InfraBuild

Building futures through sustainable steel

Environmental Product Declaration

Reinforcing Rod, Bar, Wire and SENSE 600®

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Geographical scope:	Australia

In accordance with ISO 14025 and EN 15804:2012+A1:2013

ECO PLATFORM EPD VERIFIED

AUSTRALASIA EPD® ENVIRONMENTAL PRODUCT DECLARATION

EPD® THE INTERNATIONAL EPD® SYSTEM

AUSTRALIAN MADE

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

EPD registration number	EPD-IES-0000855:005
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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
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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:	EPD Australasia Ltd

Version	Date and Description
1	November 2016 – Original EPD released under OneSteel brand.
1.1	September 2020 – Updated in line with 5-year validity, including updated hotspot data covering over 95% of all impacts. Low Relaxation Strand and Low Relaxation Wire is no longer reported in this InfraBuild EPD.
1.2	May 2022 – Updated with new InfraBuild branding and logo. No change in any reported numbers or metrics.
1.3	April 2024 – Inclusion of results and technical details for SENSE 600® . Updated the GWP results of reinforcing rod, bar and wire by updating the GWP emission factors for state-specific electricity grid in Australia, aligning with the 2023 NGA factors.
005	December 2024 – Changes to language on low emissions language. No change to any reported numbers or metrics..

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InfraBuild
Building futures through sustainable steel

Welcome

At InfraBuild, we are on a mission to inspire and drive nation-building infrastructure and the construction of Australia's tomorrow using local resources, sustainable solutions, new technology and big thinking.

InfraBuild is dedicated to conducting our business to global environmental, social and commercial standards and has stated its ambition to become a low emissions steel manufactuer. 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.

InfraBuild's Environmental Product Declarations (EPDs) are independently verified and are 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, EPDs are another way we are here to deliver value to our customers and the construction industry.

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

The major changes in this EPD include:

- Inclusion of results and technical details for SENSE 600®.
- Updated the GWP results of reinforcing rod, bar and wire by adjusting the GWP emission factors for state-specific electricity grid in Australia, aligning with the 2023 NGA factors.

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How to use this EPD

InfraBuild recognises the importance of the transparency and independent verification of our products' credentials. This Environmental Product Declaration (EPD) covers the environmental impacts of reinforcing rod, bar and wire products as well as the SENSE 600® product.

Reinforcing rod is manufactured to meet the chemical requirements of AS 1442 *Carbon steels and carbon-manganese steels — Hot rolled bars and semi-finished products*.

Reinforcing bar and wire and SENSE 600® are manufactured to the following Australian and New Zealand Standard:

1. AS/NZS 4671: 2019 *Steel for the Reinforcement of Concrete*

Our products manufactured to AS/NZS 4671 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.

These products are typically used in the construction industry.

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 InfraBuild product going into your project.
- Complies with the requirements of a valid EPD that is recognised in all versions of the Green Star 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 and Green Star Buildings Version 1, Revision B.

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

IS Tool®

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 achiev ISv2.1 Rso-6 and Rso-7 or ISv1.2 Mat-2 credits under the IS® rating scheme.

ISC ISupply

ISC's ISupply Directory connects sustainable products and services with projects and assets undertaking an IS rating.

InfraBuild has been part of the ISupply Directory since its inception. Our listing within the ISupply directory can help your project or asset achieve sustainability outcomes rewarded under the IS rating scheme.

www.iscouncil.org/isupply/

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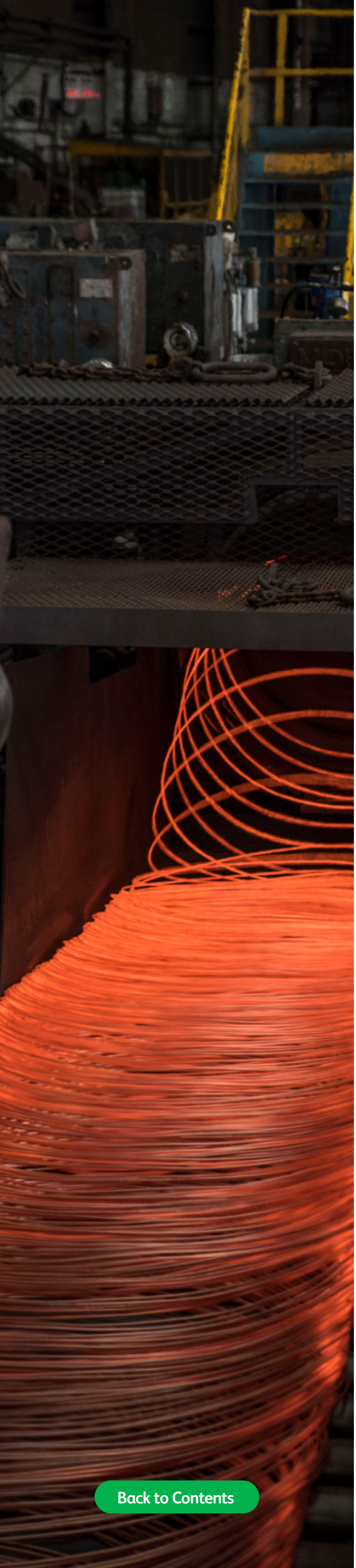

Benefits of using InfraBuild products

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 9).

Why InfraBuild?

At InfraBuild, 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.infrabuild.com

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Reinforcing Rod, Bar and Wire products

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Figure 1: Life cycle of InfraBuild products

Reinforcing Rod, Bar and Wire products

This EPD includes data on two products within the reinforcing rod, bar and wire product category. These are:

1. Reinforcing bar
2. Reinforcing rod and wire.

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

Under the United Nations Central Product Classification (UN CPC) system of classification InfraBuild reinforcing products fall into three categories:

- 41241: Bars and rods, hot rolled, in irregularly wound coils, of iron and non-alloy steel
- 41242: Other bars and rods of iron or non-alloy steel, not further worked than forged, hot rolled, hot drawn or extruded, but including those twisted after rolling
- 41264: Bars and rods, cold formed or cold finished, of alloy steel.

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

- 2221 Structural Steel Fabrication

The products are manufactured by InfraBuild at its major steelmaking and processing sites in Laverton, Vic and Rooty Hill, NSW, by Liberty Primary Steel at its integrated steelworks in Whyalla SA and other international sources.

A detailed description of the products can be found on pages 17 and page 20. The production process is described conceptually hereafter in Figure 3 (page 11).

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Steelmaking processes

InfraBuild's Rod, Bar and Wire products use steel produced using two different, but complementary, manufacturing processes.

The first involves InfraBuild's Electric Arc Furnaces (EAF), which primarily use scrap steel and electricity.

The second uses Liberty Primary Steel's integrated steel mill at Whyalla, SA, which incorporates 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.

These processes are complementary because EAF steelmaking cannot occur without scrap steel feed that has previously been created through the integrated steel manufacturing process.

The interdependency of the two processes is recognised by rating tools including Green Star® and IS® in that steel from both processes can contribute equally to obtaining credits under schemes.

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, InfraBuild 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.

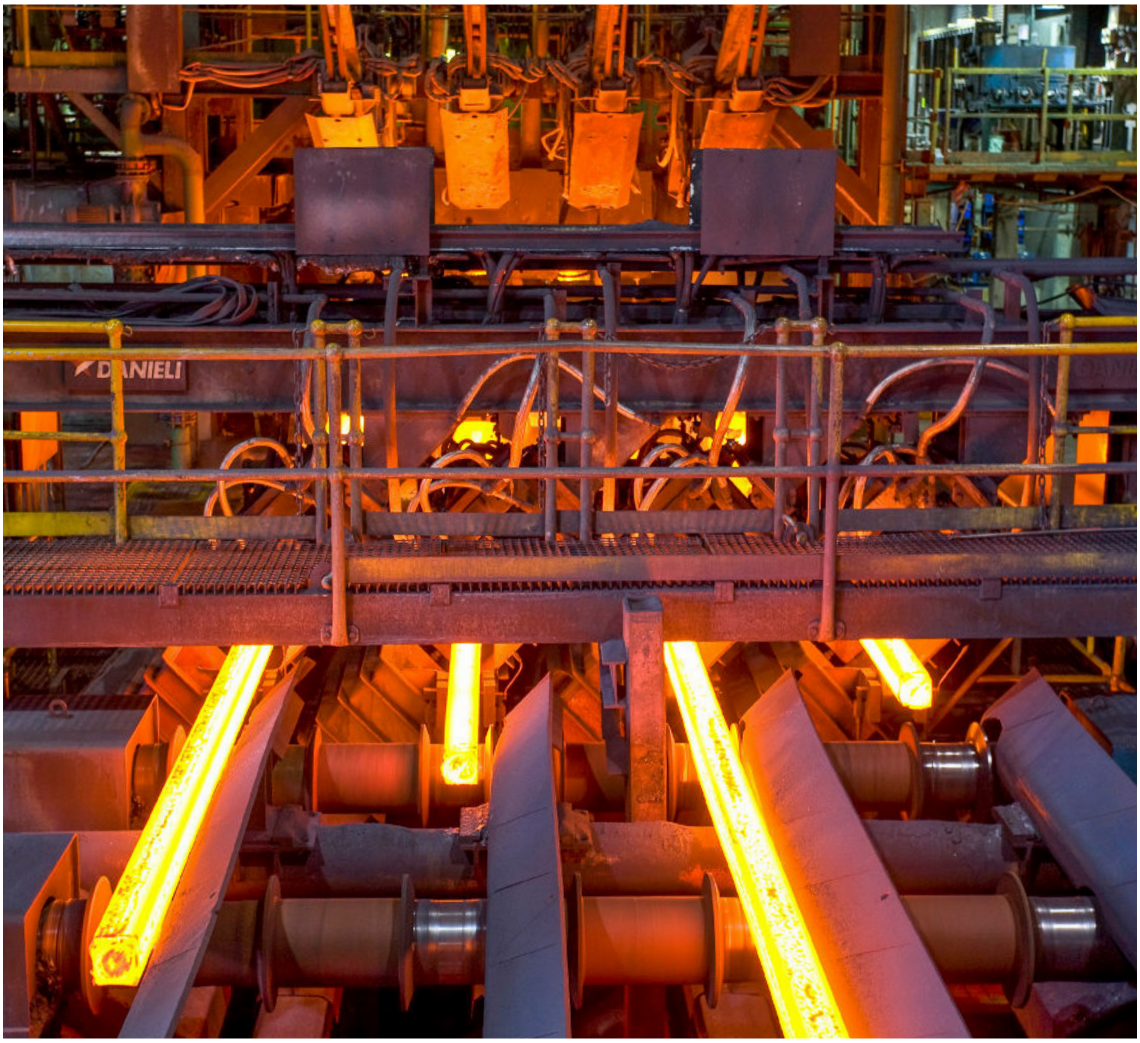

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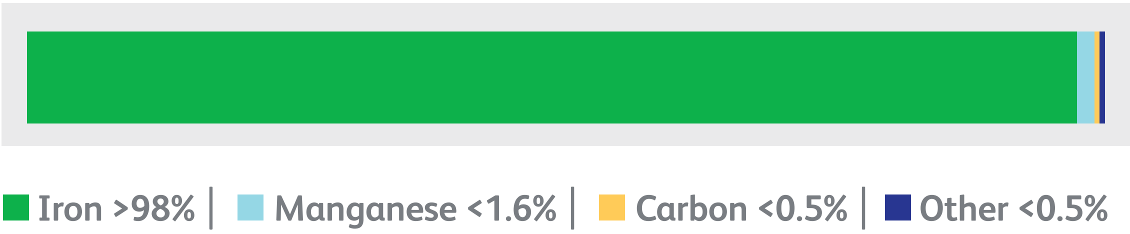
Figure 2: The typical composition of InfraBuild's reinforcing rod, bar and wire products

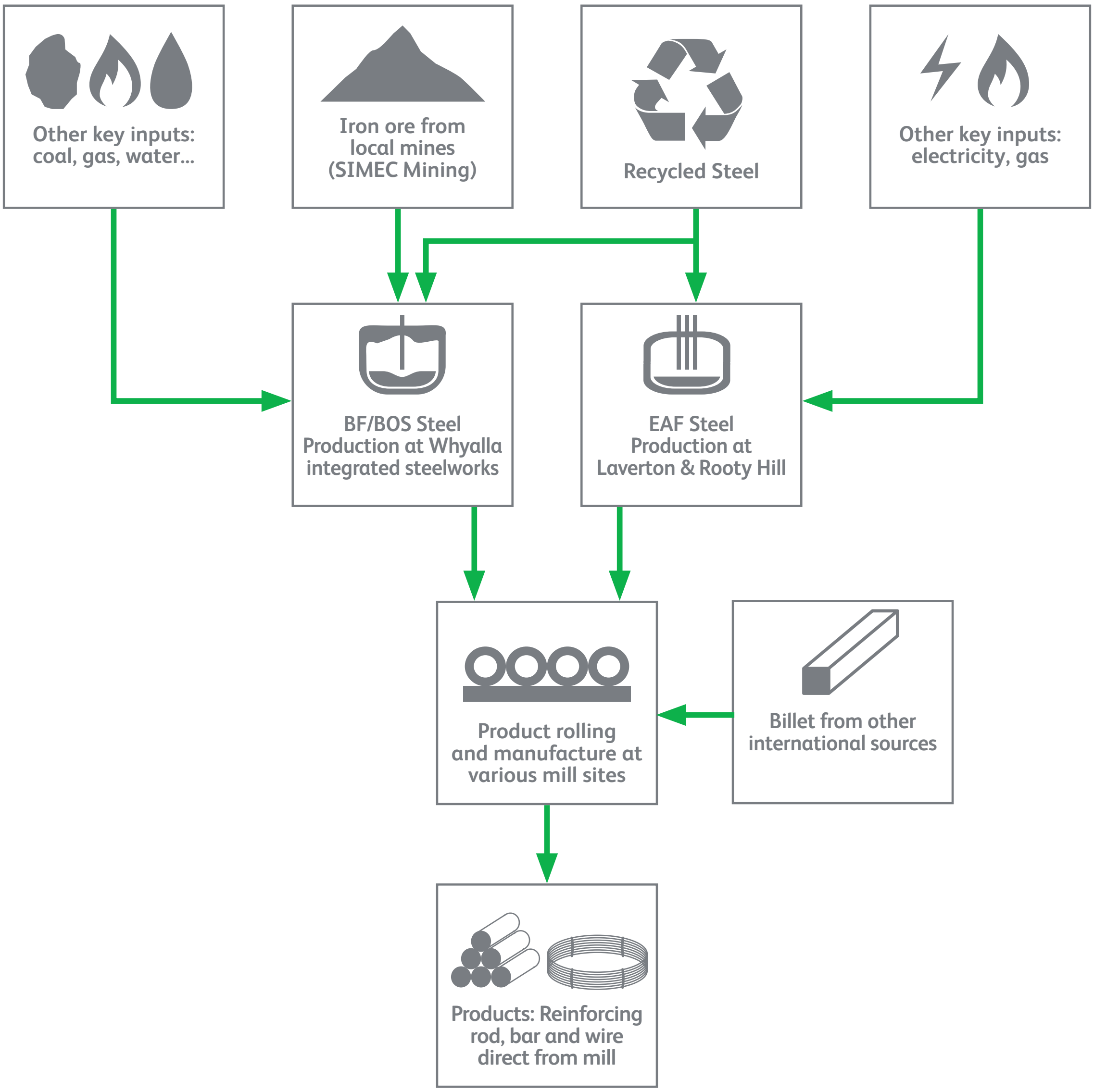


A range of alloys are used to manufacture the products and grades represented in this EPD. The use of alloys has been aggregated and averaged in this EPD. The impact of utilising alloys to produce different grades or products has no material impact on the outcome of this EPD.

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: Reinforcing rod, bar and wire products manufactured by InfraBuild



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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.

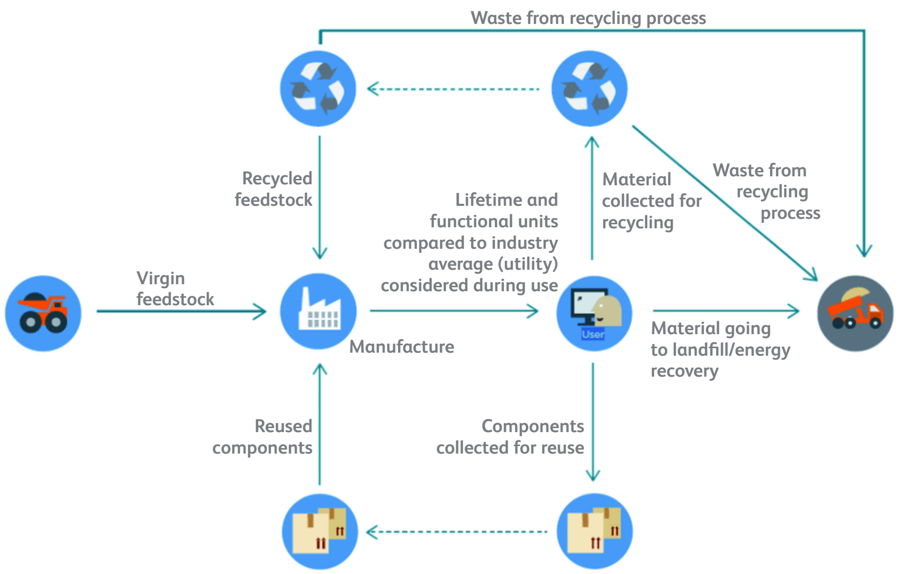
EPDs go a long way towards establishing a product's overall environmental impact by looking at the entire lifecycle of a product via an internationally standardised approach and independent verification. However on their own, EPDs stop short of quantifying a Circular Economy approach. This is where the 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)



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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.

For the Reinforcing Bar products (page 17), their MCI score of 0.698 shows a good level of circularity, reflecting a high proportion of recycled steel input as well as their recyclability potential at end of life.

For the Reinforcing Rod and Wire products (page 20), their MCI score of 0.572 shows these products are moving towards greater circularity, reflecting their recycled steel content as well as their 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 InfraBuild 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

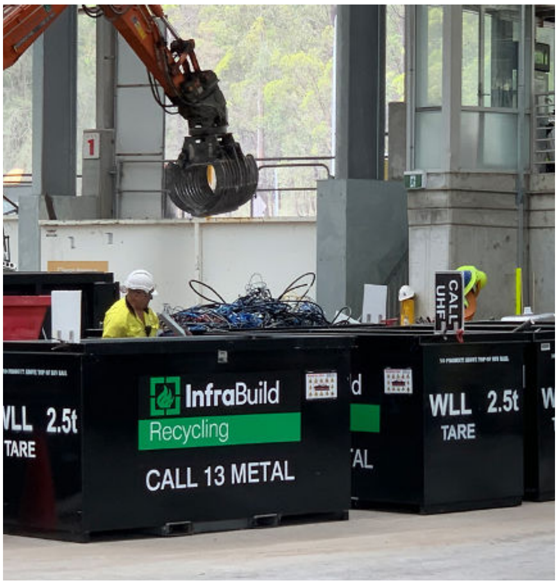
ISO 14001 is the international standard that specifies requirements for an effective Environmental Management System (EMS) that help organisations administer and control a company's environmental impact and compliance with regulations.

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."

InfraBuild has ISO 14001 EMS certification and the current certificate is available via the following link:

https://www.infrabuild.com/resources/compliance-certification/iso14001-environmental-management-system/



InfraBuild collects and processes scrap steel for use in the manufacture of new steel in its EAFs.

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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 InfraBuild sites in the production stage (A1–A3). Direct emissions measured based on the Australian National Pollutant Inventory (NPI) scheme were provided by InfraBuild for all steel manufacturing sites. Specific information on waste water composition and discharges were provided by InfraBuild 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. However, we understand that GaBi datasets for state-specific electricity in Australia do not reflect the recent changes to grid mixes. Hence, we have adjusted the GWP emission factors of state-specific grid mixes to align with the latest emission factors in the Australian Government's National Greenhouse Accounts Factors (DCCEEW, 2023). The SA grid mix (Whyalla) is modelled as 42 % natural gas, 33 % wind, and 24 % imported from VIC, with a GHG intensity (as per NGA 2023) of 0.33kg CO_2e/kWh. The NSW grid mix (Sydney EAF) is modelled as 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, with the GHG intensity (as per NGA 2023) of 0.73 kg CO_2e/kWh. The VIC grid mix (Laverton EAF) is modelled as 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, with the GHG intensity (as per NGA 2023) of 0.86 kg 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.

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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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Reinforcing Bar

Product description

Reinforcing bar is a hot rolled deformed bar of normal ductility grade 500 steel that meets AS/NZS 4671 *Steel reinforcing materials*. It is produced in both straight lengths and coils in sizes from 10mm to 50mm diameter. The required strength is achieved through either quenching and self-tempering, the addition of alloying elements, or mechanical stressing (continuous stretching).

Product	Size range (mm)	Section
Reinforcing Bar	10 mm to 50 mm diameter	

Changes in results from version 1.0 of this EPD

The first update of this EPD from version 1.0 resulted in updated results as described in this section. The results have not changed in further updates to the EPD. GWP and ADPF have increased slightly due to an increased proportion of production from Whyalla BOS. AP and EP have both decreased significantly due to improvements in EAF efficiency. POCP impacts have increased significantly due to increases in carbon monoxide, nitrogen oxides and sulphur dioxide emissions at Whyalla BOS. 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 reinforcing bar

Indicator	Production A1 – A3	Waste processing C3	Disposal C4	Recycling potential D
GWP [kg CO_2-eq.]	1,330	2.60	4.51	-64.0
ODP [kg CFC11-eq.]	1.69E-12	1.51E-14	1.46E-14	-1.49E-14
AP [kg SO_2-eq.]	4.73	0.0172	0.0127	-0.0573
EP [kg PO_4^{3-}-eq.]	0.508	0.00422	0.00135	-0.0101
POCP* [kg C_2H_4-eq.]	0.924	0.00189	0.00118	-0.0759
ADPE [kg Sb-eq.]	4.22E-04	2.93E-06	3.39E-07	-2.80E-05
ADPF [MJ]	17,500	49.2	68.5	-655

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.*

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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 reinforcing bar

Indicator	Production A1 – A3	Waste processing C3	Disposal C4	Recycling potential D
PERE [MJ]	946	4.22	4.94	-21.5
PERM [MJ]	0	0	0	0
PERT [MJ]	946	4.22	4.94	-21.5
PENRE [MJ]	17,600	50.2	70.6	-658
PENRM [MJ]	0	0	0	0
PENRT [MJ]	17,600	50.2	70.6	-658
SM [kg]	940	0	0	INA
RSF [MJ]	0	0	0	0
NRSF [MJ]	62.5	0	0	2.26
FW [m^3]	6.61	0.0131	9.43E-04	-0.0740

Wastes and other outputs

Table 6: Waste categories, 1 tonne of reinforcing bar

Indicator	Production A1 – A3	Waste processing C3	Disposal C4	Recycling potential D
HWD [kg]	4.35E-06	1.06E-06	3.20E-07	-1.33E-07
NHWD [kg]	358	0.0151	100	-9.41
RWD [kg]	0.0328	4.03E-04	8.36E-04	-0.00105
CRU [kg]	0	0	0	0
MFR [kg]	99.9	900	0	INA
MER [kg]	0.287	0	0	-0.0147
EEE [MJ]	0	0	0	0
EET [MJ]	0	0	0	0

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Table 7: Additional impact categories, 1 tonne of reinforcing bar

Indicator	Production A1 – A3	Waste processing C3	Disposal C4	Recycling potential D
HTPc [CTUh]	4.64E-08	1.23E-10	2.11E-10	-1.48E-09
HTPnc [CTUh]	8.05E-09	5.72E-12	5.71E-12	1.50E-10
LU [kg C deficit]	190	0.886	0.470	1.09
RDW [m^3 H_2O-eq.]	3.28	0.00644	6.27E-04	-0.0487
IR [kBq U235-eq.]	3.38	0.0364	0.119	-0.146
PM [kg PM2.5-eq.]	0.686	0.00246	9.02E-04	-0.0379

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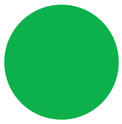
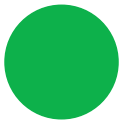
Reinforcing Rod and Wire

Product description

Steel rod is produced principally for the manufacture of reinforcing mesh. It is produced in coil in sizes from 5.5mm to 13.5mm diameter. It is manufactured to established internal standards so the final mesh product can conform to the relevant Australian Standard AS/NZS 4671.

Low ductility steel wire is used in reinforcing assemblies and is produced by cold rolling (ribbed wire) or cold drawing (round wire) in diameters from 4mm to 12mm.

Product	Size range (mm)	Section
Reinforcing Rod	5.5mm to 13.5mm diameter	
Reinforcing Wire	4mm to 12mm diameter	

Changes in results from version 1 of this EPD

The first update of this EPD from version 1.0 resulted in updated results as described in this section. The results have not changed in further updates to the EPD. GWP, ADPF, AP, EP and ADPE have decreased significantly due to an increased proportion of production from EAF and EAF efficiency improvements. POCP impacts have increased slightly due to increases in carbon monoxide, nitrogen oxides and sulphur dioxide emissions at Whyalla BOS. 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 reinforcing rod and wire

Indicator	Production A1 – A3	Waste processing C3	Disposal C4	Recycling potential D
GWP [kg CO_2-eq.]	1,750	2.60	4.51	-553
ODP [kg CFC11-eq.]	1.79E-12	1.51E-14	1.46E-14	-1.29E-13
AP [kg SO_2-eq.]	5.40	0.0172	0.0127	-0.495
EP [kg PO_4^{3-}-eq.]	0.604	0.00422	0.00135	-0.0873
POCP* [kg C_2H_4-eq.]	1.48	0.00189	0.00118	-0.657
ADPE [kg Sb-eq.]	6.21E-04	2.93E-06	3.39E-07	-2.43E-04
ADPF [MJ]	21,800	49.2	68.5	-5,670

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.*

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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 reinforcing rod and wire

Indicator	Production A1 – A3	Waste processing C3	Disposal C4	Recycling potential D
PERE [MJ]	1,120	4.22	4.94	-186
PERM [MJ]	0	0	0	0
PERT [MJ]	1,120	4.22	4.94	-186
PENRE [MJ]	21,900	50.2	70.6	-5,690
PENRM [MJ]	0	0	0	0
PENRT [MJ]	21,900	50.2	70.6	-5,690
SM [kg]	736	0	0	INA
RSF [MJ]	0	0	0	0
NRSF [MJ]	47.0	0	0	19.6
FW [m^3]	7.27	0.0131	9.43E-04	-0.640

Wastes and other outputs

Table 10: Waste categories, 1 tonne of reinforcing rod and wire

Indicator	Production A1 – A3	Waste processing C3	Disposal C4	Recycling potential D
HWD [kg]	5.29E-06	1.06E-06	3.20E-07	-1.15E-06
NHWD [kg]	448	0.0151	100	-81.4
RWD [kg]	0.0401	4.03E-04	8.36E-04	-0.00910
CRU [kg]	0	0	0	0
MFR [kg]	72.0	900	0	INA
MER [kg]	0.512	0	0	-0.127
EEE [MJ]	0	0	0	0
EET [MJ]	0	0	0	0

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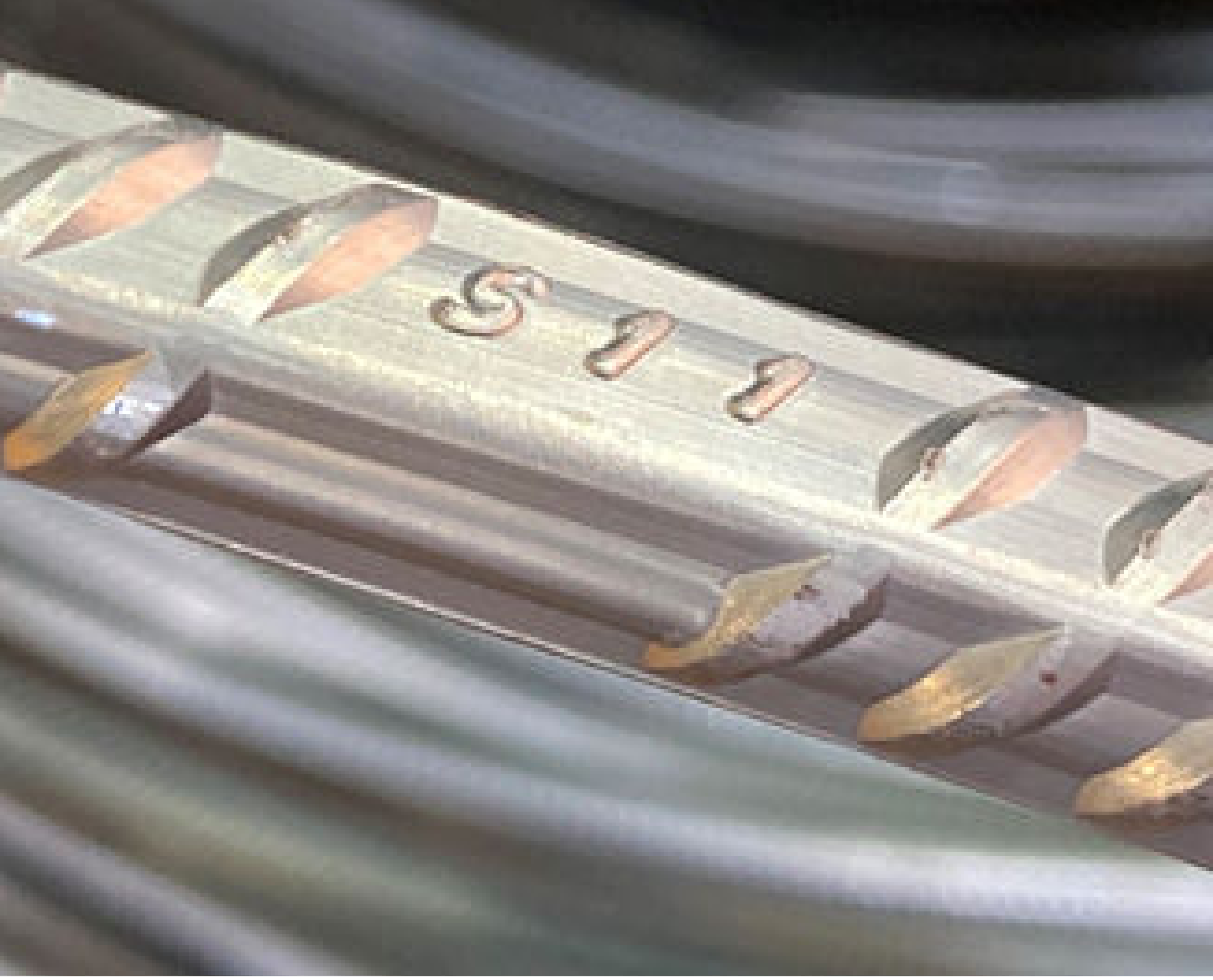
Table 11: Additional impact categories, 1 tonne of reinforcing rod and wire

Indicator	Production A1 – A3	Waste processing C3	Disposal C4	Recycling potential D
HTPc [CTUh]	5.67E-08	1.23E-10	2.11E-10	-1.28E-08
HTPnc [CTUh]	6.81E-09	5.72E-12	5.71E-12	1.30E-09
LU [kg C deficit]	230	0.886	0.470	9.42
RDW [m^3 H_2O-eq.]	3.32	0.00644	6.27E-04	-0.421
IR [kBq U235-eq.]	4.43	0.0364	0.119	-1.26
PM [kg PM2.5-eq.]	0.987	0.00246	9.02E-04	-0.328



SENSE 600® Reinforcing Bar

Introducing SENSE 600®

With SENSE 600®, we are building a sustainable tomorrow with our lower embodied carbon construction solutions.

InfraBuild is dedicated to conducting our business to global environmental, social and commercial standards and is focused to become a low emissons steel manufacturer. 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.

InfraBuild's Environmental Product Declarations (EPDs) are independently verified and are 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, EPDs are another way we are here to deliver value to our customers and the construction industry.

InfraBuild recognises that we have a major impact on our customers Scope 3 emissions profile hence it is our focus to become a low emissions steel manufacturer, delivering real value to our construction partners decarbonisation ambitions. This is where we need to work smarter and more efficiently to deliver lower carbon embodied solutions to our customers - optimising the use of lower carbon intensity steel and reducing the amount we consume and supply. This principle will be core to the range of products and solutions InfraBuild delivers as part of its SENSE Solutions market offering.

Benefits of using SENSE 600® 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. In theory 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 5 (page 25).

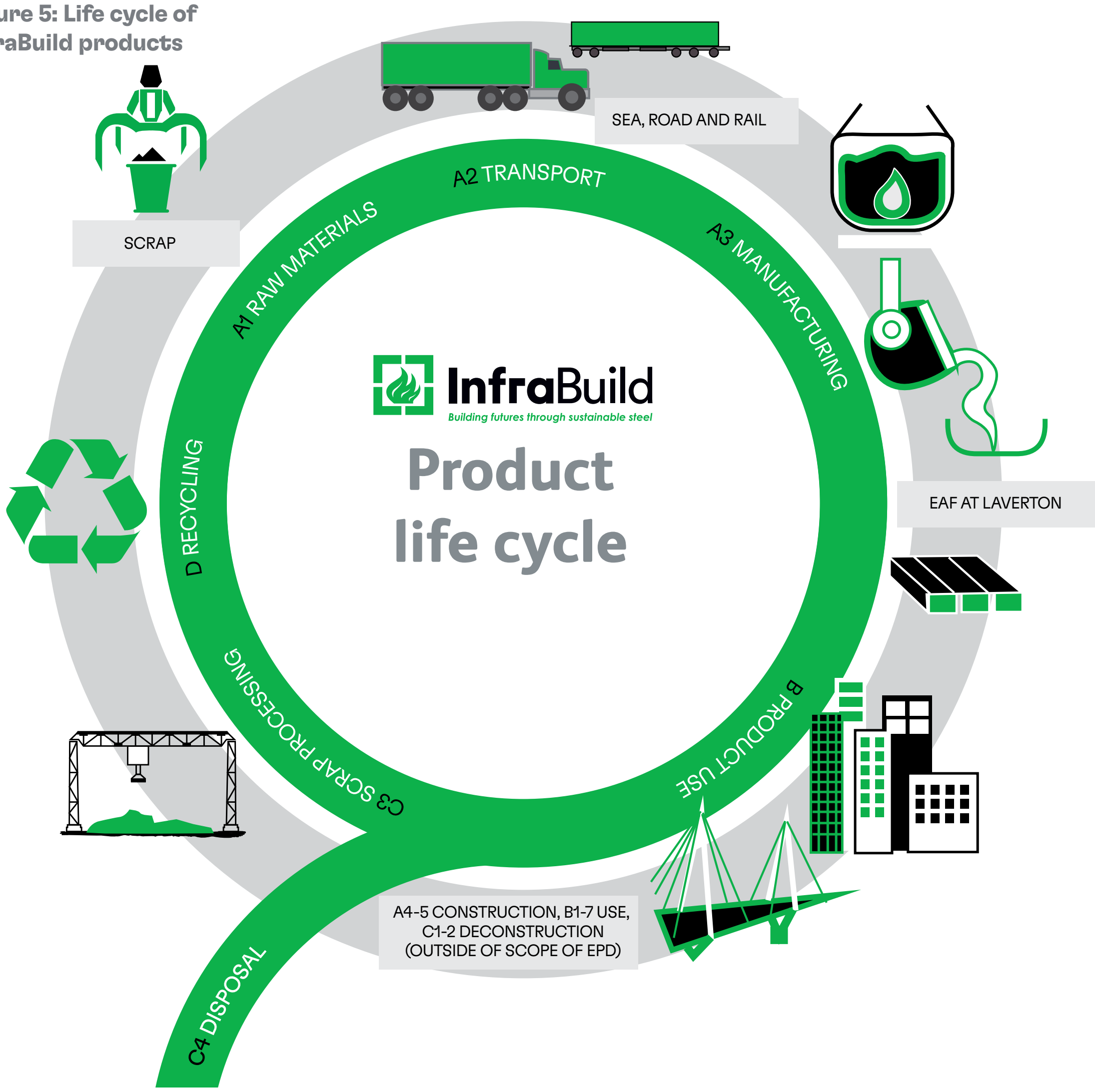
Why SENSE 600®?

SENSE Solutions is committed to its role in supporting Australia's shift to a lower carbon emission economy.

The development of innovative new products and solutions that improve building design, construction efficiency and lower embodied carbon outcomes are our focus.

For more information refer to **www.infrabuild.com/sense-solutions/**

Figure 5: Life cycle of InfraBuild products



Reinforcing products

This EPD includes data on one product within the reinforcing rod, bar and wire product category. This is:

1. SENSE 600® reinforcing bar

Products included in this EPD are available in a wide range of sizes.

Under the United Nations Central Product Classification (UN CPC) system of classification InfraBuild reinforcing products fall into three categories:

- 41241: Bars and rods, hot rolled, in irregularly wound coils, of iron and non-alloy steel
- 41242: Other bars and rods of iron or non-alloy steel, not further worked than forged, hot rolled, hot drawn or extruded, but including those twisted after rolling
- 41264: Bars and rods, cold formed or cold finished, of alloy steel.

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

- 2221 Structural Steel Fabrication

The products are manufactured by InfraBuild at its major steelmaking and processing sites in Laverton, Vic. A detailed description of the product can be found on page 33.

This EPD relates to products manufactured by InfraBuild and therefore does not include imported products or components. The production process is described conceptually hereafter in Figure 7 (page 27).

Steelmaking processes

InfraBuild uses steel produced only from its own Electric Arc Furnaces (EAF) in Laverton (Victoria, Australia), which primarily uses scrap steel and electricity, to produce SENSE 600® products.

As such, InfraBuild takes advantage of the reduced emissions intensity associated with our EAF manufacturing process to deliver the SENSE 600® products that have a lower GWP compared to InfraBuild's standard 500 grade reinforcing range.

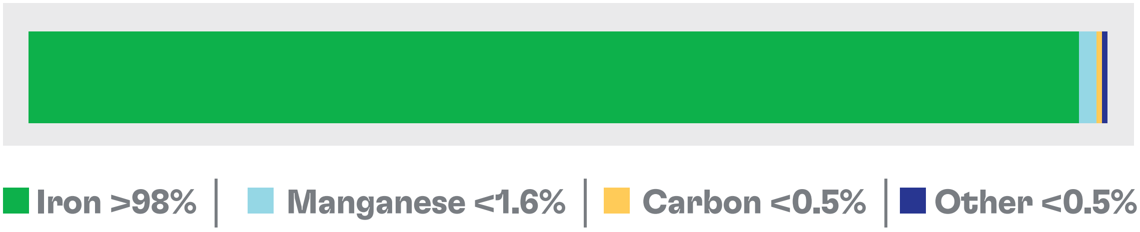
As SENSE 600® is also rolled in reduced diameters, that provide the same Load Capacity as InfraBuild's standard 500 grade reinforcing products, a mass saving of up to 16.7 % can be achieved in certain applications.

The combination of 100 % EAF production and up to 16.7 % mass saving in certain applications can deliver further reduction of embodied carbon for the SENSE 600® option compared to InfraBuild's standard 500 grade reinforcing range.

The reduction will be project specific and depends on the application. Our SENSE 600® website: **www.infrabuild.com/sense-solutions/sense600/** provides further information on the potential savings for your project.

As a manufacturer, InfraBuild 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.

Figure 6: The typical composition of InfraBuild's reinforcing rod, bar and wire products



A range of alloys are used to manufacture the products at Laverton EAF. The use of alloys was aggregated and averaged in the original study, which also forms the underlying data for SENSE 600®. Quantities of some alloys and other additions have been scaled up based on the recipe for SENSE 600®. The amounts of alloys used are very small and continue to represent less than 0.5 percent of the total content.

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.

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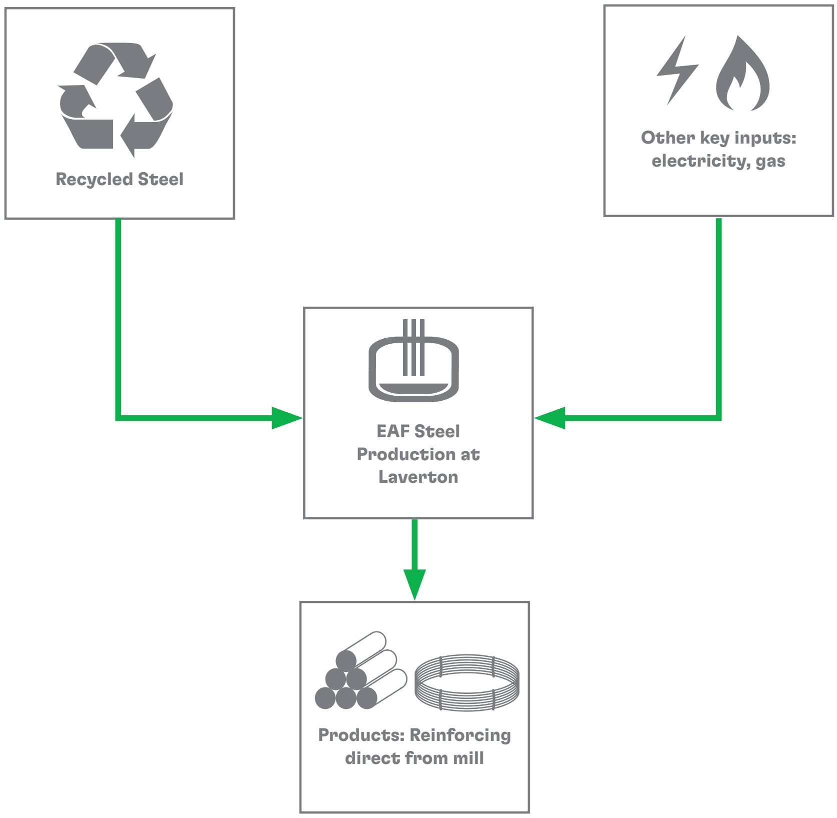
Figure 7: SENSE 600® Reinforcing products manufactured by InfraBuild



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The Material Circularity Indicator

SENSE 600® products have an MCI score of 0.898, which shows a high level of circularity, reflecting the high level of recycled steel input as well as their recyclability potential at end of life.

The Material Circularity Indicator calculations include comparison of the product's use stage intensity to industry average. This can be used to consider the impact of lightweighting. SENSE 600® can deliver lightweighting of up to 16.7% less mass compared to 500N reinforcing steel. If the full benefits of lightweighting were achieved in building design, the MCI would increase up to 0.915.

Please see page 12 for more information on the MCI.

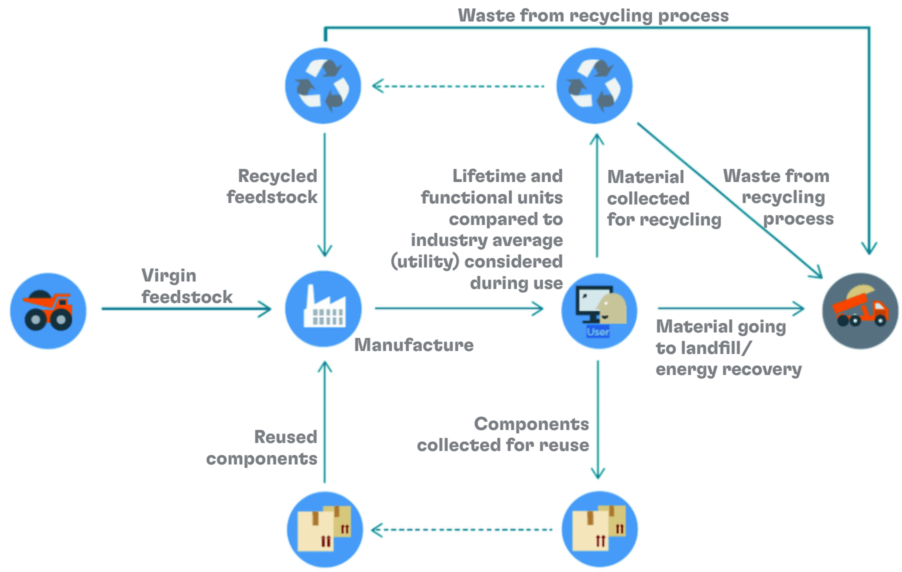
What this looks like in practice

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

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 InfraBuild 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.

Figure 8: Diagrammatic representation of Material Flows (Ellen McArthur Foundation 2015)



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ISO 14001

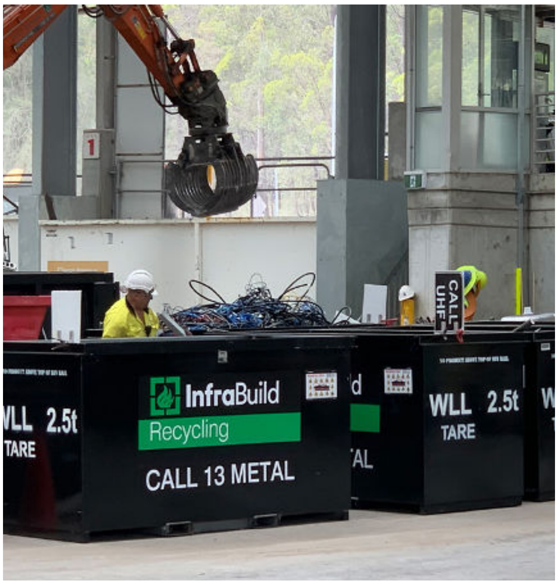
ISO 14001 is the international standard that specifies requirements for an effective Environmental Management System (EMS) that help organisations administer and control a company's environmental impact and compliance with regulations.

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."

InfraBuild has ISO 14001 EMS certification and the current certificate is available via the following link:

https://www.infrabuild.com/resources/compliance-certification/iso14001-environmental-management-system/



InfraBuild collects and processes scrap steel for use in the manufacture of new steel in its EAFs.

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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 12. This scope is referred to as 'cradle-to-gate with options'.

The production phase of this EPD includes the transportation and processing of scrap steel, 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.

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).																

Table 12: Modules included in the scope of the EPD

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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Version EPD-IES-0000855:005

Key assumptions

Data for core processes:

SENSE 600® is a new product and does not yet have one years worth of production data. The results are based on the original data as described below with minor changes made to additions (eg alloys and fluxes) at Laverton EAF based on the recipe for SENSE 600®.

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

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. For remaining processes the original study data is used, based on an annual average for the time period July 2013 to June 2014.

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 is based on the annual average for the time period July 2018 to June 2019, and does not reflect any differences to alloys used for SENSE 600®.

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).

However, we understand that GaBi datasets for state-specific electricity in Australia do not reflect the recent changes to grid mixes. Hence, we have adjusted the GWP emission factors of state-specific grid mixes to align with the latest emission factors in the Australian Government's National Greenhouse Accounts Factors (DCCEEW, 2023).

Electricity consumption accounts for a significant proportion of total energy sources for the EAF processes. The VIC grid mix (Laverton EAF) is predominantly lignite (80%) with 6.3% wind, 3.2% natural gas, 2.4% imported from TAS, and 1.1% import from NSW and has a carbon intensity (as per NGA 2023) of 0.86kg 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.

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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 13: 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 14: 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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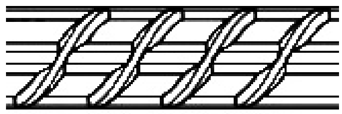
SENSE 600® Reinforcing Bar

Product description

Reinforcing bar is a hot rolled deformed bar of normal ductility grade 600 steel that meets AS/NZS 4671 Steel reinforcing materials. It is produced in both straight lengths and coils in sizes from 11mm to 37mm diameter. The required strength is achieved through either quenching and self-tempering, the addition of alloying elements, or mechanical stressing (continuous stretching).

Product	Size range (mm)	Section
Reinforcing Bar	11 mm to 37 mm diameter	

Results of assessment

Environmental impact indicators

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

Table 15: Potential environmental impacts, 1 tonne of SENSE 600® reinforcing bar

Indicator	Production A1 – A3	Waste processing C3	Disposal C4	Recycling potential D
GWP [kg CO_2-eq.]	966	2.41	4.51	541
ODP [kg CFC11-eq.]	1.27E-12	1.40E-14	1.46E-14	1.26E-13
AP [kg SO_2-eq.]	4.06	0.0160	0.0127	0.484
EP [kg PO_4^{3-}-eq.]	0.383	0.00391	0.00135	0.0852
POCP* [kg C_2H_4-eq.]	0.292	0.00176	0.00118	0.642
ADPE [kg Sb-eq.]	2.16E-04	2.72E-06	3.39E-07	2.37E-04
ADPF [MJ]	14,300	45.6	68.5	5,540

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.*

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Resource indicators

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

Table 16: Resource use, 1 tonne of SENSE 600® reinforcing bar

Indicator	Production A1 – A3	Waste processing C3	Disposal C4	Recycling potential D
PERE [MJ]	840	3.92	4.94	182
PERM [MJ]	0	0	0	0
PERT [MJ]	840	3.92	4.94	182
PENRE [MJ]	14,400	46.6	70.6	5,560
PENRM [MJ]	0	0	0	0
PENRT [MJ]	14,400	46.6	70.6	5,560
SM [kg]	1,170	0	0	INA
RSF [MJ]	0	0	0	0
NRSF [MJ]	95.4	0	0	-19.1
FW [m^3]	9.14	0.0122	9.43E-04	0.625

Wastes and other outputs

Table 17: Waste categories, 1 tonne of SENSE 600® reinforcing bar

Indicator	Production A1 – A3	Waste processing C3	Disposal C4	Recycling potential D
HWD [kg]	3.90E-06	9.81E-07	3.20E-07	1.12E-06
NHWD [kg]	281	0.0140	100	79.5
RWD [kg]	0.0345	3.74E-04	8.36E-04	0.00889
CRU [kg]	0	0	0	0
MFR [kg]	137	900	0	INA
MER [kg]	0.0784	0	0	0.124
EEE [MJ]	0	0	0	0
EET [MJ]	0	0	0	0

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Table 18: Additional impact categories, 1 tonne of SENSE 600® reinforcing bar

Indicator	Production A1 – A3	Waste processing C3	Disposal C4	Recycling potential D
HTPc [CTUh]	3.98E-08	1.14E-10	2.11E-10	1.25E-08
HTPnc [CTUh]	1.02E-08	5.31E-12	5.71E-12	-1.27E-09
LU [kg C deficit]	131	0.822	0.470	-9.20
RDW [m^3 H_2O-eq.]	5.35	0.00597	6.27E-04	0.411
IR [kBq U235-eq.]	2.98	0.0338	0.119	1.23
PM [kg PM2.5-eq.]	0.390	0.00229	9.02E-04	0.321

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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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References

- CEN. (2012). EN 15804:2012+A1:2013; Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products. Brussels: European Committee for Standardization.
- DCCEEW. (2023). Australian National Greenhouse Accounts Factors Workbook 2023. Canberra: Australian Government Department of Climate Change, Energy, the Environment.
- Ellen McArthur Foundation. (2015) Circularity Indicators: An approach to measuring circularity. Available: https://www.ellenmacarthurfoundation.org/assets/downloads/insight/Circularity-Indicators_Project-Overview_May2015.pdf
- EPD Australasia (2018). Instructions of the Australasian EPD Programme V3.0, 2018-09-18. Retrieved from https://epd-australasia.com/wp-content/uploads/2018/09/Australasian-Annex-to-GPI_3.0-2018.pdf
- Frischknecht, R., Braunschweig, A., Hofstetter, P., & Suter, P. (2000). Human health damages due to ionising radiation in life cycle impact assessment. Environmental Impact Assessment Review (20), 159-189.
- Grant, T., Renouf, M. A., Sevenster, M., Ridoutt, B., Ximenes, F., Logie, J., . . . Lane, J. (2016). Best Practice Guide to Life Cycle Impact Assessment in Australia. Australian Life Cycle Assessment Society. Retrieved from www.alcas.asn.au
- Greco, S.L., Wilson, A.M., Spengler J.D., and Levy J.I. (2007). Spatial patterns of mobile source particulate matter emissions-to-exposure relationships across the United States. Atmospheric Environment (41), page 1011-1025.
- Green Building Council of Australia (2019). Green Star Design & As Built v1.3 Submission Guidelines. Retrieved from https://new.gbca.org.au/rate/rating-system/design-and-built/.
- Guinée, J. B., Gorrée, M., Heijungs, R., Huppes, G., Kleijn, R., de Koning, A., . . . Huijbregts, M. (2002). Handbook on life cycle assessment. Operational guide to the ISO standards. Dordrecht: Kluwer.
- IEPDS. (2019). PCR 2012:01, Construction products and Construction services, Version 2.31, 2019-12-20. The Internatinal EPD® System. Retrieved from http://www.environdec.com/en/PCR/Detail/?Pcr=8098.
- ISO (2006). ISO 14025:2006; Environmental labels and declarations — Type III environmental declarations — Principles and procedures. Geneva: International Organization for Standardization.
- Milà i Canals, L., Romanyà, J., & Cowell, S. J. (2006). Method for assessing impacts on life support functions (LSF) related to the use of 'fertile land' in Life Cycle Assessment (LCA). Journal of Cleaner Production, 15, 1426-1440.
- Pickin, J., Randell, P., Trinh, J., & Grant, B. (2018). National Waste Report 2018. Australia: Department of the Environment and Energy.
- Rabi, A. and Spadaro, J.V. (2004). The RiskPoll software, version is 1.051 (dated August 2004). www.arirabl.com.
- Ridoutt, B. G., & Pfister, S. (2012). A new water footprint calculation method integrating consumptive and degradative water use into a single stand-alone weighted indicator; in Int J Life Cycle Assess (Received: 29 February 2012; Accepted: 8 June 2012 ed.). pringer-Verlag.
- Rosenbaum, R. K., Bachmann, T. M., Swirsky Gold, L., Huijbregts, M., Jolliet, O., Juraske, R., . . . Hauschild, M. Z. (2008). USEtox—the UNEP-SETAC toxicity model: recommended characterisation factors for human toxicity and freshwater ecotoxicity in life cycle impact assessment. Int J Life Cycle Assess, 13(7), 532–546.
- Sphera (2020); GaBi Databases 2020. http://www.gabi-software.com/support/gabi/gabi-database-2020-lci-documentation/.
- Standards Australia (2007). AS 1442:2007, Carbon steels and carbon-manganese steels - Hot rolled bars and semi-finished products. SAI Global.
- Standards Australia (2019). AS/NZS 4671, Steel for the reinforcement of concrete. SAI Global.
- thinkstep-anz (2020); InfraBuild EPD Background Report v1.0. 24/08/2020
- thinkstep-anz (2024); InfraBuild LCA Report Appendix Q: SENSE 600-v1.0. 30/04/2024.

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