrous Oxide and produce carbon monoxide to foam the slag.

De-slagging
De-slagging is carried out after the refining process to remove slag from the furnace. The furnace is tilted forward to allow slag to be poured out of the furnace through the slag door.

Tapping
During Tapping, the furnace is tilted backward and the liquid steel is tapped out through the spout into a preheated ladle to transfer to the ladle furnace station. The total duration of Tapping takes about 3 minutes at 1600 to 1610 degree Celsius.

Furnace turn-around
Furnace turn-around is the period following completion of Tapping until the furnace is ready for the next heat cycle. During this period, the electrode and roof are raised and the furnace lining is inspected for refractory damage. Maintenance service of the furnace bottom is carried out on a regular basis to reduce power-off time for the EAF to maximise furnace productivity.

Ladle Operation
NatSteel use the A/C Ladle Furance System. During the operation, the desired steel composition is achieved where alloy additions are made based on the bath analysis and the desired steel grade. Deoxidisers may be added to the steel to lower the oxygen content. This process is commonly referred as “killing the steel”.

Continuous Casting
After the ladle operation, the ladle containing the liquid steel is transferred by an overhead crane to a four-strand, continuous casting machine. The caster employed by NatSteel has a turret system allowing one ladle on standby and another in operation spouting molten steel into a tundish.

The tundish acts as a reservoir that receives steel from the ladle and distributes steel to a four-strands copper moulds system.

After the steel is distributed, Molten steel will enter a water-cooled mould and is transported into a direct spray cooling system.

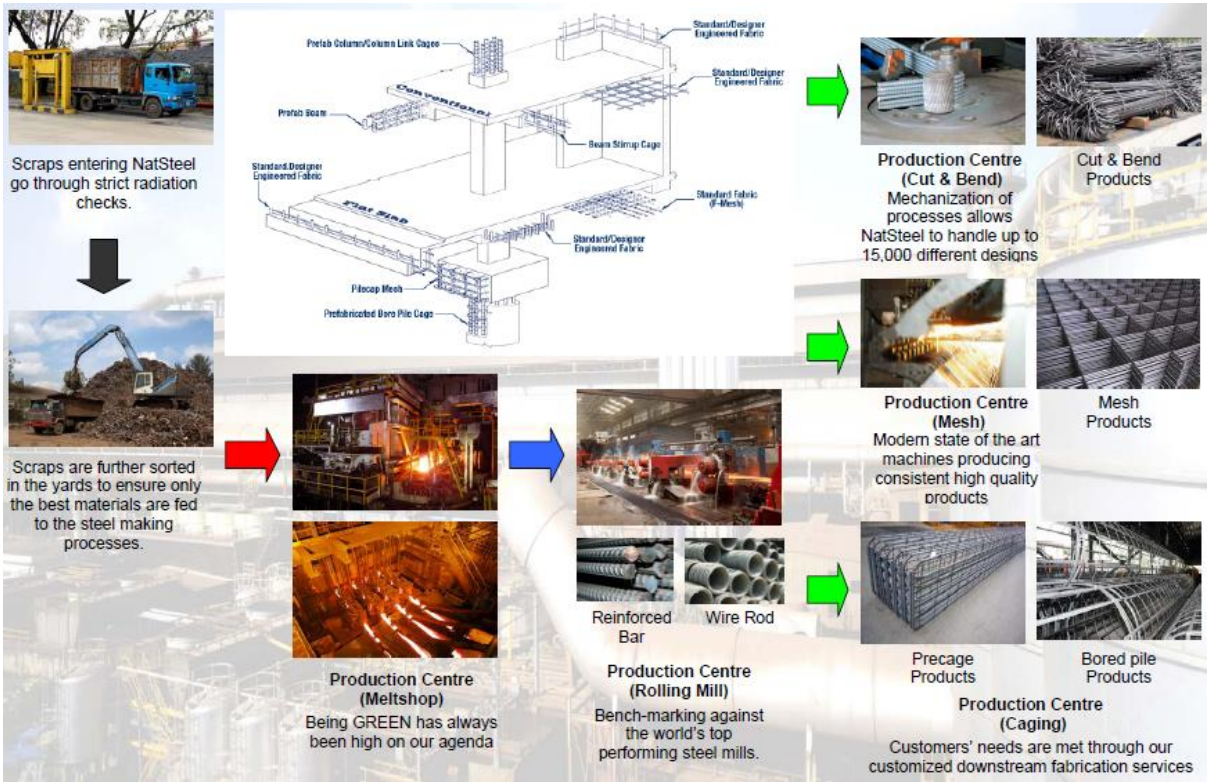
Once the steel is cooled, billets of 160-mm square section are cast. The billet then passes through the withdrawal and straightening rolls after which it is cut by a hydraulic shear.

Hot-Charging of billets
The billets in the continuous caster are transferred to the runout table which are either hot-charged or stacked away for rolling at the rolling mill. To reduce energy consumption, the billets are sent directly to the reheating furnace from the continuous casting process.

The Rolling Processes
The rolling mill in NatSteel has the capability to roll bars (10 to 50 mm) and wires (5.5 to 16mm) using a Pusher Reheating Furnace that uses light fuel oil.

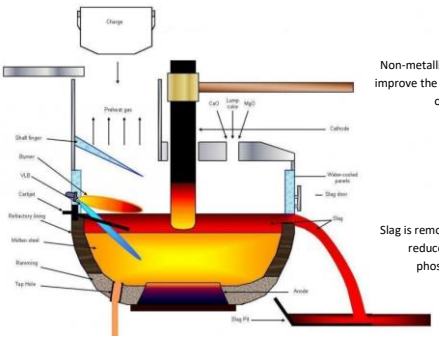
During the rolling process, Billets are charged into the reheating furnace by a hydraulic pusher. The heating of billets to the rolling temperature takes place in the Reheating Furnace. Hot billets are discharged individually from the reheating furnace to rolling into bars or wires of various sizes through roughing, intermediate, and finishing stages.

Process flow diagram



SCRAP PROCESSING
Scrap of various grades are collected and processed before being fed to the Electric Arc Furnace

Furnace Charging
Scrap is transferred to the furnace via bucket, and the electrode is raised to allow charging from shaft, before the shaft roof is closed and the electrode is lowered to strike an arc on the scrap

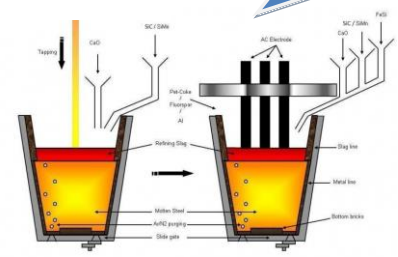


Refining
Non-metallic alloys are added to improve the chemical composition of the steel

De-Slagging
Slag is removed via a slag door , this reduces the possibility of phosphorus reversion

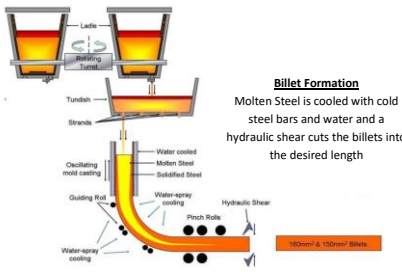
Melting
Electrical energy from graphite electrodes and chemical energy from virtual lance burners melt the scrap

Tapping
Molten steel from EAF is poured into the ladle via Eccentric Bottom Tapping (EBT). The taphole at the bottom allows molten steel to be transferred without slag contamination



Ladle Refining
Addition of more compounds to further adjust the chemistry of the molten steel, with continued purging and stirring to achieve homogenity

Teeming
Homogenized steel with correct temperature and chemistry is transferred to tundish for billet casting



Billet Formation
Molten Steel is cooled with cold steel bars and water and a hydraulic shear cuts the billets into the desired length

Continuous Casting Machine
Tundish feed molten steel continuously to the mold at a regulated rate

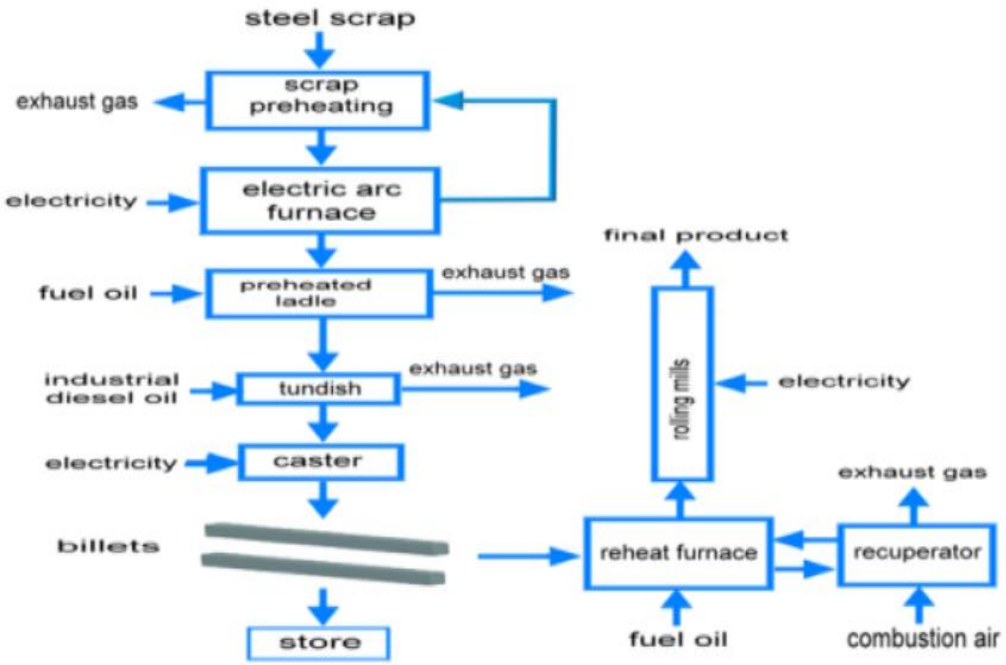


Fig.1 - Steel-production process and energy inputs

Life Cycle Assessment Calculation Rules

Declared unit description

1 tonne steel reinforcing bar/coil

System boundary

In accordance with the modular approach as defined in EN15804:2012+A1:2013, this cradle-to-gate with options EPD includes the processes covered in the product manufacturing stages A1 to A3; end of life scenarios in modules C3, C4; and material and energy recovery scenarios in module D.

Data sources, quality and allocation

Specific primary data derived from the NatSteel Holdings Pte Ltd production process in Singapore have been modelled using Simapro v9.1 LCA software and the BRE LINA database v2.0.33. In accordance with the requirements of EN15804, the most current available data has been used. The manufacturer-specific data from NatSteel Holdings Pte Ltd covers a period of 1 year (01/04/19 – 31/03/20). Secondary data has been obtained for all other upstream and downstream processes that are beyond the control of the manufacturer (i.e. raw material production) from the ecoinvent 3.2 database. All ecoinvent datasets are complete within the context used, and confirm to the system boundary and the criteria for the exclusion of inputs and outputs according to the requirements specified in EN15804. Calculations were performed to enable allocation of processes to the steel products. Allocation procedures were by physical allocation and are according to EN15804 and are based on ISO14044 guidance.

Cut-off criteria

No inputs or outputs have been excluded. All raw materials and packaging inputs, plus their transport, process and general energy and water use, production and non-production waste, have been included, except for direct emissions to water and soil, which are not measured.

End of life scenarios

This EPD includes two sets of results which are published below. The first set of results present the impacts of a 100% steel waste to landfill scenario in end of life Module C4. The second set of results present the impacts of a 100% steel waste to recycling scenario in end of life Module C4. Both sets of results also include Module D, which presents the results of the environmental loads or benefits that have been calculated according to each respective end of life scenario.

NatSteel export their product to many different countries where the end of life scenario varies considerably. The two sets of results for Modules C4 and D presented in this EPD are therefore intended to allow flexibility for end-users of the EPD to calculate the impacts applicable to their own country or region.

LCA Results (Module C4 = 100% to landfill scenario)

Results per declared unit, 1 tonne steel reinforcing bar/coil, for the declared modules, can be found in the following tables:

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Parameters describing environmental impacts

			GWP	ODP	AP	EP	POCP	ADPE	ADPF
			kg CO_2 equiv.	kg CFC 11 equiv.	kg SO_2 equiv.	kg $(PO_4)^{3-}$ equiv.	kg C_2H_4 equiv.	kg Sb equiv.	MJ, net calorific value.
Product stage	Raw material supply	A1	8.30e+1	1.18e-5	3.36e-1	1.52e-1	6.63e-2	1.74e-4	1.29e+3
	Transport	A2	6.41e+0	1.16e-6	4.02e-2	7.17e-3	4.67e-3	1.44e-5	9.59e+1
	Manufacturing	A3	4.01e+2	5.31e-5	2.45e+0	4.87e-1	3.70e-1	2.16e-4	7.69e+3
	Total (of product stage)	A1-3	4.90e+2	6.61e-5	2.83e+0	6.46e-1	4.41e-1	4.04e-4	9.07e+3
End of life	Waste processing	C3	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Disposal	C4	5.19e+0	1.79e-6	4.00e-2	9.87e-3	6.91e-3	5.61e-6	1.51e+2
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	7.92e+1	1.13e-5	3.21e-1	1.45e-1	6.33e-2	1.66e-4	1.23e+3

GWP = Global Warming Potential;
ODP = Ozone Depletion Potential;
AP = Acidification Potential for Soil and Water;
EP = Eutrophication Potential;
POCP = Formation potential of tropospheric Ozone;
ADPE = Abiotic Depletion Potential – Elements;
ADPF = Abiotic Depletion Potential – Fossil Fuels.

Parameters describing resource use, primary energy

			PERE	PERM	PERT	PENRE	PENRM	PENRT
			MJ	MJ	MJ	MJ	MJ	MJ
Product stage	Raw material supply	A1	1.52e+2	1.73e-4	1.52e+2	1.44e+3	0.00e+0	1.44e+3
	Transport	A2	1.45e+0	4.38e-6	1.45e+0	9.57e+1	0.00e+0	9.57e+1
	Manufacturing	A3	1.63e+2	8.32e-4	1.63e+2	7.49e+3	0.00e+0	7.49e+3
	Total (of product stage)	A1-3	3.16e+2	1.01e-3	3.16e+2	9.02e+3	0.00e+0	9.02e+3
End of life	Waste processing	C3	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Disposal	C4	3.89e+0	5.90e-6	3.89e+0	1.50e+2	0.00e+0	1.50e+2
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	1.45e+2	1.65e-4	1.45e+2	1.37e+3	0.00e+0	1.37e+3

PERE = Use of renewable primary energy excluding renewable primary energy used as raw materials;
PERM = Use of renewable primary energy resources used as raw materials;
PERT = Total use of renewable primary energy resources;
PERE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials;
PENRM = Use of non-renewable primary energy resources used as raw materials;
PENRT = Total use of non-renewable primary energy resource

LCA Results (continued)

Parameters describing resource use, secondary materials and fuels, use of water						
			SM	RSF	NRSF	FW
			kg	MJ net calorific value	MJ net calorific value	m^3
Product stage	Raw material supply	A1	1.15e+3	0.00e+0	0.00e+0	8.33e-1
	Transport	A2	0.00e+0	0.00e+0	0.00e+0	2.12e-2
	Manufacturing	A3	0.00e+0	0.00e+0	0.00e+0	2.64e+1
	Total (of product stage)	A1-3	1.15e+3	0.00e+0	0.00e+0	2.73e+1
End of life	Waste processing	C3	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Disposal	C4	0.00e+0	0.00e+0	0.00e+0	1.72e-1
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	1.10e+3	0.00e+0	0.00e+0	7.95e-1

SM = Use of secondary material;
RSF = Use of renewable secondary fuels;
NRSF = Use of non-renewable secondary fuels;
FW = Net use of fresh water.

Other environmental information describing waste categories					
			HWD	NHWD	RWD
			kg	kg	kg
Product stage	Raw material supply	A1	2.90e+1	6.59e+0	4.39e-3
	Transport	A2	4.02e-2	3.78e+0	6.60e-4
	Manufacturing	A3	2.59e+1	8.52e+0	1.53e-2
	Total (of product stage)	A1-3	5.50e+1	1.89e+1	2.03e-2
End of life	Waste processing	C3	0.00e+0	0.00e+0	0.00e+0
	Disposal	C4	5.41e-2	1.00e+3	1.02e-3
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	2.77e+1	6.29e+0	4.19e-3

HWD = Hazardous waste disposed;
NHWD = Non-hazardous waste disposed;
RWD = Radioactive waste disposed.

LCA Results (continued)

Other environmental information describing output flows – at end of life						
			CRU	MFR	MER	EE
			kg	kg	kg	MJ per energy carrier
Product stage	Raw material supply	A1	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Transport	A2	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Manufacturing	A3	0.00e+0	1.80e+2	0.00e+0	0.00e+0
	Total (of product stage)	A1-3	0.00e+0	1.80e+2	0.00e+0	0.00e+0
End of life	Waste processing	C3	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Disposal	C4	0.00e+0	0.00e+0	0.00e+0	0.00e+0
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0.00e+0	0.00e+0	0.00e+0	0.00e+0

CRU = Components for reuse;
MFR = Materials for recycling;
MER = Materials for energy recovery;
EE = Exported energy.

LCA Results (Module C4 = 100% to recycling scenario)

Results per declared unit, 1 tonne steel reinforcing bar/coil, for the declared modules, can be found in the following tables:

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Parameters describing environmental impacts									
			GWP	ODP	AP	EP	POCP	ADPE	ADPF
			kg CO_2 equiv.	kg CFC 11 equiv.	kg SO_2 equiv.	kg $(PO_4)^{3-}$ equiv.	kg C_2H_4 equiv.	kg Sb equiv.	MJ, net calorific value.
Product stage	Raw material supply	A1	8.30e+1	1.18e-5	3.36e-1	1.52e-1	6.63e-2	1.74e-4	1.29e+3
	Transport	A2	6.41e+0	1.16e-6	4.02e-2	7.17e-3	4.67e-3	1.44e-5	9.59e+1
	Manufacturing	A3	4.01e+2	5.31e-5	2.45e+0	4.87e-1	3.70e-1	2.16e-4	7.69e+3
	Total (of product stage)	A1-3	4.90e+2	6.61e-5	2.83e+0	6.46e-1	4.41e-1	4.04e-4	9.07e+3
End of life	Waste processing	C3	1.87e+0	8.38e-8	8.40e-3	2.75e-3	6.56e-4	7.04e-7	2.73e+1
	Disposal	C4	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-3.80e+0	-5.40e-7	-1.54e-2	-6.96e-3	-3.04e-3	-7.97e-6	-5.91e+1

GWP = Global Warming Potential;
ODP = Ozone Depletion Potential;
AP = Acidification Potential for Soil and Water;
EP = Eutrophication Potential;
POCP = Formation potential of tropospheric Ozone;
ADPE = Abiotic Depletion Potential – Elements;
ADPF = Abiotic Depletion Potential – Fossil Fuels.

Parameters describing resource use, primary energy

			PERE	PERM	PERT	PENRE	PENRM	PENRT
			MJ	MJ	MJ	MJ	MJ	MJ
Product stage	Raw material supply	A1	1.52e+2	1.73e-4	1.52e+2	1.44e+3	0.00e+0	1.44e+3
	Transport	A2	1.45e+0	4.38e-6	1.45e+0	9.57e+1	0.00e+0	9.57e+1
	Manufacturing	A3	1.63e+2	8.32e-4	1.63e+2	7.49e+3	0.00e+0	7.49e+3
	Total (of product stage)	A1-3	3.16e+2	1.01e-3	3.16e+2	9.02e+3	0.00e+0	9.02e+3
End of life	Waste processing	C3	1.36e+0	9.20e-7	1.36e+0	2.70e+1	0.00e+0	2.70e+1
	Disposal	C4	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-6.96e+0	-7.92e-6	-6.96e+0	-6.60e+1	0.00e+0	-6.60e+1

PERE = Use of renewable primary energy excluding renewable primary energy used as raw materials;
PERM = Use of renewable primary energy resources used as raw materials;
PERT = Total use of renewable primary energy resources;
PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials;
PENRM = Use of non-renewable primary energy resources used as raw materials;
PENRT = Total use of non-renewable primary energy resource

LCA Results (continued)

Parameters describing resource use, secondary materials and fuels, use of water

			SM	RSF	NRSF	FW
			kg	MJ net calorific value	MJ net calorific value	m^3
Product stage	Raw material supply	A1	1.15e+3	0.00e+0	0.00e+0	8.33e-1
	Transport	A2	0.00e+0	0.00e+0	0.00e+0	2.12e-2
	Manufacturing	A3	0.00e+0	0.00e+0	0.00e+0	2.64e+1
	Total (of product stage)	A1-3	1.15e+3	0.00e+0	0.00e+0	2.73e+1
End of life	Waste processing	C3	0.00e+0	0.00e+0	0.00e+0	1.86e-2
	Disposal	C4	0.00e+0	0.00e+0	0.00e+0	0.00e+0
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-5.23e+1	0.00e+0	0.00e+0	-3.82e-2

SM = Use of secondary material;
RSF = Use of renewable secondary fuels;
NRSF = Use of non-renewable secondary fuels;
FW = Net use of fresh water.

Other environmental information describing waste categories					
			HWD	NHWD	RWD
			kg	kg	kg
Product stage	Raw material supply	A1	2.90e+1	6.59e+0	4.39e-3
	Transport	A2	4.02e-2	3.78e+0	6.60e-4
	Manufacturing	A3	2.59e+1	8.52e+0	1.53e-2
	Total (of product stage)	A1-3	5.50e+1	1.89e+1	2.03e-2
End of life	Waste processing	C3	3.44e-3	1.13e-1	3.57e-5
	Disposal	C4	0.00e+0	0.00e+0	0.00e+0
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.33e+0	-3.02e-1	-2.01e-4

HWD = Hazardous waste disposed;
NHWD = Non-hazardous waste disposed;
RWD = Radioactive waste disposed.

LCA Results (continued)

Other environmental information describing output flows – at end of life						
			CRU	MFR	MER	EE
			kg	kg	kg	MJ per energy carrier
Product stage	Raw material supply	A1	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Transport	A2	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Manufacturing	A3	0.00e+0	1.80e+2	0.00e+0	0.00e+0
	Total (of product stage)	A1-3	0.00e+0	1.80e+2	0.00e+0	0.00e+0
End of life	Waste processing	C3	0.00e+0	1.00e+3	0.00e+0	0.00e+0
	Disposal	C4	0.00e+0	0.00e+0	0.00e+0	0.00e+0
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0.00e+0	0.00e+0	0.00e+0	0.00e+0

CRU = Components for reuse;
MFR = Materials for recycling;
MER = Materials for energy recovery;
EE = Exported energy.

Scenarios and additional technical information

Scenarios and additional technical information			
Scenario	Parameter	Units	Results
C1 to C4 End of life	Description of scenario		
C3	NatSteel utilise their own waste pre-processing facility (NSR). Approximately 22% of the throughput of the scrap steel comes from construction and demolition sites, and includes Rebar, Wire Rod and Deformed Bar In Coil. After cleaning and sorting, the majority of this then undergoes a further cutting process, where the remainder are already small enough and ready for input to the electric arc furnace.		
C4 (landfill)	Disposal steel waste to landfill (100% scenario)	Kg	1,000
C4 (recycling)	Disposal steel waste to recycling (100% scenario)	Kg	1,000
Module D (applicable to Module C4 Steel waste to recycling scenario only)	Description of scenario		
	After building demolition, steel reinforcing bar/coil is transported to NatSteel's pre-processing facility and can be used as an input material for the steelmaking process. Since the composition of the manufactured steel includes 95% recycled content, the pre-processed steel reinforcing bar/coil can be used as a replacement for the 5% virgin material. Therefore, 1,000 kg of scrap steel waste recovered from building demolition sites can be used to offset the impacts of 45.8 kg of virgin material. The dataset used to represent avoided impacts of the virgin material used in NatSteel's steel reinforcing bar/coil manufacture was: 'Billet (intermediate), Steel Reinforcing Bar, Coil'.		

Additional information

Interpretation

The scrap-based carbon steel feedstock of NatSteel Holdings Pte Ltd is made via the electric arc furnace (EAF) route. The bulk of the environmental impacts and primary energy demand are attributed to the manufacturing phase, covered by information modules A1-A3 of EN15804:2012+A1:2013.

References

BSI. Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products. BS EN 15804:2012+A1:2013. London, BSI, 2013.

BSI. Environmental labels and declarations – Type III Environmental declarations – Principles and procedures. BS EN ISO 14025:2010 (identical to ISO 14025:2006). London, BSI, 2010.

BSI. Environmental management – Life cycle assessment – Principles and framework. BS EN ISO 14040:2006. London, BSI, 2006.

BSI. Environmental management – Life cycle assessment – Requirements and guidelines. BS EN ISO 14044:2006. London, BSI, 2006.

Singapore Standards Council SS 560:2016 – Specification for steel for the reinforcement of concrete – Weldable reinforcing steel – Bar, coil and decoiled product.

Malaysian Standard MS 146:2014 – Steel for the reinforcement of concrete – Weldable reinforcing steel – Bar, coil and decoiled product – Specification.

Indian Standard IS 1786:2008 – High strength deformed steel bars and wires for concrete reinforcement – specification.

Australian/New Zealand Standard AS/NZS 4671:2019 – Steel for the reinforcement of concrete.

Pre Consultants bv. SimaPro 8 LCA Software 2013. http://www.pre-sustainability.com

ecoinvent Centre. Swiss Centre for life Cycle Inventories. http://www.ecoinvent.org