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Environmental Product Declaration

Hot Rolled Structural and Rail

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In accordance with ISO 14025 and EN 15804+A1

AUSTRALASIA EPD® ENVIRONMENTAL PRODUCT DECLARATION

ECO PLATFORM EPD VERIFIED

LIBERTY

Produced under EPD Australasia by thinkstep-anz in accordance with ISO 14025 and EN 15804+A1

EPD registration number	S-P-01547 Version 1.2
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Valid until	2025-06-29
Geographical scope	Australia

General information

An Environmental Product Declaration, or EPD, is a standardised and verified way of quantifying the environmental impacts of a product based on a consistent set of rules known as PCR (Product Category Rules).

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CEN standard EN 15804 served as the core PCR:	
PCR:	PCR 2012:01 Construction products and Construction services, Version 2.31, 2019-12-20
PCR review was conducted by:	The Technical Committee of the International EPD® System
Chair:	Massimo Marino. Contact via info@environdec.com
Independent verification of the declaration and data, according to ISO 14025:	☐ EPD process certification (Internal) ☑ EPD verification (External)
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Verifier accredited or approved by: AUSTRALASIA EPD® ENVIRONMENTAL PRODUCT DECLARATION	EPD Australasia Ltd

Version	Date and Description
1	November 2016 – Original EPD released under OneSteel brand (S-P-00854 Version 1).
1	September 2020 – Updated in line with 5-year validity, including updated hotspot data covering over 95 % of all impacts. Hot rolled structural steel and merchant bar sections manufactured by InfraBuild Steel are now covered in the InfraBuild EPD (S-P-00854 Version 1.1.).
1.2	Update logo and Sales & Service contact details.

Contents

Welcome

Liberty Primary Steel is a manufacturer of structural steel and rails and a supplier to InfraBuild in Australia and Liberty Steel internationally.

Liberty Primary Steel's iconic Whyalla Steelworks in South Australia is an integrated steelworks that manufactures cast steel, special grade billets and steel long products, including structural, rail and sleeper sections.

Liberty Primary Steel is dedicated to conducting our business to global environmental, social and commercial standards and has stated its ambition to become carbon neutral by 2030. Our commitment to the environment includes optimising the eco-efficiency of our products through the product life cycle. This means improving resource and energy efficiencies in the production and distribution of our products, and during the use of steel products. We are committed to the promotion of the recovery, reuse and recycling of steel and other products.

Liberty Primary Steel's Environmental Product Declaration (EPD) is independently verified and is a premier contributors to our holistic commitment to the environmentally sustainable manufacture and application of our products. Alongside our sustainable manufacturing practices, as well as our expertise in technical product applications and customisation, this EPD is another way we are here to deliver value to our customers and the wider industry.

Recognising our customers' needs and the increasing demand for standardisation and greater transparency around environmental performance, Liberty Primary Steel is proud to publish the sustainability credentials of our supply chain and products.

The major changes in this EPD include:

- Update of logo and Sales & Service contact details.

www.libertygfg.com

How to use this EPD

Liberty Primary Steel recognises the importance of the transparency and independent verification of our products' credentials.

This Environmental Product Declaration (EPD) covers the environmental impacts of structural and rail products manufactured to the following Australian Standards or Technical Specifications:

1) Structural steel manufactured to AS/NZS 3679.1 *Structural steel Part 1: Hot rolled bars and sections*
2) Steel sleepers manufactured to AS 1085.17 *Railway track material. Part 17: Steel sleepers*
3) Rail manufactured in accordance with the respective Liberty Primary Steel Technical Specifications (RT23 for 60kg, 50kg and 41kg Rail, RT19 for 68kg Rail, RT25 for 53kg Rail and RT27 for 47kg Rail). These Technical Specifications are based upon Australian Standard AS1085.1 with clarifications and enhancements included therein. Copies of these Technical Specifications are available on request.

These products are typically used in the construction, manufacturing and rail industries.

Our products manufactured to AS/NZS 3679.1 are third-party certified by the Australasian Certification Authority for Reinforcing and Structural Steels (ACRS) to independently confirm they consistently meet the requirements of the Standard.

General guidance

EPDs are independently verified documents that include information about the environmental impact of products throughout their life cycle.

EPDs require the completion of Life Cycle Inventory (LCI), a Life Cycle Assessment (LCA) and verification to best practice international and Australian standards.

- Life Cycle Inventory (LCI) is the collection of data on the inputs, processes and outputs within a defined system boundary
- Life Cycle Assessment (LCA) is the modelling of LCI in accordance with ISO 14040 and ISO 14044 standards
- Third party verification of the output of the LCA in the format of an EPD.

The EPD owner has the sole ownership, liability and responsibility for the EPD.

EPDs are not always comparable

When comparing EPDs it is important to recognise:

- EPDs within the same product category from different programmes may not be comparable
- EPDs of construction products may not be comparable if they do not comply with EN 15804 or if they are produced using different Product Category Rules
- EPDs of construction products from a group of manufacturers may not be comparable to an EPD of a similar construction product that has been generated by a single manufacturer.

Understanding the detail is important in comparisons. Expert analysis is required to ensure data is truly comparable to avoid unintended distortions.

Benefits of using this EPD

- Provides an independently verified representation of the environmental impact of the Liberty Primary Steel product going into your project.
- Complies with the requirements of a valid EPD that is recognised in the Green Star Design & As Built v1.3 and Innovation Challenge of Green Star legacy tools by the Green Building Council of Australia (GBCA).
- Complies with the requirements of IS® rating tool by the Infrastructure Sustainability Council (ISC).

Green Building Council Australia
Member 2020–2021

Green Star® Points

This EPD complies with requirements under the Green Building Council of Australia's rating tool, Green Star – Design & As Built v1.3.

Green Star points for EPDs can be claimed under the Sustainable Products credit when the following criteria are met:

✓ EN 15804 and ISO 14025 compliant
✓ Verified by an independent third party
✓ Cradle-to-gate scope.

This EPD meets these requirements.

Infrastructure Sustainability Council

This EPD complies with requirements under the Infrastructure Sustainability Council's IS® rating scheme:

✓ Compliant with ISO 14025
✓ Compliant with EN15804
✓ Verified by a third party.

This EPD may help your project achieve ISv2.0 Rso-7 or ISv1.2 Mat-2 credits under the IS® rating scheme.

Benefits of using Liberty Primary Steel products

Why steel?

Steel is fundamental to the way we live, work and play.

As one of the most utilised materials in the world, steel supports the buildings we use, strengthens the roads and bridges that connect us and contributes to a more sustainable built environment.

From design and construction, through to building and infrastructure use, and then at the end of the asset lifespan, steel offers construction proponents unique sustainability benefits.

Steel can be readily adapted for various uses. It allows asset owners to modify existing structures to cater for future uses and tenants, as well as extending the structure's lifespan beyond its initial intent.

Steel is a 100% recyclable material, with no loss in material strength or quality.

Modern design techniques and the use of higher strength grades can also reduce the mass of steel used in structures.

To understand the environmental performance of steel, the full life cycle of steel must be taken into consideration. The key steps in the life cycle of steel are shown in Figure 1 (page 8).

Why Liberty Primary Steel?

At Liberty Primary Steel, we understand that sustainability is not just about environmental impact.

We strive to improve our social licence to operate across social, economic and environmental arenas while upholding our core values of Family, Change and Sustainability.

For more information refer to www.libertygfg.com

Figure 1: Life cycle of Liberty Primary Steel products

Hot Rolled Structural and Rail products

This EPD includes data on two product groups within the hot rolled structural and rail product category. These include:

1. Structural sections
2. Rail and sleeper sections.

Each of the products included in this EPD are available in a wide range of sizes.

All structural products are available in 300PLUS®, some in other grades as well.

Under the United Nations Central Product Classification (UN CPC) system of classification these products fit into two categories:

- 41251 – Angles, shapes and sections, of iron or non-alloy steel, not further worked than hot-rolled, hot-drawn or extruded
- 41253 – Railway and tram track construction material of iron or steel.

Under the Australian and New Zealand Standard Industrial Classification (ANZSIC), the products within this EPD are described by the following Class Codes and Titles;

- 2221 Structural Steel Fabrication
- 2299 Other Fabricated Metal Product Manufacture

The products are manufactured by Liberty Primary Steel at its major steelmaking and processing site in Whyalla, SA. The steel products are specific products from one manufacturer (Liberty Primary Steel), rather than an industry average. A detailed description of the products can be found on pages 16 and 19.

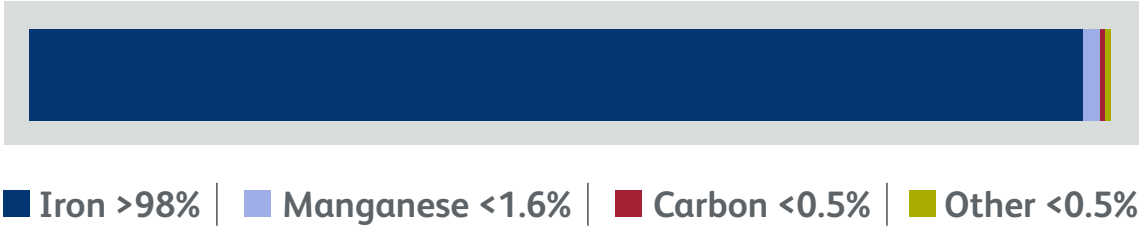
This EPD relates to products manufactured by Liberty Primary Steel and therefore does not include imported products or components. The production process is described conceptually hereafter in Figure 3 (page 10).

Steelmaking processes

Liberty Primary Steel produces steel through an integrated steel mill, which includes key unit processes such as coke manufacture, Blast Furnace (BF) and Basic Oxygen Steelmaking (BOS). This process primarily uses raw materials such as coal and iron ore.

Manufacturers and designers alike play a key role in improving the sustainability credentials of steel and steel structures. Designers are encouraged to select the most suitable steel for an application to maximise the efficiency of the design and thus reduce the quantities consumed. As a manufacturer, Liberty Primary Steel works to provide products and services that are increasingly sustainable. These include our higher strength steel solutions that have the capacity to reduce the amount of steel consumed on a project.

Figure 2: The typical composition of Liberty Primary Steel's hot rolled and rail products

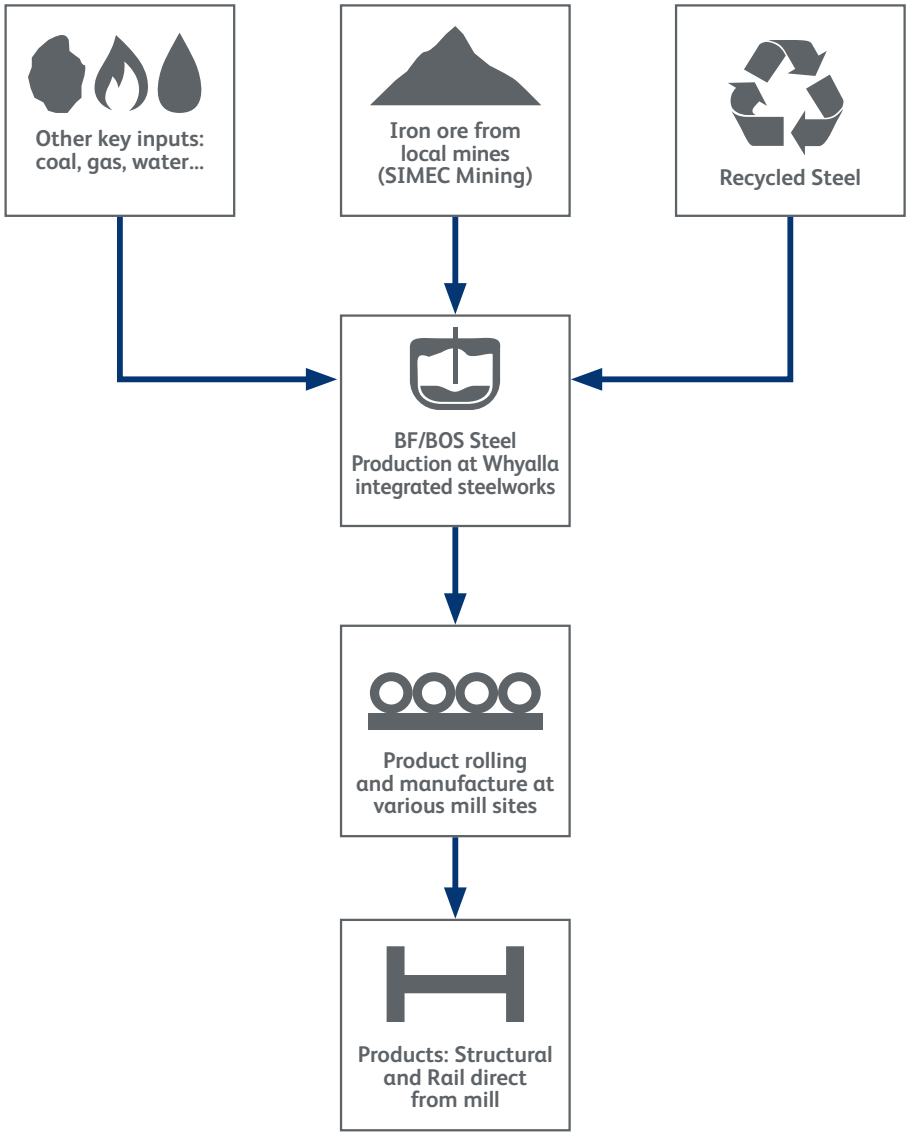


A range of alloys are used to manufacture the products and grades represented in this EPD. The use of alloys has been aggregated and averaged in this EPD. The impact of utilising alloys to produce different grades or products has no material impact on the outcome of this EPD.

Products have been grouped such that the variations between the EPD outcomes for individual sections within the same product grouping are deemed as not significant to the EPD result. The upstream manufacturing processes are common across the various products represented within a product group.

The products included in this EPD do not contain any substances of high concern as defined by European REACH regulation.

Figure 3: Structural and rail products manufactured by Liberty Primary Steel



The Material Circularity Indicator

The Circular Economy is a system that requires us to reconsider the entire lifecycle of our products and resources by designing out waste. That means making use of materials and technologies that extend the lifespan and potential reuse value of the things we produce, while minimising as far as possible unintended waste and pollutants.

With that, there remains a need to quantify this process so producers can know just how circular their products are. The Material Circularity Indicator (MCI) not only provides a benchmark for improving a product but can add extra value to an EPD, providing a more complete picture of the overall sustainability credentials of that product.

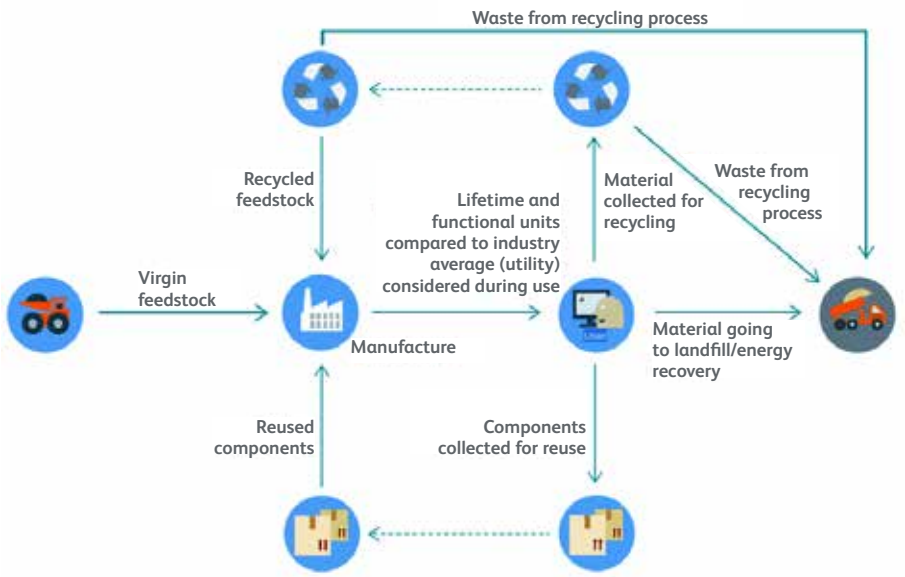
EPDs go a long way towards establishing a product's overall environmental impact by looking at the entire lifecycle of a product via an internationally standardised approach and independent verification. However on their own, EPDs stop short of quantifying a Circular Economy approach. This is where the MCI can help to offer a more complete picture and ensure that circular economy steps are well underway.

The Ellen McArthur Foundation, building on their strong work publicising the Circular Economy, developed the MCI to measure the circularity of products. The indicator's focus is on Technical Cycles, "in which products, components and materials are kept in the market at the highest possible quality and for as long as possible, through repair and maintenance, reuse, refurbishment, remanufacture, and ultimately recycling". (Ellen McArthur Foundation 2015)

With this, we can see that the MCI is particularly relevant to organisations working in building and infrastructure areas and encouraging more circular design principles from the extraction of raw resources, to the construction and eventual demolition stages.

This process is demonstrated in Figure 4 below, with the MCI tracking material flows from virgin stock, to use and eventual reuse. In short, its focus is entirely on the materials going in and the waste coming out along each step of a product's lifecycle. It also considers a product's utility when making the calculation, which includes the intensity of use and intended lifespan. Finally, the MCI has a simple scale of 0–1, with 0.1 indicating a linear process and 1 indicating a fully circular one. A result of less than 0.1 indicates a linear product with lower-than-average utility.

Figure 4: Diagrammatic representation of Material Flows (Ellen McArthur Foundation 2015)



What this looks like in practice

As part of the development of this EPD, thinkstep-anz were commissioned to develop an MCI for the products in this EPD.

With a score of 0.377, these products are shown to be considerably better than fully linear, reflecting the high recyclability potential at end of life.

Increased use of the MCI as a metric for infrastructure projects will help the industry to improve resource efficiency across the whole life of a project. InfraBuild is playing its part by transparently providing MCI results in all EPDs.

In a broader sense, and in line with the objectives of the MCI according to the Ellen McArthur Foundation, this MCI provides Liberty Primary Steel with important information to add to its growing sustainability picture. Although this MCI only applies to one of many products, it is nonetheless vital information as production shifts from a linear model to a circular one.

ISO 14001

ISO 14001 is the international standard that specifies requirements for an effective Environmental Management System (EMS) that help organisations administer and control a company's environmental impact and compliance with regulations.

Although it is a voluntary standard that organisations can certify to, the GBCA Green Star Design & As Built tool uses ISO 14001 as one criteria to define a 'Responsible Steel Maker'.

This requirement states: "The steel making facilities where the structural and/or reinforcing steel for the project is sourced have a currently valid and certified ISO 14001 Environmental Management System (EMS) in place. Valid ISO 14001 Environmental Management System (EMS) certificates must be provided from the steel making facilities where the structural and/or reinforcing steels in the project were produced."

Liberty Primary Steel has ISO 14001 EMS certification and the current certificate is available via the following link:

www.infrabuild.com/en-au/resource-centre/resources/iso14001-c10317-certificate-of-registration-whyalla/

Technical information

Declared Unit

This EPD is valid for a declared unit of one tonne (t) of product ready for dispatch to a customer.

System boundaries

The system boundary of this EPD includes stages A1-A3, C3-C4 and D as shown in Table 1. This scope is referred to as 'cradle-to-gate with options'.

The production phase of this EPD includes mining of raw materials, transport to, between and within the different manufacturing sites, and manufacturing of semi-finished steel followed by rolling and forming into the final product at the exit gate.

When a structure reaches its end-of-life, the majority of the steel used in the structure is recovered and scrapped for recycling (C3). A recycling rate of 90% has been applied for this EPD (National Waste Report 2018). The remaining 10% is assumed to be landfilled (C4).

Module D considers the environmental impact and benefit of steel recycling in its second life cycle.

Information contained in this EPD excludes the use phase environmental impacts of the product, which are considered to be too variable to provide meaningful representation.

Table 1: Modules included in the scope of the EPD

Product stage			Construction process stage		Use stage							End-of-life stage				Benefits and loads beyond the system boundary
Raw material supply	Transport of raw materials	Manufacturing	Transport to customer	Construction / Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction / demolition	Transport to waste processing	Waste processing	Disposal	Reuse- Recovery- Recycling- potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	X	X	X

X = included in the EPD; MND = module not declared (such a declaration shall not be regarded as an indicator result of zero).

Life cycle inventory (LCI) data

The Life Cycle Inventory data used in this EPD has been collected and applied according to EN 15804:2012+A1:2013, ISO 14025 and PCR 2012:01 Construction Products and Construction Services v2.31 (2019-12-20) of the International EPD® System.

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Key assumptions

Data for core processes:

Primary (specific) data was collected for all inputs and outputs from Liberty Primary Steel sites in the production stage (A1–A3). Direct emissions measured based on the Australian National Pollutant Inventory (NPI) scheme were provided by Liberty Primary Steel for all steel manufacturing sites. Specific information on waste water composition and discharges were provided by Liberty Primary Steel for processes likely to contaminate the water and therefore require treatment.

The original version of this EPD (2016) was based on an annual average for the time period July 2013 to June 2014. This EPD is based on an annual average for the time period July 2018 to June 2019, for all hotspots covering all inputs with a combined contribution of more than 95% of all main EN15804 impact categories.

Data for upstream and downstream processes:

Secondary (generic) data was used for all raw materials, energy and transport processes, as allowed under the PCR (IEPDS 2019). All data is from the GaBi Life Cycle Inventory Database 2020 and is typically representative of the years 2016 to 2019, depending on the dataset (Sphera 2020). Australian data was used where possible. Where regional data was unavailable, average data or data from other regions was used.

Data for credit and burden:

Our own processes for production of virgin steel and recycled steel have been used to calculate the credit or burden for the net recycling of scrap in Module D. This differs from the approach taken in 2014, which used global average data provided by worldsteel.

Electricity mixes:

Electricity consumption was modelled using state-specific grid mixes. The background data for the electricity sources (such as coal, wind power, etc.) is based on background data from the GaBi Life Cycle Inventory Database 2020 (Sphera 2020). Electricity consumption accounts for a significant proportion of total energy sources for the EAF processes. The SA grid mix (Whyalla) is 42% natural gas, 33% wind, and 24% imported from VIC, with a carbon intensity of 792 g CO_2e/kWh. The NSW grid mix (Sydney EAF) is predominantly hard coal (77%) with, 3.3% natural gas, 4.1% hydro, 2.5% wind, 6.5% imported from VIC, and 5.6% imported from QLD, and has a carbon intensity of 1,020 g CO_2e/kWh. The VIC grid mix (Laverton EAF) is predominantly lignite (80%) with 6.3% wind, 6.3% hydro, 3.2% natural gas, 2.4% imported from TAS, and 1.1% import from NSW, and has a carbon intensity of 1,320 g CO_2e/kWh.

Recycling:

When a structure reaches its end-of-life, the majority of the steel used in the structure is recovered. The recycling rate was based on a report on the waste industry prepared for the Australian Government, which indicates an average recycling rate of 90% for metals in Australia. (National Waste Report 2018). The remaining 10% is assumed to be lost to landfill (C4).

Allocation:

Where required, co-product allocation using the most relevant physical quantity (mass, volume or energy) was applied for core processes. Economic allocation was applied, using annual average prices for the time period July 2018 to June 2019, where the differences in the price of the co-products was large (>25%), including lead waste, zinc dross, and mill scale.

Secondary material inputs (e.g. steel scrap and tyres) reach end-of-waste state at the entry gate to a recycling facility. The recycling process is included within the system boundary, but the inputs are treated as burden free.

No allocation is applied to EAF and BOS slag produced by the steel works, which are managed on site to reach end-of-waste state and either used in site construction works or given away at no cost to a third party.. Allocation rules for secondary data (upstream/downstream processes) are documented on the GaBi website (Sphera 2020). Recycling allocation follows the polluter pays principle in line with EN 15804 and the PCR.

Cut off criteria:

Environmental impacts relating to personnel, infrastructure, and production equipment not directly consumed in the process are excluded from the system boundary as per the PCR (IEPDS 2019). The only inputs knowingly excluded from the inventory are packaging materials for minor inputs such as alloys, greases, etc., which are used in very small quantities.

Environmental impact indicators

EN 15804 and PCR 2012:01 v2.31 require the environmental indicators below, calculated based on CML characterisation factors (as updated in 2012).

Table 2: Environmental indicators based on CML characterisation factors

Impact category [Abbreviation]	Unit	Description
Global warming (climate change) potential [GWP]	kg CO_2 equivalent	Potential of greenhouse gases – such as carbon dioxide – to increase absorption of heat reaching Earth's atmosphere, intensifying the natural greenhouse effect.
Stratospheric ozone depletion potential [ODP]	kg CFC 11 equivalent	Potential of emissions that contribute to the reduction of the stratospheric ozone layer.
Acidification potential of land and water [AP]	kg SO_2 equivalent	Potential of emissions to cause acidifying effects in the environment, typically due to acid rain. Potential downstream effects include fish mortality, forest decline and the deterioration of building materials.
Eutrophication potential [EP]	kg PO_4^{3-} equivalent	Potential of emissions – such as nitrogen and phosphorus – to increase nutrient levels in both aquatic and terrestrial ecosystems, which can cause undesirable shifts in species composition and elevated biomass production (e.g. algal blooms).
Photochemical ozone creation potential [POCP]	kg C_2H_4 equivalent	Potential of emissions to contribute to air pollution (ground-level smog - mainly ozone), which can be harmful to human and ecosystem health and can also damage crops.
Depletion of abiotic resources (elements) [ADPE]	kg Sb equivalent	Decrease of the availability of non-renewable material resources.
Depletion of abiotic resources (fossil) [ADPF]	MJ net calorific value	Decrease of the availability of non-renewable fossil fuel resources.

The following impact categories have been added to comply with the 'Additional Life Cycle Impact Reporting' requirement listed in the 'Green Star – Design and As Built' (2014) rating tool from the Green Building Council of Australia.

Table 3: Impact categories added to comply with the 'Additional Life Cycle Impact Reporting' requirement

Impact category [Abbreviation]	Unit	Description	Methodology
Human toxicity, cancer [HTPc]	CTUh	Toxic effects of chemical emissions on human health due to cancer effects.	USEtox (Rosenbaum et al. (2008))
Human toxicity, non-cancer [HTPnc]	CTUh	Toxic effects of chemical emissions on human health due to non-cancer effects.	USEtox (Rosenbaum et al. (2008))
Land use [LU]	kg C deficit	Degradation of soil quality and fertility using Soil Organic Carbon as a proxy for Soil Organic Matter.	SOM model (Milà i Canals, Romanyà, & Cowell, 2006)
Resource depletion - water [RDW]	m^3 H_2O equivalent	Consumption of fresh water related to local and global water scarcity.	Water Stress Indicator* (Ridoutt & Pfister (2012))
Ionising radiation [IR]	kBq U-235 equivalent	Radioactive substances released to the environment that can be damaging to human health and ecosystems.	Human health impacts (Frischknecht et al. (2000))
Particulate matter [PM]	kg PM2.5 equivalent	Contribution to air pollution which can have respiratory effects.	Riskpoll (Rabi and Spadaro (2004))

**Using catchment specific characterisation factors from ALCAS http://auslci.com.au/Documents/WaterCatchmentswithnames.png.*

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Structural sections

Liberty Primary Steel produces the following structural sections, which are made to AS/NZS 3679.1 *Structural Steel Part 1: Hot rolled bars and sections* and are generally used in the construction and manufacturing industries.

Product	Size range (mm)	Section
Equal Angles	125x125x8 to 200x200x26*	
Parallel Flange Channels	180x75 to 380x100*	
Universal Beams	150x75 to 612x229	
Universal Columns	97x99 to 327x311	

**Smaller angle and channel sections are described in the InfraBuild* Hot Rolled Structural and Merchant Bar EPD.

300PLUS® is manufactured by Liberty Primary Steel for hot rolled structural steel sections for Australia and exceeds the minimum requirements of AS/NZS 3679.1 grade 300. Other grades, including grade 350, are available for some sections and quantities.

Changes in results from previous EPD

GWP, ADPF, AP, EP and POCP have all increased due to increased in coke consumption and the replacement of synthetic coke oven gas by natural gas due to internal distribution issues. ADPE impacts have increased significantly due to increases in alloy quantities used at Whyalla BOS, partly due to changes in steel chemistry and partly due to improved data collection. ODP has decreased by three orders of magnitude, due to updates in the background data sets reflecting the phase out of ozone depleting substances.

Results of assessment

Environmental impact indicators

The following indicators describe potential environmental impacts for each product per declared unit.

Table 4: Potential environmental impacts, 1 tonne of structural sections

Indicator	Production A1 – A3	Waste processing C3	Disposal C4	Recycling potential D
GWP [kg CO_2-eq.]	3.32E+03	2.41E+00	4.51E+00	-2.10E+03
ODP [kg CFC11-eq.]	2.47E-12	1.40E-14	1.46E-14	-4.89E-13
AP [kg SO_2-eq.]	7.81E+00	1.60E-02	1.27E-02	-1.88E+00
EP [kg PO_4^{3-}-eq.]	9.40E-01	3.91E-03	1.35E-03	-3.31E-01
POCP* [kg C_2H_4-eq.]	3.30E+00	1.76E-03	1.18E-03	-2.49E+00
ADPE [kg Sb-eq.]	1.28E-03	2.72E-06	3.39E-07	-9.21E-04
ADPF [MJ]	3.53E+04	4.56E+01	6.85E+01	-2.15E+04

The results from the impact assessment are only relative statements which give no information about the endpoint of the impact categories, exceeding of threshold values, safety margins or risk.

**POCP values are slightly reduced due to nitrogen monoxide (NO) having a negative characterisation factor in the CML-IA methodology (Guinée et. al., 2002) implemented within EN 15804:2012+A1:2013. It should not be interpreted as NO reducing summer smog. This dampening effect present because the GaBi Databases used in this project (Sphera, 2020) split NO_x emissions into NO and NO_2 for both mobile and stationary fuel combustion. POCP would be slightly higher if these emissions were instead grouped together as NO_x. Extra care should be taken when comparing POCP values between EPDs.*

Resource indicators

The following indicators describe the use of renewable and non-renewable material resources, renewable and non-renewable primary energy and water.

Table 5: Resource use, 1 tonne of structural sections

Indicator	Production A1 – A3	Waste processing C3	Disposal C4	Recycling potential D
PERE [MJ]	2.03E+03	3.92E+00	4.94E+00	-7.06E+02
PERM [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT [MJ]	2.03E+03	3.92E+00	4.94E+00	-7.06E+02
PENRE [MJ]	3.55E+04	4.66E+01	7.06E+01	-2.16E+04
PENRM [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT [MJ]	3.55E+04	4.66E+01	7.06E+01	-2.16E+04
SM [kg]	2.96E+02	0.00E+00	0.00E+00	INA
RSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF [MJ]	0.00E+00	0.00E+00	0.00E+00	7.43E+01
FW [m^3]	9.43E+00	1.22E-02	9.43E-04	-2.43E+00

Wastes and other outputs

Table 6: Waste categories, 1 tonne of structural sections

Indicator	Production A1 – A3	Waste processing C3	Disposal C4	Recycling potential D
HWD [kg]	8.54E-06	9.81E-07	3.20E-07	-4.35E-06
NHWD [kg]	7.69E+02	1.40E-02	1.00E+02	-3.09E+02
RWD [kg]	6.87E-02	3.74E-04	8.36E-04	-3.45E-02
CRU [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR [kg]	3.00E-01	9.00E+02	0.00E+00	INA
MER [kg]	7.05E-01	0.00E+00	0.00E+00	-4.84E-01
EEE [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EET [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00

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Table 7: Additional impact categories, 1 tonne of structural sections

Indicator	Production A1 – A3	Waste processing C3	Disposal C4	Recycling potential D
HTPc [CTUh]	9.20E-08	1.14E-10	2.11E-10	-4.86E-08
HTPnc [CTUh]	3.92E-09	5.31E-12	5.71E-12	4.93E-09
LU [kg C deficit]	3.81E+02	8.22E-01	4.70E-01	3.58E+01
RDW [m^3 H_2O-eq.]	3.13E+00	5.97E-03	6.27E-04	-1.60E+00
IR [kBq U235-eq.]	8.26E+00	3.38E-02	1.19E-01	-4.80E+00
PM [kg PM2.5-eq.]	1.97E+00	2.29E-03	9.02E-04	-1.25E+00

Rail products

Product description

Liberty Primary Steel produces steel rail suitable for the Australian market in sizes from 41 to 68 kg/m.

Rail is manufactured in accordance with the respective Liberty Primary Steel Technical Specifications (RT23 for 60kg, 50kg and 41kg Rail, RT19 for 68kg Rail, RT25 for 53kg Rail and RT27 for 47kg Rail). These Technical Specifications are based upon Australian Standard AS1085.1 with clarifications and enhancements included therein. Copies of these specifications are available on request.

Liberty Primary Steel produces both Plain Carbon ('As Rolled') and Head Hardened rails.

Liberty Primary Steel also produces Trak-Lok® steel sleepers that form part of the structure of a railway track.

Steel sleepers manufactured to AS 1085.17 *Railway track material. Part 17: Steel sleepers.*

Product	Size Range (mm)	Section
Rail	137 x 127 to 185 x 152	
Sleeper	258 x 97 to 300 x 122	

The LCA results listed in the following tables are applicable to both steel rails and sleepers.

Changes in results from previous EPD

GWP, ADPF, AP, EP and POCP have all increased due to increased in coke consumption and the replacement of synthetic coke oven gas by natural gas due to internal distribution issues. ADPE impacts have increased significantly due to increases in alloy quantities used at Whyalla BOS, partly due to changes in steel chemistry and partly due to improved data collection. ODP has decreased by three orders of magnitude, due to updates in the background data sets reflecting the phase out of ozone depleting substances.

Results of assessment

Environmental impact indicators

The following indicators describe potential environmental impacts for each product per declared unit.

Table 8: Potential environmental impacts, 1 tonne of rail product

Indicator	Production A1 – A3	Waste processing C3	Disposal C4	Recycling potential D
GWP [kg CO2-eq.]	3.32E+03	2.41E+00	4.51E+00	-2.10E+03
ODP [kg CFC11-eq.]	2.47E-12	1.40E-14	1.46E-14	-4.89E-13
AP [kg SO2-eq.]	7.81E+00	1.60E-02	1.27E-02	-1.88E+00
EP [kg PO43--eq.]	9.40E-01	3.91E-03	1.35E-03	-3.31E-01
POCP* [kg C2H4-eq.]	3.30E+00	1.76E-03	1.18E-03	-2.49E+00
ADPE [kg Sb-eq.]	1.28E-03	2.72E-06	3.39E-07	-9.21E-04
ADPF [MJ]	3.53E+04	4.56E+01	6.85E+01	-2.15E+04

The results from the impact assessment are only relative statements which give no information about the endpoint of the impact categories, exceeding of threshold values, safety margins or risk.

**POCP values are slightly reduced due to nitrogen monoxide (NO) having a negative characterisation factor in the CML-IA methodology (Guinée et. al., 2002) implemented within EN 15804:2012+A1:2013. It should not be interpreted as NO reducing summer smog. This dampening effect present because the GaBi Databases used in this project (Sphera, 2020) split NO_x emissions into NO and NO_2 for both mobile and stationary fuel combustion. POCP would be slightly higher if these emissions were instead grouped together as NO_x. Extra care should be taken when comparing POCP values between EPDs.*

Resource indicators

The following indicators describe the use of renewable and non-renewable material resources, renewable and non-renewable primary energy and water.

Table 9: Resource use, 1 tonne of rail product

Indicator	Production A1 – A3	Waste processing C3	Disposal C4	Recycling potential D
PERE [MJ]	2.03E+03	3.92E+00	4.94E+00	-7.06E+02
PERM [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT [MJ]	2.03E+03	3.92E+00	4.94E+00	-7.06E+02
PENRE [MJ]	3.55E+04	4.66E+01	7.06E+01	-2.16E+04
PENRE [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT [MJ]	3.55E+04	4.66E+01	7.06E+01	-2.16E+04
SM [kg]	2.96E+02	0.00E+00	0.00E+00	INA
RSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF [MJ]	0.00E+00	0.00E+00	0.00E+00	7.43E+01
FW [m^3]	9.43E+00	1.22E-02	9.43E-04	-2.43E+00

Wastes and other outputs

Table 10: Waste categories, 1 tonne of rail product

Indicator	Production A1 – A3	Waste processing C3	Disposal C4	Recycling potential D
HWD [kg]	8.54E-06	9.81E-07	3.20E-07	-4.35E-06
NHWD [kg]	7.69E+02	1.40E-02	1.00E+02	-3.09E+02
RWD [kg]	6.87E-02	3.74E-04	8.36E-04	-3.45E-02
CRU [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR [kg]	3.00E-01	9.00E+02	0.00E+00	INA
MER [kg]	7.05E-01	0.00E+00	0.00E+00	-4.84E-01
EEE [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EET [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00

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Table 11: Additional impact categories, 1 tonne of rail product

Indicator	Production A1 – A3	Waste processing C3	Disposal C4	Recycling potential D
HTPc [CTUh]	9.20E-08	1.14E-10	2.11E-10	-4.86E-08
HTPnc [CTUh]	3.92E-09	5.31E-12	5.71E-12	4.93E-09
LU [kg C deficit]	3.81E+02	8.22E-01	4.70E-01	3.58E+01
RDW [m^3 H_2O-eq.]	3.13E+00	5.97E-03	6.27E-04	-1.60E+00
IR [kBq U235-eq.]	8.26E+00	3.38E-02	1.19E-01	-4.80E+00
PM [kg PM2.5-eq.]	1.97E+00	2.29E-03	9.02E-04	-1.25E+00

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Acronyms

ADPE	Abiotic Depletion Potential For Non-Fossil Resources
ADPF	Abiotic Depletion Potential For Fossil Resources
AP	Acidification Potential
AusLCI	Australian Life Cycle Inventory Database
BF	Blast Furnace
BOS	Basic Oxygen Steelmaking
CML	Centre Of Environmental Science At Leiden
CRU	Components For Reuse
CTUh	Comparative Toxic Unit (human toxic potential)
EAF	Electric Arc Furnace
EEE	Exported Electrical Energy
EET	Exported Thermal Energy
EP	Eutrophication Potential
EPD	Environmental Product Declaration
FW	Net Use Of Fresh Water
Gabi	Ganzheitliche Bilanzierung (German For Holistic Balancing)
GWP	Global Warming Potential
HTPc	Human Toxicity Potential, Cancer Effects
HTPnc	Human Toxicity Potential, Non-Cancer Effects
HWD	Hazardous Waste Disposed
INA	Indicator Not Assessed. A result marked with 'INA' indicates this is unable to be assessed using the worldsteel data set for scrap
IR	Ionising Radiation
ISO	International Organization For Standardization
LCA	Life Cycle Assessment
LCI	Life Cycle Inventory
LU	Land Use
MCI	Material Circularity Indicator
MER	Materials For Energy Recovery
MFR	Materials For Recycling
NHWD	Non-Hazardous Waste Disposed
NPI	National Pollutant Inventory
NRSF	Use Of Non-Renewable Secondary Fuels
ODP	Ozone Depletion Potential
PERE	Use Of Renewable Primary Energy Excluding Renewable Primary Energy Resources Used As Raw Materials
PERM	Use Of Renewable Primary Energy Resources Used As Raw Materials
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 Resources
PERT	Total Use Of Renewable Primary Energy Resources
PM	Particulate Matter
POCP	Photochemical Ozone Creation Potential
RDW	Resource Depletion - Water
RSF	Use Of Renewable Secondary Fuels
RWD	Radioactive Waste Disposed
SM	Use Of Secondary Material
UN CPC	United Nations Central Product Classification

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