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Recycling of Steel

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World Steel Association
The World Steel Association (worldsteel) is a non-profit organisation with headquarters in Brussels, Belgium. A second office in Beijing, China, opened in April 2006.

worldsteel represents steel producers, national and regional steel industry associations, and steel research institutes in every major steel-producing country.

Members represent around 85% of global steel production.
worldsteel – our key focus areas

worldsteel is active in key areas of interest to the steel industry:

- Automotive
- Climate change and environment
- Communications
- Construction
- Education and training
- Life cycle assessment
- Raw materials
- Safety and health
- Sustainability
- Steel market analysis
- Technology
Steel use by sector

STEEL USE 2019
1,768 Mt

- Building and infrastructure: 52%
- Metal products: 16%
- Mechanical equipment: 10%
- Electrical equipment: 3%
- Automotive: 12%
- Other transport: 5%
- Domestic appliances: 2%

Service life categories:
- Long service life
- Medium service life
- Short service life
Put more simply:

- Steel pool
  - Secondary steel
  - Primary steel

- EAF process
  - scrap
  - iron ore (DRI)

- BF/BOF Process
  - iron ore
  - scrap
Steel is produced via two main routes: The blast furnace-basic oxygen furnace (BF-BOF) route and the electric arc furnace (EAF) route.

Today about 72% of steel is produced using the BF-BOF route. 28% is produced via the EAF route. Crude steel is then rolled into finished steel products, such as coil, plate, sections or bars.
Steel production per process route

Crude steel production

Million tonnes

- BOF
- EF
- OHF
- Other

Years:
End-of-life scrap availability

Increased scrap use in either EAF or BF route will lower specific CO$_2$ emissions of the industry as a whole.
Steel is the most recycled material in the world.

About 630 million tonnes of scrap are recycled every year saving nearly 950 million tonnes of CO₂ annually that would have been emitted from the production of virgin steel.

Over 25 billion tonnes of steel scrap have been recycled to make new steel since 1900. This has reduced iron ore consumption by around 35 billion tonnes, as well as cutting coal consumption by 18 billion tonnes.

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All steel needs scrap

BOF process: up to 30% scrap

Steel Production - Route 1: Blast furnace or integrated route
To produce 1,000 kg of crude steel, the main inputs are roughly:

- 1,370 kg of iron ore,
- 780 kg of coal,
- 270 kg of limestone, and
- 125 kg of steel scrap.

EAF process: up to 100% scrap

Steel Production - Route 2: Electric arc furnace route
The primary raw materials are steel scrap, direct reduced iron (DRI) and/or hot metal, and electricity. To produce 1,000 kg of crude steel, the EAF route uses roughly:

- 710 kg of steel scrap,
- 586 kg of iron ore,
- 150 kg of coal and
- 88 kg of limestone, and
- 2.3 GJ of electricity.
All products therefore contain scrap

On average, new steel products contain 30% recycled steel. Today’s steel products will become tomorrow’s cans, trains, bridges, or buildings.

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Quality

Steel scrap can be converted into higher value steels.

Steel is a permanent material that can be infinitely recycled and is 100% recyclable without loss of quality.

Steel closes the material loop without being confined to a single application. All types of steel can be recycled back into new steel of various grades, keeping their inherent material properties.
Scrap recycling

• Waste products: often shredded or incinerated
• Steel is magnetic – easiest material to separate from the waste stream
• Scrap is selected based on a ‘recipe’
• Coated and Galvanised steel scrap
  – Pre-consumer scrap from our customers is ‘cleanest’
  – Scrap is melted
  – De-zincing / de-tinning processes
  – Zinc in EAF dust
  – Emissions from coatings are captured in the flue gases
Global greenhouse gas emissions by sector

This is shown for the year 2016 – global greenhouse gas emissions were 49.4 billion tonnes CO₂ eq.

OurWorldinData.org – Research and data to make progress against the world’s largest problems.
Source: Climate Watch, the World Resources Institute (2020).
Licensed under CC-BY by the author Hannah Ritchie (2020).
Who is interested in steel’s business?
IEA: industry CO₂ emissions
worldsteel step up programme

step up

Efficiency improvement - the step up programme

Efficiency review process that supports improvements in plant operations to efficiency levels corresponding with the steel industry’s top performers

4 key levers: raw material quality, energy efficiency, process reliability and process yield

Optimised operations leads to lower CO2 intensity in steelmaking

Raw materials and Energy are the two most important cost factors in steelmaking
Circular economy

Steel is fundamental to achieving a circular economy. It ensures the maximum value of resources through recovery and reuse, remanufacturing and recycling.

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Circular economy concept will have impact on steel demand via multiple channels

New applications to enable the circular economy may support steel demand

Reuse and remanufacturing extend a service life of steel applications

Impact on steel demand
- Lower steel intensity
- Longer life of steel containing goods
- Reduced demand for steel containing goods
- Lower scrap availability

Impact on raw materials
- Increase scrap supply
The road to decarbonisation

• Move to a more circular economy
  – While recycling is key for steel, this is the ‘last resort’ for a circular economy
  – Design for reduced consumption, waste
  – Design for dismantling, reuse and remanufacture
  – Recover more scrap for recycling

• Recycling steel scrap saves 1.6 tonnes CO$_2$e (GHG emissions) per tonne scrap
By sector, global steel recovery rates for the following areas are estimated to be at least:

- 85% Construction
- 90% Automotive
- 90% Machinery
- 50% Electrical and domestic appliances

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Steel attributes — Benefits of steel recycling

- Infinite recycling without loss of properties
- Permanent material
- Easy magnetic separation and recovery

- Raw materials conservation
- 70% Energy saving
- Job creation

One tonne of steel recycled saves on average:
- 1,400 kg iron ore
- 740 kg coal
- 120 kg limestone

Recycling a single steel can saves:
- 1 laundry load, or
- 1 hour TV, or
- 24 hours of a 10 watt LED bulb

Jobs required for scrap collection, separation and recycling
The life cycle of steel
The LCI data quantifies ‘cradle to gate’ inputs (resources, energy) and outputs (environmental emissions) of steel production from:

- the extraction of resources and use of recycled materials,
- production of steel products to the steelworks’ gate,
- reuse and remanufacturing, and
- end-of-life recovery and recycling of steel.
Reporting of impacts
GWP for slab production

For a product’s life cycle, recycled content is irrelevant in terms of environmental impact
Thank you for your attention. Any questions?

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