#steelFacts

worldsteel
ASSOCIATION

#steelFacts

A collection of amazing facts about **steel**

What is Steel?

Steel is a highly innovative and indispensable material. Its extensive use stems from its versatile properties like strength, ductility, conductivity, magnetism, and others.

Pages 6-27

Safety and health

The steel industry is committed to the goal of achieving an injury-free and healthy workplace for all employees and contractors.

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Climate action

Our industry fully supports the aims of the Paris Agreement. We are committed to a low-carbon future.

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Wider sustainability

The steel industry is committed to transparent data disclosure and continual improvement in environmental performance issues, including water use, air quality, and maximising resource use.

Pages 64-85

Our people

The success of the steel industry is intrinsically linked to its diverse people. Education and training for a net-zero future is a priority.

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Steel is everywhere

Steel is the most commonly used metal in the world. It is everywhere in our lives.

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What is Steel?

Steel is a highly innovative and indispensable material. Its extensive use stems from its versatile properties like strength, ductility, conductivity, magnetism, and others.

Steel

is an alloy of iron and carbon containing less than **2% carbon** and small amounts of manganese, silicon, phosphorus, sulphur, and oxygen.

Steel

is not a single product. There are more than

3,500

different grades of steel with many different physical, chemical, and environmental properties, allowing a range of thicknesses and shapes. Each grade of steel has properties designed for its specific application.

Stainless steel is a steel alloy containing at least **10.5% chromium**. The chromium reacts with the oxygen in the air to form a protective layer, making it resistant to corrosion and rust. There are over **200** types available.

All steel
is originally made from
iron

Iron is the **4th** most common element in Earth's crust after oxygen (46%), silicon (28%), and aluminium (8%).

Steel can be up to
1,000x
times stronger than iron.

As early as the

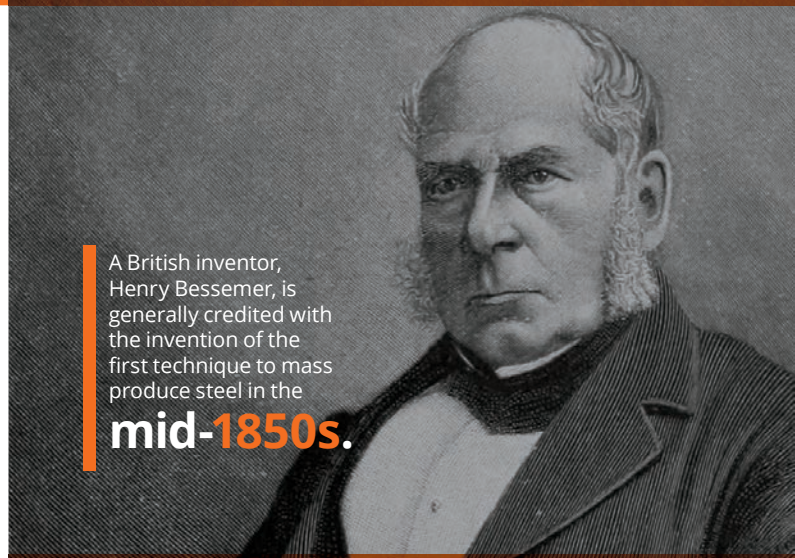
11th century BC,

an archaeological find in Cyprus indicates that as early as the 11th century BC craftsmen were producing quench-hardened steel knives.

In the

3rd century BC,

craftsmen in southern India were using crucibles to smelt wrought iron with charcoal to produce 'wootz' steel – a material that is still admired today for its quality.



A British inventor, Henry Bessemer, is generally credited with the invention of the first technique to mass produce steel in the

mid-1850s.

Some sources suggest that as early as the

2nd century BC,

the Chinese developed a process akin to the Bessemer method.

Steel is primarily produced today using technology based on the Bessemer process, known as the **blast furnace (BF)-basic oxygen furnace (BOF) process.**

The traditional method of making steel involves charging iron ore, coke, and limestone to a blast furnace at

1,700°C,

significantly hotter than volcanic lava.

The Bessemer process involves **blowing air through molten pig iron** to oxidise the material and separate impurities.

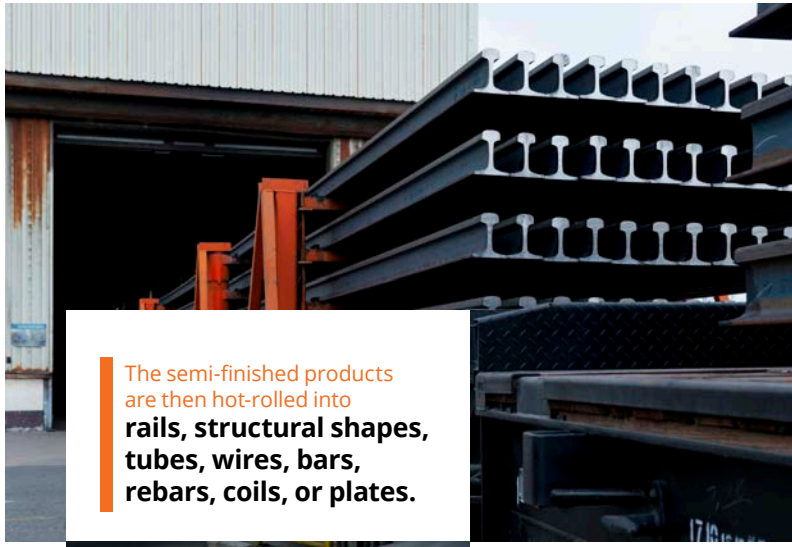
The direct reduced iron (DRI) technique of steelmaking removes oxygen from iron ore using natural gas, **and in the future hydrogen, bypassing the need for a blast furnace and emitting less CO_2.**

Electric arc furnaces (EAFs), introduced in the late 19th century for specialty steel production, didn't see large-scale use until the 1960s **when scrap became increasingly available.**

An **EAF** can be charged with **100% steel scrap.**

BOFs can be charged with as much as **30% scrap.**

Once the steelmaking process is completed, **liquid steel is cast into semi-finished products such as blooms, billets, or slabs.**



The semi-finished products are then hot-rolled into **rails, structural shapes, tubes, wires, bars, rebars, coils, or plates.**

The finishing operations include **cold rolling, metal coating, or painting.**

To prevent rust formation when steel comes into contact with water and oxygen,

most steels are metallically coated.

Cars are typically painted, while enamel is used on refrigerators.

New and innovative steels are continually being developed.

In 2024, the steel industry invested 8.31% of revenue

in capital investment projects, research, and process improvement.

Steel Production

BF-BOF route

To produce **1,000 kg** of crude steel, the main inputs are roughly:

1,370 kg	780 kg	270 kg	125 kg
iron ore	coal	limestone	steel scrap

Steel Production

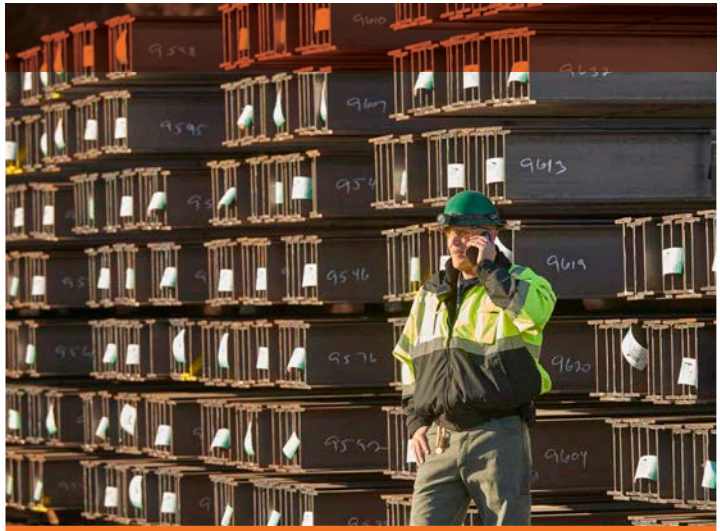
EAF route

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	586 kg	150 kg	88 kg	2.3 GJ
steel scrap	iron ore	coal	limestone	electricity

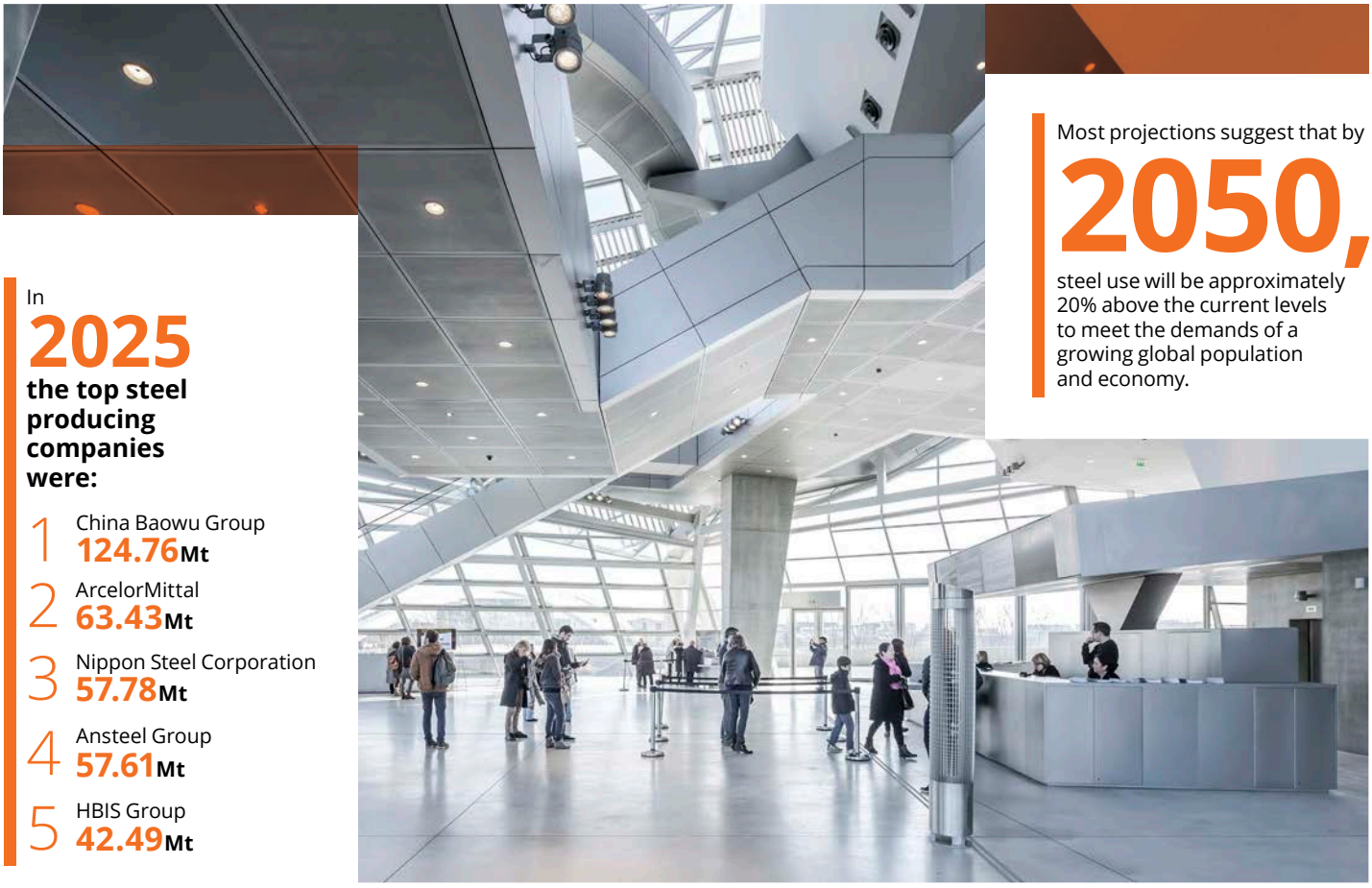
Global crude steel production has increased from 189 Mt in 1950 to 1,849 Mt in 2025 and **production has more than doubled since 2000.**

1950	2000	2025
189 Mt	**850**Mt	**1,849**Mt



In **2025** the top steel producing countries were:

China	India	USA	Japan	Russia
960.8 Mt	**164.9**Mt	**81.9**Mt	**80.7**Mt	**67.9**Mt



In
2025
the top steel producing companies were:

1. China Baowu Group **124.76Mt**
2. ArcelorMittal **63.43Mt**
3. Nippon Steel Corporation **57.78Mt**
4. Ansteel Group **57.61Mt**
5. HBIS Group **42.49Mt**

Most projections suggest that by

2050,

steel use will be approximately 20% above the current levels to meet the demands of a growing global population and economy.

Safety and health

The steel industry is committed to the goal of achieving an injury-free and healthy workplace for all employees and contractors.

worldsteel relies on 6 safety and health principles:

- All injuries and work related illness can and must be prevented.
- Managers are responsible and accountable for safety and health performance.
- Employee engagement and training is essential.
- Working safely is a condition of employment.
- Excellence in safety and health drives excellent business results.
- Safety and health must be integrated into all management processes.

Companies need to apply the 6 principles across 4 focus areas:

- Safety culture and leadership
- Occupational safety management
- Process safety management
- Occupational health management

Each year, worldsteel recognises excellence in its member companies that have **demonstrated significant improvements in the 4 focus areas of safety and health.**

Sharing of **learnings and best practices** among members is encouraged and promoted through forums such as **workshops**, **Safety and Health Committee meetings** and **virtual platforms.**

The **worldsteel Day for Safety and Health** is observed on

28 April

every year, coinciding with the International Labor Organization (ILO)'s World Day for Safety and Health at Work.

More than

90%

of steel-producing sites have implemented a framework for recording potential serious injuries and fatalities, with a focus on preventive measures.

The total number of fatalities reported to worldsteel has decreased from 129 in 2016 to 74 in 2025, which represents

a decrease of 42.6%.

The fatality frequency rate decreased

28% over the last decade,

from 0.025 in 2016 to 0.018 in 2025.

The lost time injury frequency rate decreased

36.6% from 1.01 in 2016 to 0.64 in 2025.

A small ratio of lost time injuries (LTIs) to fatalities suggests that **while less common, these types of incidents represent a higher risk of fatalities** without effective prevention, compared to those with a higher ratio.

All frequency rates are calculated per

1,000,000

hours worked.

The five top causes of fatalities for employees are: falling from height, overhead cranes, on-site road vehicles, moving machinery, and hot substances.

Critical risks faced by contractors are different from those for employees, reflecting the different nature of activities done by each group.

The
five top causes
of fatalities for contractors are:

1. **falling from height**
2. **gassing and asphyxiation**
3. **falling objects**
4. **Hot metal**
5. **Mobile equipment**

Falling from height and moving machinery have historically remained the leading causes of fatalities for employees as well as contractors.

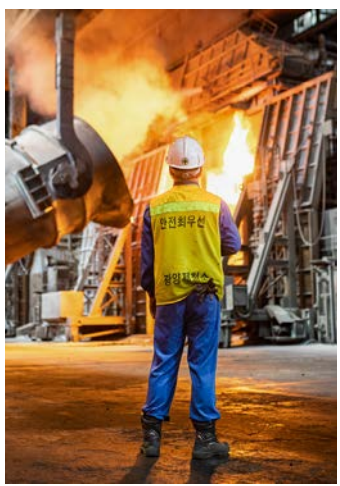
Reported occupational sickness levels vary between regions due to differences in industry composition, regulatory standards, access to healthcare, cultural attitudes towards reporting, and socio-economic disparities.

worldsteel promotes competency development through guidance notes
on various topics and collaboration with domain-experts such as 3M, Draeger, and ISN on workshops, webinars, and training on critical risks.

worldsteel's process safety management framework is based on

17 key elements

focused on a committed culture, operational and maintenance excellence, management of change, risk management and continuous improvement.



worldsteel has adopted a 4-tiered approach with

14 KPIs

for reporting process safety events in alignment with the American Petroleum Institute Recommended Practice (API RP) 754.

Climate action

Our industry fully supports the aims of the Paris Agreement. We are committed to a low-carbon future.

In 2024, on average,

1.92

tonnes of CO_2 are emitted for every tonne of steel produced. The steel industry generates **between 7 and 9% of global CO_2 emissions.**

In 2024, the average CO_2 intensity of the **BF-BOF** route was

2.34

The average CO_2 intensity of the **DRI-EAF** route was

1.47

The average CO_2 intensity of the **scrap EAF** route was

0.69

Over
98%
of current steel production is located in countries that have **already set net-zero targets.**

The majority of the CO_2 emitted by the steel industry comes from the **chemical reaction involved in the reduction of iron ore.** A simplified representation of the reaction is:

$$Fe_2O_3(s) + 3CO(g) \rightarrow 2Fe(l) + 3CO_2(g)$$

There is
no single solution to low-carbon steelmaking
and a broad portfolio of technological options will be required to be deployed alone or in combination as local circumstances permit.

Many promising options to reduce carbon emissions from the steel industry are being explored and developed:

One solution in the medium term could be **preventing the emissions of CO_2 by using carbon capture, utilisation, and storage (CCUS).**

Sustainable biomass

can serve as a substitute for coal as a reductant.

This is particularly of interest in certain areas of the world, like South America.

Substituting hydrogen for carbon

as a reductant is another promising technology to cut CO_2 emissions.
This process results in the generation of H_2O (water) instead of CO_2.
A simplified representation of the reaction is:

$3Fe_2O_3 + 9H_2 \rightarrow 6Fe + 9H_2O$

The types of low-carbon hydrogen are generally described using colours:

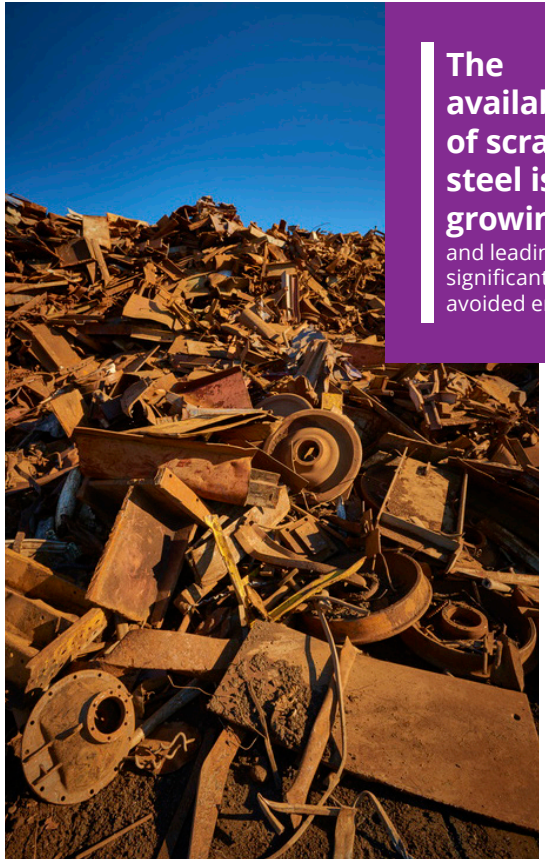
Green hydrogen is produced by water electrolysis with renewably-generated energy.

Blue hydrogen is derived from natural gas using steam methane reforming, combined with carbon capture and storage (CCS).

Other hues of low carbon hydrogen exist - such as **pink hydrogen** produced using nuclear energy, and turquoise hydrogen (methane pyrolysis).

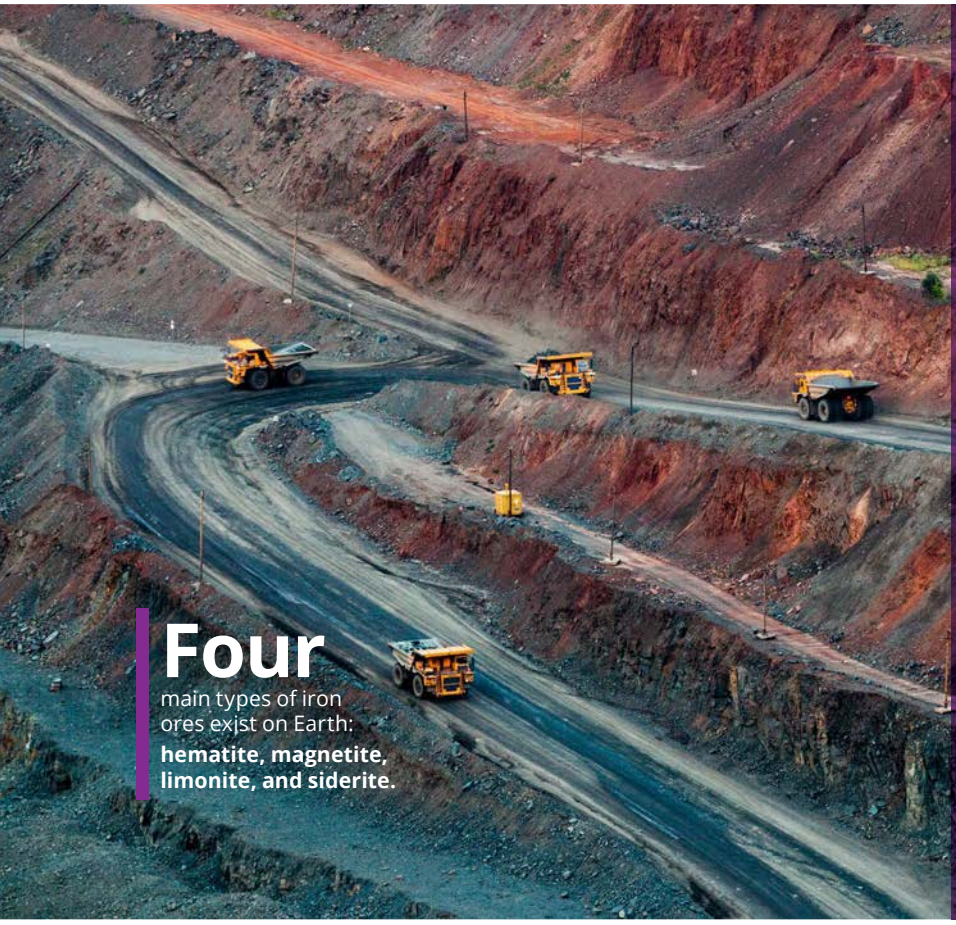
Technologies are also under development that **extract iron directly using electricity in an electrolysis-based process**, though these are less mature and will likely take longer to develop and deploy.

Treated domestic waste and plastics can also be used in ironmaking to reduce emissions, thereby enhancing the overall sustainability of the industrial ecosystem.



The availability of scrap steel is growing,
and leading to significant levels of avoided emissions.

The quality of iron ore
directly impacts the volume of CO_2 emissions from iron production.



Four
main types of iron ores exist on Earth:
hematite, magnetite, limonite, and siderite.

Magnetite,
with high iron content of up to
70%, is the highest quality iron ore.

Hematite,
despite having a slightly lower iron content than magnetite
(50-70%),
is the most commonly used.

The iron ore content of lower quality ores can be increased through beneficiation.
Iron ore beneficiation techniques include **crushing, grinding, gravity separation, flotation and magnetic separation.**

Without steel, **the goals of the Paris Agreement will not be achieved.**

Steel will enable society's overall decarbonisation

- almost every greenhouse gas mitigation technology relies on steel, including the generation of thermal and renewable energy, electrification, mass transport, and the hydrogen economy.

New technologies are emerging to convert steelmaking gases into methanol and ethanol, **reducing CO_2 emissions, conserving energy, and lessening fossil fuel reliance** in sectors like transportation.

The steel industry is dedicated to collaborating with partners across our ecosystem to find solutions. This includes involving suppliers, customers, governments, and other industries.

The cost of the transition is expected to be between **$3.5 and $5.5 trillion,** with approximately $1.2 trillion of the cost in steel production and the remainder in the upstream and downstream value chain.

Wider sustainability

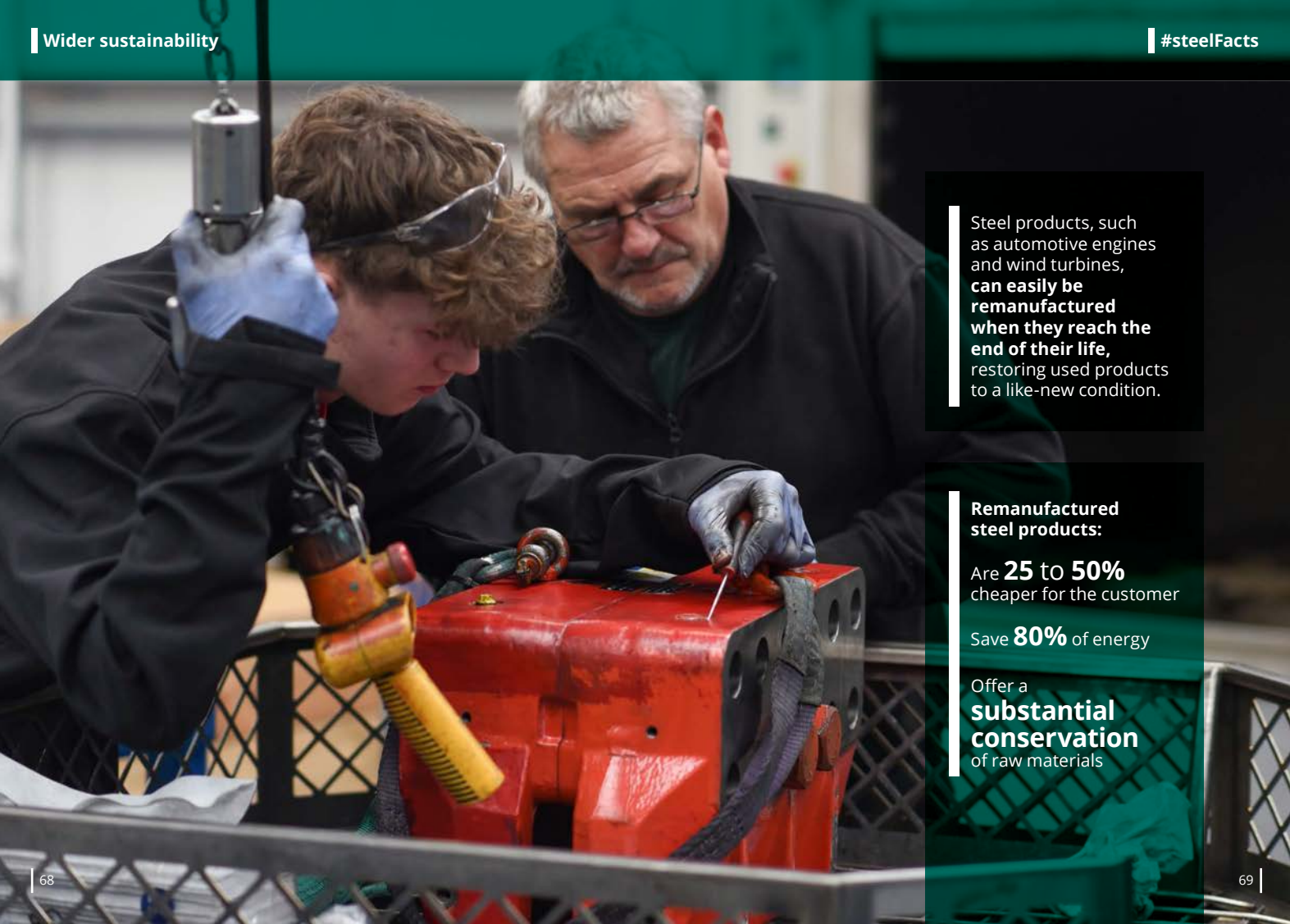
The steel industry is committed to transparent data disclosure and continual improvement in environmental performance issues, including water use, air quality, and maximising resource use.

Steel is fundamental to achieving a circular economy.

It ensures the maximum value of resources through **recovery and reuse, remanufacturing and recycling.**

Many steel companies and manufacturers are designing products with reuse in mind.

When a steel product is reused, it extends its lifecycle and conserves resources.



Steel products, such as automotive engines and wind turbines, **can easily be remanufactured when they reach the end of their life,** restoring used products to a like-new condition.

Remanufactured steel products:

Are **25** to **50%** cheaper for the customer

Save **80%** of energy

Offer a **substantial conservation** of raw materials

Steel products are durable and simply last a long time.
In applications with long service lives, like buildings or infrastructure, recycling may not occur for up to

200 years or more.

For steel packaging, the recycling process could take place after only a few weeks. In the case of vehicles, this duration could extend to 15-20 years.

Steel is a permanent material.

Its inherent magnetism facilitates collection. **It can be infinitely recycled and is 100% recyclable without loss of quality.**

By sector, global steel recovery rates are estimated at

85%
for construction,

90%
for automotive,

90%
for machinery,

50%
electrical and domestic appliances.

In 2022, the global steel industry **recycled around**

650-700 million tonnes

of steel in the form of scrap, saving around 1 billion tonnes of CO_2 emissions that would have been emitted from producing virgin steel.

On average,

new steel products contain 30% recycled steel.

Today's steel products will become tomorrow's cans, trains, bridges, or buildings.

New lightweight, high-strength steels make applications both lighter and stronger.

These innovative steels help other industries reduce their environmental footprint.

The automotive industry serves as an excellent example.

The steel industry uses its resources efficiently and produces very little waste.

According to the data provided by our members, on average:

98%

of global steel industry raw materials used for steelmaking are converted.

70%

are converted into steel products.

28%

are converted into co-products. As little as 2% become waste.

Slag is the highest volume steel industry solid co-product.

On average, for the blast furnace route,

400kg of slag is produced for each tonne of crude steel.

In the electric arc furnace route, around

170kg of slag is produced per tonne of steel.

Nearly

100% **of the steel industry's co-products can be used.**

Slag

is used in cement, road construction, fertilisers, hydraulic engineering and sea forestation.

Emulsions and oils

are used as reducing agents.

Process gases

are used to produce heat and/or electricity.

Iron oxides and zinc

are recovered from dust and sludges.

According to the International Energy Agency, **substituting cement clinker with slag cement allows significant reductions in annual energy consumption and CO_2 emissions - up to**

500,000,000GJ

or

200Mt

of CO_2 annually

Steelmaking process gases are used to produce heat and/or electricity. When process gases are fully reused, they can provide

60% to 100%

of the plant's power. Any excess energy can be supplied to the local grid.

The steel industry supports the
ISO 14046:2014
standard for water footprints. It is currently the only methodology that contains all the factors necessary to assess a product or an organisation's water footprint.

Around
90%
of water used in the steel industry is cleaned, cooled and returned to source. Most of the loss is due to evaporation.

Water from the steel industry returned to rivers and other sources is often
cleaner than when extracted.

Sea water
is almost exclusively used in cooling operations and the loss during these processes may account for
less than 1%
of the total due to evaporation.

The industry has access to technologies that manage emissions of **SOx, NOx, dust, and heavy metals,** thus meeting increasingly stringent regulatory requirements.

Fabric dust filters in steel plants typically have a collection efficiency rate of more than **99%** even when particle size is very small.

worldsteel's eco-profiles aim to communicate life cycle-related environmental indicators on a global basis transparently.
Here are a few examples:

According to worldsteel's eco-profiles, the total amount of non-renewable primary energy resources per tonne of cold rolled coil is **28.59 GJ.**

According to worldsteel's eco-profiles, the total amount of iron and steel scrap required to make one tonne of rebar is **0.522** metric tonnes.

According to worldsteel's eco-profiles, one tonne of wire rod requires using **1.59 GJ** renewable primary energy resources.

Our people

The success of the steel industry is intrinsically linked to its diverse people. Education and training for a net-zero future is a priority.

Globally, over

6 million

people work for the steel industry.

About

2 million

people are working in steelmaking plants around the world.

About

2.5 million

people are employed globally in the downstream processes of steelmaking, which include rolling, stamping, service centres, and trading.

About

1.5 million

people work in support services as contractors.

For every job
created in the steel industry,
8.1 indirect jobs are created,
or in other words, the steel industry
supports the employment of

49.3 million people.

The steel industry's
net-zero transition
will require the best and brightest talent. A job in the steel industry gives you a unique opportunity to contribute to climate change solutions.

The steel industry recognises the importance of a
sustainable and just transition.

In **2022**, employees in the steel industry received

7.78 days of training per year.

Since 2008,

steeluniversity,

a web-based industry university has provided education and training to thousands of current and future employees of steel companies and related businesses,

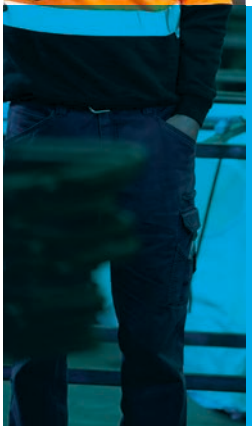
currently offering more than 30 training modules.

Since 1998,

steelManagement,

a worldsteel management course, has equipped more than 900 future steel leaders to drive transformation and cultural change through strategic thinking, action, and influence.

steelChallenge, an online competition, **plays a significant role in shaping the future workforce by exposing participants to sustainable industry practices.** Since 2005, steelChallenge attracts around 2,000 students and professionals annually.



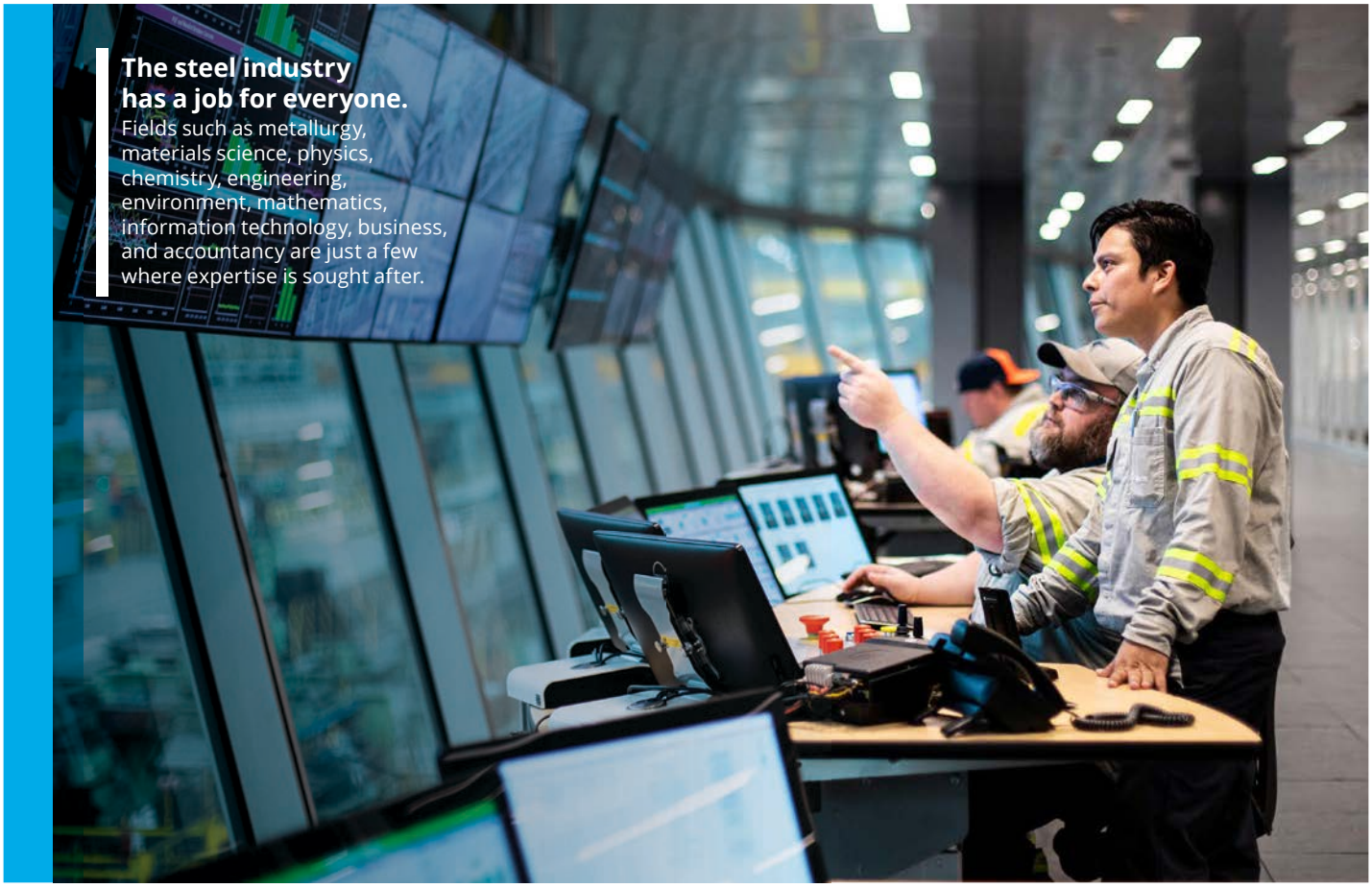
Ongoing research into new breakthrough technologies like hydrogen reduction is opening up new areas of expertise.

The skills expected to become in demand for the next decades include **decarbonisation technologies, hydrogen storage, cybersecurity and AI, among others.**

The steel industry is actively consolidating a future proof skills directory.
This repository fosters a strong connection between the steel industry and universities, aligning educational curricula with real-world needs and better **preparing future graduates for the demands of the steel sector.**

Many steel companies contribute to local community sports programmes,
educational initiatives, and health programmes, assisting the communities in growing alongside them.

The steel industry is
actively leading programmes for minorities and encouraging diversity in the workplace.



The steel industry has a job for everyone.

Fields such as metallurgy, materials science, physics, chemistry, engineering, environment, mathematics, information technology, business, and accountancy are just a few where expertise is sought after.

Steel is everywhere

Steel is the most commonly used metal in the world. It is everywhere in our lives.

Steel is inextricably linked with economic growth and prosperity. **It has enabled our modern way of life.**

Steel demand is distributed as follows:

52% buildings and infrastructure

16% mechanical equipment

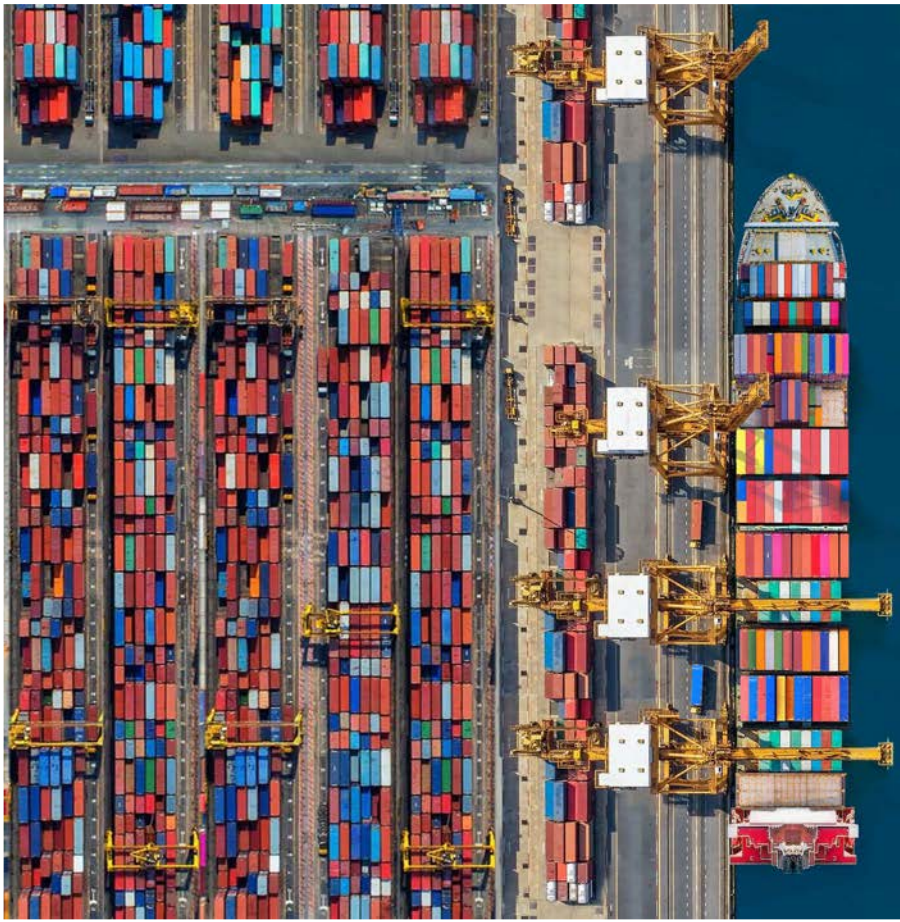
12% automotive

10% metal products

5% other transport

3% electrical equipment

2% domestic appliances



Around

25%

of steel is traded internationally.

In 2025, the amount of steel in use in the world today equalled

209 kg

per person.

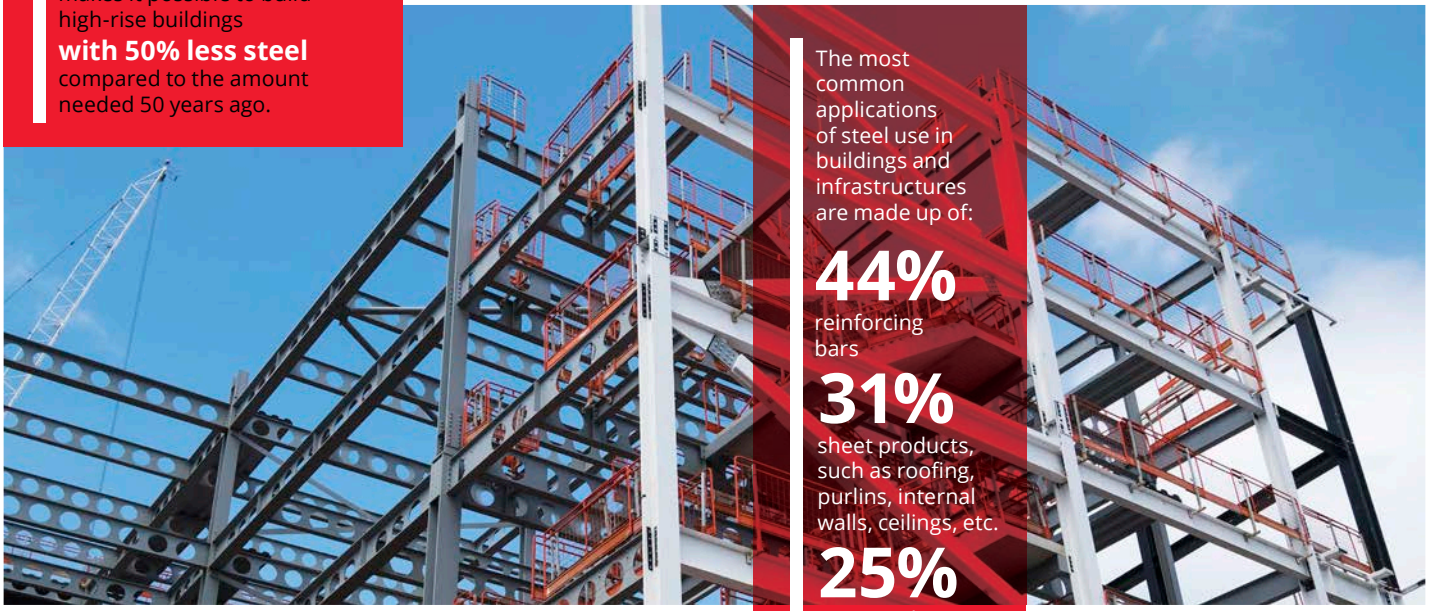
Bridges are built to last.

In 1883, New York's Brooklyn Bridge became the world's first steel bridge to carry traffic. More than 140 years later it still carries around **150,000 vehicles and pedestrians a day.**

Skyscrapers are made possible by steel.

Completed in 1885, the New York Home Insurance Building in Chicago, Illinois is **the first 10-storey building to be supported by a structural steel frame.**

Substituting advanced high-strength steels for regular steels
makes it possible to build high-rise buildings
with 50% less steel
compared to the amount needed 50 years ago.

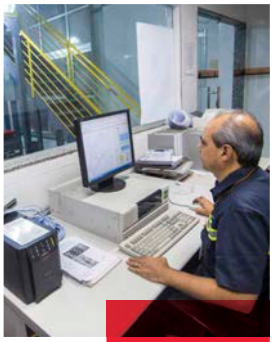


The most common applications of steel use in buildings and infrastructures are made up of:

44%
reinforcing bars

31%
sheet products, such as roofing, purlins, internal walls, ceilings, etc.

25%
structural sections



Digitising the construction sector's chain of custody
enables manufacturers to **monitor product quality throughout its lifecycle,** thereby facilitating part reuse.

In earthquake-prone zones, the foundations of light-steel-framed buildings are up to
75% lighter than those of concrete buildings.
Steel buildings are also more **flexible and ductile, making them safer and more durable.**

Steel-framed structures are inherently **non-combustible, nor contribute to the spread or intensity of a fire.**

The much acclaimed
first mass-produced car,
the Ford Model T, came off the production line in 1908. Already then, engineers made use of a highly strong and light material - vanadium steel - in critically stressed parts, such as the crankshaft, forged front axle, and wheel spindles.

In **assessing automotive emissions,** the methodology should be based on a **life cycle approach**.

Automakers utilise
advanced high-strength steel
– boasting up to **2,000 megapascals** strength – to lighten vehicles and reduce energy requirements for both internal combustion and electric vehicles (EVs).

When taking a life cycle approach

to compare functionally equivalent automotive components, advanced high-strength steels consistently show substantially lower emissions than competing materials, emitting in the production phase:

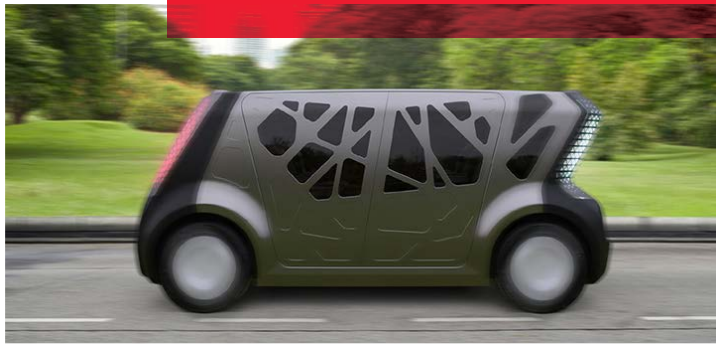
1/6th
of the CO_2 emissions when compared to aluminium

1/9th
compared to carbon fibre and

1/10th
versus magnesium.

Automakers choose steel

for EV body structures for its lightweight nature, safety features, battery protection, and affordability.



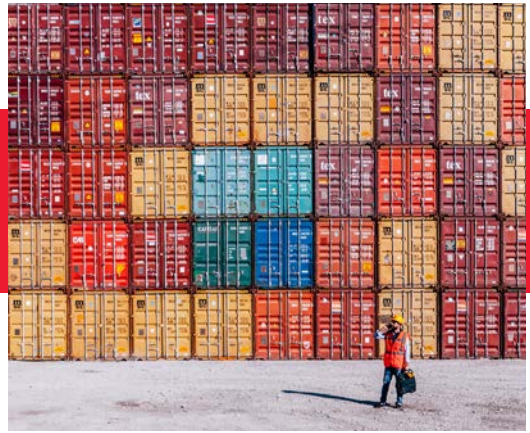
E-mobility wouldn't exist without steel.

Due to its high silicon content and sophisticated processing, electrical steels exhibit low electrical conductivity, high magnetic permeability and reduced core loss, a perfect solution for electric generators and motors.

Every major cargo ship is made of steel.

Steel shipping containers

are globally utilised, with some being innovatively transformed into functional homes or large infrastructures like football stadiums.



Steel makes up around

10-15%

of the mass of high-speed trains. The main steel components of these trains are bogies (structures underneath the trains including wheels, axels, bearings, bogie frames, and motors). Most freight wagons are made of steel.

Selectively using

duplex stainless steel bars

in areas prone to chloride diffusion into concrete (often near the sea) prevents hidden corrosion, subsequent concrete spalling and structural failure.

Stainless steels can be reliably and repeatedly sanitised at temperatures of more than

130°C

ensuring the highest possible levels of hygiene.

Stainless steel **is the hygienic material of choice in the food and beverage industries.** It is used in the processing of milk and dairy products, beer and winemaking, cooking meats, packaging, and more.

Stainless steels are also used for

medical implants

because they are **strong, tough, biocompatible and highly corrosion-resistant.**

The OECD estimates that levels of water loss vary from 17-30% in many developed cities.
In Tokyo, replacing the old lead and ductile iron pipes with stainless steel pipes reduced recorded water loss from

17% to just 2%.

Other cities have since followed the Tokyo model with similar or better outcomes.

Stainless steel microwave-safe food containers are safe and versatile.
With just one box, you can store, freeze, and then reheat your food in a microwave oven or in a traditional oven.

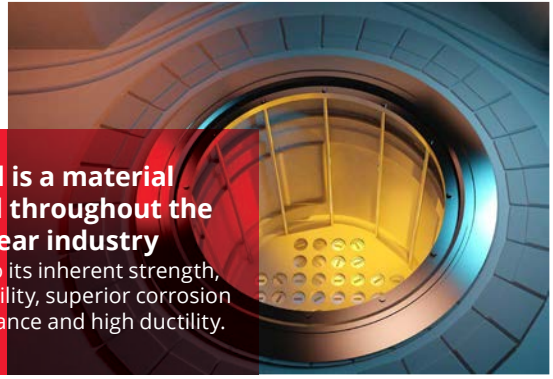
Food stored in steel cans **helps reduce waste by offering an extended shelf life of up to**

five years

while preserving all the nutritional vitamins of fresh food.

Steel is crucial for providing the world with energy,
whether it's based on fossil fuels, nuclear technology, or renewable sources such as hydroelectric, tidal, wind, geothermal, and solar power.

Pipes can be manufactured to endure extreme temperatures of over
400°C and below -40°C.
They are designed to offer absolute reliability throughout their entire lifespan, which can extend up to 50 years.



Steel is a material used throughout the nuclear industry
due to its inherent strength, durability, superior corrosion resistance and high ductility.

A wind turbine is comprised of between **84% and 90% iron and steel materials,** used in the tower, nacelle and rotor. An average of **300 - 600 tonnes of iron and steel** are required for a typical 4 MW onshore wind turbine. Significant amounts of steel are also used in the foundation.

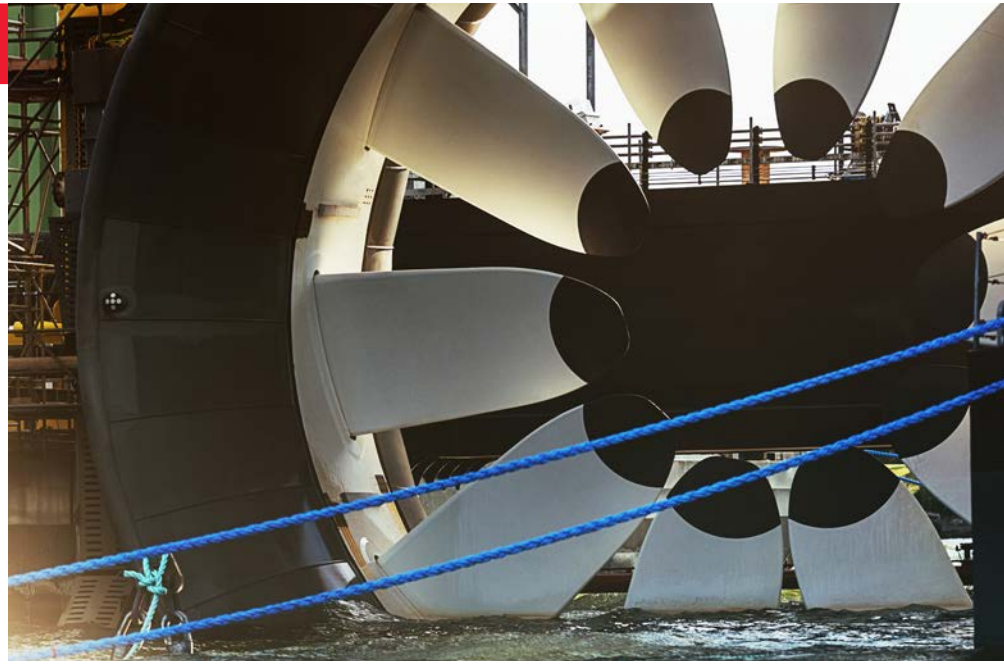
Amongst all renewables, solar power has experienced the fastest growth. **Steel is used in the base, pumps, tanks, and heat exchangers of solar power installations.**

Tidal power relies on steel

for turbine nacelles and foundation support structures.

Ground source heat pumps

in geothermal power stations are made of steel.



Heavy agricultural machinery compacts the soil, reducing the land's long-term capability of food production.
High-strength steels can make machinery 30-50% lighter, without compromising durability.

Steel is the foundation of many sports:

fencing, skiing, snowboarding, bobsledding, trampolining, football and rugby goalposts, weightlifting, Moto GP, and ice skating all rely on steel.

Steel has been used to make **hundreds of artificial reefs,** providing homes for milions of varieties of marine life.

Steel is used in recreation, from the slides in children's playgrounds to the roller coasters in amusement parks.

Steel is pivotal to culture.

Without it, movie theaters, libraries, sports stadiums, and concert halls wouldn't exist. Similarly, many musical instruments also owe their existence to steel.

The World Steel Association (worldsteel) is one of the largest and most dynamic industry associations in the world, with members in every major steel-producing country. worldsteel represents steel producers, national and regional steel industry associations, and steel research institutes. Members represent around 85% of global steel production.

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Design: Make Alias London Limited

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