The Sustainability of Steel

Sustainable development is a global priority. Through efficient use of resources, intelligent design of products and their uses, and reduction of greenhouse emissions and water use, the Australian steel industry can lower the impact of climate change.

Steel is the world's most important engineering and construction material. It underpins almost every aspect of our lives – buildings, transport, infrastructure, home appliances and lifestyle goods. Not surprisingly then, Australian steelmaking companies produce more than 4.5 million tonnes of steel per annum, and the rate of steel use in Australia is 290kg per capita (worldsteel, 2016).

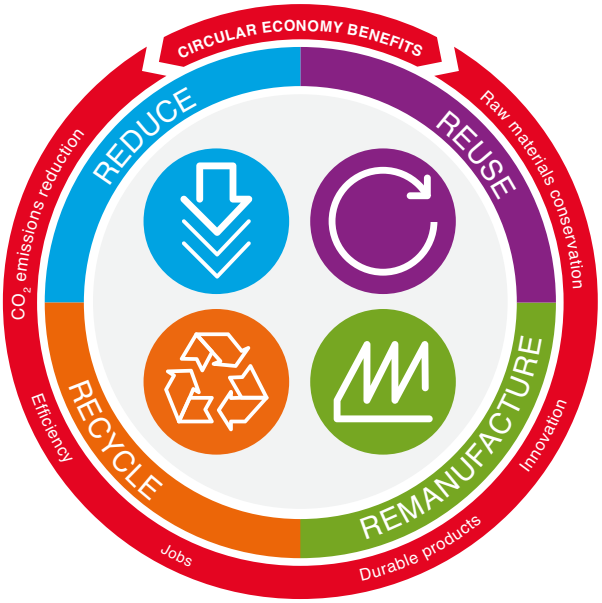
With such rates of production, it is vital that the Australian steel industry is a major proponent of sustainable practices. The steel industry has made immense efforts to limit environmental pollution in the last decades. Producing one tonne of steel today requires just 40% of the energy that it did in 1960 (worldsteel, 2018).

According to Tony Dixon (Chief Executive, Australian Steel Institute), "Sustainable futures are predicated on innovation. Flexibility, innovation, collaboration and communication are fundamental to an environmentally sustainable future for steel manufacturing specifically, and the steel supply chain in general. Australian industry understands that it must invest in more productive and efficient practices and embrace innovation."

"We have the clear mandate from our community, and the opportunity to promote a cleaner and healthier environment, by working together towards improving the environmental sustainability of the entire steel supply chain, from steelmaking and construction to recycling and reuse, implementing innovative technology and best practice sustainable design."

"We have the responsibility to our and future generations to set in place the solutions and tools that enable improved performance and reduced environmental impact, moving towards a lifecycle perspective and what we think of as a circular economy."

"There are three primary focus areas that can help us move towards a true circular economy: responsible steelmaking; environmentally aware steelwork fabrication and processing; and steel as an environmentally responsible design solution," said Dixon.



Responsible Steelmaking

Steelmakers have an obligation to safeguard the environment by pursuing sustainable technologies and abiding by certification designed to ensure the environmental credentials of their products.

Acting Responsibly

The major steel companies of the world have joined the World Steel Association Climate Action Group. At the core of this program is the collection and reporting of CO_2 emissions data by the steel plants in all the major steel-producing countries.

In Australia, BlueScope Steel and Liberty have both contributed to the CO_2 data collection program for more than ten consecutive years. BlueScope Steel reports a reduction in carbon emissions of over 40% since 2011 (BlueScope Steel Sustainability Report 2017-2018).

Improving Steel's Performance

The energy and greenhouse gas emission intensity of steel production has decreased markedly. In the last 50 years, the steel industry has reduced its energy consumption per tonne of steel produced by 60% (worldsteel, 2018) through continuous improvement and technological change.

Over this time, Australia's steel industry has moved from 100% ingot casting to 100% continuous casting, improving yields and saving approximately 25% of the energy formerly required to make slabs.

Recycling and Reuse

The ability of steel to be reused and recycled, again and again, into new steel products, is one of its main and unrivalled sustainability virtues. Measured in tonnes, steel is easily the most recycled material in the world, with approximately 650 mega tonnes, equivalent to over 80%, recycled annually (worldsteel, 2018).

In Australia, in percentage terms, metals have the highest recycling rate of all solid waste generated in Australia – 82%, compared with 74% of concrete waste, 55% of paper waste and 38% of glass waste (Australian Bureau of Statistics, 2006).

Environmental Product Declarations

Environmental Product Declarations (EPD), and other similar forms of certification, are designed to convey the environmental credentials of a product.

They can contain an assessment of embodied energy, greenhouse gas estimate, global warming effect and often have an environmental impact rating that takes account of, for example, varying regional factors. They also track the stewardship of a product, which includes the relative sustainability of mining, transport, energy use, manufacturing, waste disposal and other factors involved in its generation.

There has been a significant uptick in the production of EPDs in Australia, with approximately 10 now available from BlueScope Steel and Liberty.

Environmentally Aware Steelwork Fabrication and Processing

The flagship ASI solution for environmentally aware steelwork fabrication and processing is the Environmental Sustainability Charter.

Established in conjunction with the Green Building Council Australia (GBCA), the Charter requires participating downstream enterprises associated with steelwork fabrication, processing or contracting, to commit to conducting their businesses in ways that:

- Reduce their environmental footprint
- Demonstrate environmental responsibility
- Seek the same commitment in their subcontractors and suppliers
- Share their knowledge of sustainability with others

By using steel fabricated or processed by a member of the ASI Environmental Sustainability Charter, the environmental credentials for a project can be reinforced and, if relevant, the project may gain a point towards GBCA Green Star rating.

For further information about the ASI Environmental Sustainability Charter see the article on page 22.

Steel as an Environmentally Responsible Design Solution

Steel's strength, lightness and durability combine to enable sustainable construction solutions. The use of steel as the structural solution means less weight on foundations, longer spanning spaces, simplification of design, ease of construction and minimal site waste.

Whether it is structural efficiency, futureproofing or design for deconstruction and reuse, steel has an environmentally responsible design solution.

Steel provides product and structural designers with the ultimate opportunity to configure solutions around the 'Four Rs' of the circular economy:

- **Reduce:** New innovative, stronger, lighter steel products require less steel, conserving energy and raw materials.
- **Reuse:** Steel's durability enables many products to be reused, extending the product lifecycle and conserving resources.
- **Remanufacture:** Remanufacturing restores used steel products to like-new condition, extending the overall product lifecycle and saving valuable resources.
- **Recycle:** Steel is 100% recyclable and the most recycled material worldwide. 650 mega tonnes are recycled every year, avoiding over 900 mega tonnes of CO_2 emissions.

Design for Reconstruction and Reuse

Not only is steel the solution for adapting and extending the life of existing structures, steel members themselves can be recovered and reused at the end of the life of that structure.

Modern best practice ensures that steel members are permanently identified by grade, and that buildings are designed with deconstruction and recovery in mind.

Reuse is the second or subsequent use of a material (in its original form) after its first life, with little or no reprocessing. Reuse offers an even greater environmental advantage than recycling, since there are no (or far fewer) environmental impacts associated with reprocessing. The ease of holing and welding onto existing steel makes steel an ideal material to reuse.

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Optimising Deconstruction and Reuse

To facilitate greater reuse, it is important that designers not only use steel but also plan to optimise future reuse. Steps to maximise the opportunity for reusing structural steel include:

- Use bolted connections in preference to welded joints to allow the structure to be dismantled during deconstruction
- Use standard connection detailing, including bolt sizes and the spacing of holes, in consultation with the fabricator
- Ensure easy and permanent access to connections

Designers can also identify the origin and properties of each component, using barcoding, e-tagging or stamping. An inventory of these products should then be maintained in the detail design model. Building Information Modelling (BIM) is particularly well suited to recording information of this type.

Just one example of steel reuse can be found in the repurposing of the multi-level Greenland Centre, located on the corner of Bathurst and Pitt Streets in Sydney. Here, the existing steel frame of the original Sydney Water office tower has been reused and will be extended upwards to create a residential tower block consisting of 66 storeys.

Steelmaking: Now and into the Future

Initiatives to reduce the environmental impact of steelmaking have produced serious gains in recent years, particularly in relation to reduction of greenhouse gas emissions, water savings, and sustainable use of steelmaking by-products.

Greenhouse Gas Emissions

A significant reduction in greenhouse gas is being achieved through the turning of what were once waste products into valuable by-products. The Liberty steel plant in Whyalla, South Australia, currently generates more than 35% of its own energy through the reuse of waste gases (Liberty Sustainability Report, 2015).

BlueScope Steel reports a reduction in carbon emissions of over 40% since 2011 and an 8% reduction in emissions intensity per tonne of steel (BlueScope Steel Sustainability Report, 2017-2018).

The Victorian EPA has recognised the achievements of BlueScope's Western Port works in reducing airborne emission by 32% to 67% despite production increases. For example, extensive redesign of the No. 2 paint line resulted in major natural gas savings and the halving of greenhouse gas emissions.

Water Recycling

The installation of advanced water treatment technology has markedly reduced water consumption in steelmaking, using recycled water and reducing water consumption by as much as 50% over ten years.

BlueScope Steel's Port Kembla plant has reduced water consumption in steelmaking from over 5.0 to 2.5 kl per tonne of slab over the past 10 years. An initiative between BlueScope Steel and Sydney Water will further reduce the demand for fresh water by 50%. Fresh and recycled water use has been reduced by 8% from the 2015-2016 financial year with further reductions planned for 2018 (BlueScope Steel Sustainability Report, 2017-2018).

By-Products

Approximately 80% of Australia's 1.6 million tonnes of blast furnace slag is now used as cement substitute in concrete-making, and about 60% of the one million tonnes of steelmaking slag is now used as road base to replace quarried material.

Spent acid from sheet and coil galvanizing and pickling processes is being used in fertiliser production. Coal seam methane gas (which is 20 times more potent than CO_2 as a greenhouse gas) is being captured in collieries supplying the steelworks at Port Kembla, and is then turned into electricity.

Liberty's Polymer Injection Technology follows three years of close collaboration between Liberty and the University of New South Wales to replace some of the coke used as a slag foaming agent in Electric Arc Furnace (EAF) steelmaking with polymers, including recycled rubber and plastic. When injected, the coke-polymer blend improves slag foaming properties for more efficient use of electrical energy and to potentially reduce carbon consumption produced by coal-fired power stations. Polymers that are often diverted to landfill are recycled into value-added steel products.

For more information about the sustainability of steel, visit:
https://www.steel.org.au/focus-areas/environmental-sustainability

THE WORLD'S MOST RECYCLED MATERIAL: FAST FACTS

- Steel is 100% recyclable
- Steel is the most recycled material in the world, with about 650 mega tonnes recycled in 2017, including pre- and post-consumer scrap.
- By sector, global steel recovery rates are estimated at 85% for construction, 85% for automotive (reaching close to 100% in the US), 90% for machinery, and 50% for electrical and domestic appliances.
- In 2017, the recovery and use of steel industry by-products had reached a worldwide material efficiency rate of 96.3%.
- Recycling steel accounts for significant energy and raw material savings. Over 1,400kg of iron ore, 740kg of coal, and 120kg of limestone are saved for every 1,000kg of steel scrap made into new steel.
- The energy used to produce a tonne of steel has been reduced by 61% in the last 50 years.
- Steel is the main material used in delivering renewable energy: solar, tidal, geothermal and wind.
- Approximately 90% of water used in the steel industry is cleaned, cooled and returned to source. Most of the 10% loss is due to evaporation. Water returned to rivers and other sources is often cleaner than when extracted.
- Steelmaking is nearing zero-waste, with current material efficiency rates at 97.6%. This means that over 97% of raw materials used on-site are converted to products and by-products that are re-used or recycled.

All figures provided by the worldsteel Association.