About the 2008 Sustainability Report

This report provides readers with an overview of the challenges facing the world steel industry in the three key sustainability areas – environmental, social and economic – and how the industry is addressing these challenges. We focus on the most important issues, based on a 2007 survey of over 500 stakeholders in 12 countries in Europe, North America, South America, Australia, Asia and Africa. We also continue to measure and report on our progress in fulfilling our sustainable development commitments, developed by our member companies in 2002. You will find links throughout the report to further information and resources on our website: worldsteel.org.
Steel forms the basis of modern society. From clean water and energy to sophisticated modes of transport and infrastructure, steel is everywhere, enabling us to meet our needs.

Steel is also essential to economic growth. There has recently been a sharp rise in demand, driven by developing countries. The steel industry must continue to grow by 3-5% worldwide and by 8-10% in China, India and Russia to meet projected demand, expected to double by 2050.

**Taking action to address our sustainability challenges**

As the producers of steel, it is our responsibility to help meet the growing demand for steel in a sustainable way. With companies all across the world, we are faced with a broad range of sustainable development challenges, and we remain committed to taking action, individually and together as an industry, in addressing them.

In this report we intend to provide readers with an overview of the actions we are taking to address these challenges on many different fronts. We also continue to report on our progress in fulfilling our sustainable development commitments.

Our key sustainable development priorities include:

**Safety and health:** the safety and health of the people who work in our industry is our top priority. All injuries and work-related illness can and must be prevented. Our industry is committed to the goal of an injury-free, illness-free and healthy workplace.

**Climate change:** with current projections of growth in steel production worldwide, CO₂ emissions from our industry will inevitably increase from present levels by 2050. We are developing a global steel sector approach to address this challenge. Also, we are collaborating as an industry to make breakthrough technologies a reality, to lower the production emissions from steel production.

**Adding value:** we are shifting our focus from increasing the volume of steel in use to maximising the contribution of steel over product life cycles, especially the use phase. This is done, for example, by providing lighter, safer, long-lasting and more intelligent structures for transport and construction. We also continue to work with designers to create products that are easy to reuse and recycle at the end of their life, to maximise steel recycling. The recyclability of steel is one of its most valuable properties, saving precious raw materials and significant energy for future generations.

Engaging with our stakeholders is also integral to fulfilling our sustainable development commitments. We welcome your feedback and ideas at report@worldsteel.org or by post at:

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On behalf of the Board of Directors,
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Sustainable development is development aimed at improving the quality of life for everyone, now and for generations to come. For the world steel industry, it means valuing the interdependence of environmental, social and economic aspects in all decision-making.

In 2002, the world steel industry worked together through the World Steel Association (worldsteel) to establish a policy on sustainable development including a vision and commitments.

In 2003, sustainability indicators were established by worldsteel member companies, in consultation with external organisations, to measure progress in fulfilling these commitments (see p. 29). Each indicator aims to address one or more of the commitments outlined here.

**Our Vision**

We, the Member Companies of the World Steel Association, are committed to a vision where steel is valued as a major foundation of a sustainable world. This is achieved by a financially sound industry, taking leadership in environmental, social and economic sustainability.

<table>
<thead>
<tr>
<th>Sustainable Development Focus Area</th>
<th>Sustainable Development Commitments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value for stakeholders</td>
<td>We seek to develop sustainably and are committed to:</td>
</tr>
<tr>
<td>Environmental protection</td>
<td>Operate our businesses in an efficient and financially sustainable way in order to supply steel products and solutions that satisfy our customer’s needs and provide value to our stakeholders.</td>
</tr>
<tr>
<td>Safety and health</td>
<td>Optimise the eco-efficiency of our products through the product life-cycle, including increased resource and energy efficiency in the production of steel and during the use of steel products. We are committed to the promotion of the recovery, reuse and recycling of steel.</td>
</tr>
<tr>
<td>Local communities</td>
<td>Foster the well-being of employees in the steel industry and provide them with a safe and healthy working environment.</td>
</tr>
<tr>
<td>Ethical standards</td>
<td>Demonstrate social responsibility by promoting values and initiatives that show respect for the people and communities associated with our businesses.</td>
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<tr>
<td>Stakeholder engagement</td>
<td>Conduct our business with high ethical standards in our dealings with employees, customers, suppliers and the community.</td>
</tr>
<tr>
<td>Disclosure and transparency</td>
<td>Engage our stakeholders and independent third parties in constructive dialogue to help fulfil our sustainable development commitments.</td>
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<tr>
<td></td>
<td>Build on our knowledge of sustainability and willingly share it with others. We will be open and active in our communications and help steel companies and organisations in the supply chain to implement sustainable practices.</td>
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</tbody>
</table>
There are thousands of different types of steel, designed to meet the specific needs of end users. And steels are ever evolving. Many current products were developed in the last 10 years.

Steels are alloys based on iron. Depending on the desired properties, a multitude of other elements can be present in small amounts. The variety of steels is not only defined by chemical composition, but also by a variety of microstructures on a nano and sub-nano scale which lead to an impressive range of achievable properties and ensure that there is much scope to develop steels further.

As shown in the table below, China, the EU, Japan, the US and Russia accounted for 74% of the 1.3 billion metric tons of crude steel produced worldwide in 2007. China used approximately 408 million metric tons (mmt) of steel in 2007, 34% of world steel use. Steel use in China is expected to increase by a further 11.5% in 2008, compared with a 4.2% increase in the rest of the world.\(^1\)

Steels are produced using two main methods:

- Integrated steelmaking route, based on the blast furnace (BF) and basic oxygen furnace (BOF), which uses raw materials including iron ore, coal, limestone and recycled scrap steels.
- Electric arc furnace (EAF) route, based on the EAF which uses primarily recycled scrap steels or direct reduced iron (DRI) and electricity.

Both production routes can be followed by advanced secondary metallurgical treatments which create the desired chemical composition of the steels.

This is followed by casting (solidifying of the molten steel) and shaping into the desired physical form. Continuous casting is the most commonly used process by which to form steel billets, blooms and slabs. These semi-finished steel products are then rolled into finished steel products such as beams, bars or sheet and may undergo further finishing processes, such as galvanising, before being used in construction or sent to manufacturers to be made into steel-containing products such as cars, cans or ships.

In 2007, the BOF and EAF methods were used to produce 66.3% and 31.2% of the world’s steels, respectively.\(^2\) Steel production via open-hearth furnace (OHF) steelmaking, at just 2.5% of steels produced in 2007, continues to decline owing to its environmental and economic disadvantages.

Iron ore is plentiful, but steelmaking based on recycled steels generally requires less energy and material resources than using iron ore from the ground.

However, steels remain in use for decades before they are recycled. As steel demand is still rising, there are not enough recycled steels available to meet worldwide demand. Therefore, demand is met through the combined use of the BOF and EAF production methods.

<table>
<thead>
<tr>
<th>No.</th>
<th>Country/Region</th>
<th>Crude Steel Production (million metric tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>China</td>
<td>489.2</td>
</tr>
<tr>
<td>2</td>
<td>European Union (27)</td>
<td>209.5</td>
</tr>
<tr>
<td>3</td>
<td>Japan</td>
<td>120.2</td>
</tr>
<tr>
<td>4</td>
<td>United States</td>
<td>98.2</td>
</tr>
<tr>
<td>5</td>
<td>Russia</td>
<td>72.4</td>
</tr>
<tr>
<td>6</td>
<td>India</td>
<td>53.1</td>
</tr>
<tr>
<td>7</td>
<td>South Korea</td>
<td>51.6</td>
</tr>
<tr>
<td>8</td>
<td>Ukraine</td>
<td>42.8</td>
</tr>
<tr>
<td>9</td>
<td>Brazil</td>
<td>33.8</td>
</tr>
<tr>
<td>10</td>
<td>Turkey</td>
<td>25.8</td>
</tr>
</tbody>
</table>

Top 10 steel-producing countries/regions in 2007
(Source: World Steel in Figures 2008)

Where does all the steel go?\(^3\)

Steel Applications

\(^1\) China         \(^2\) World Steel in Figures 2008  \(^3\) World Steel in Figures 2008
The climate change challenge

Steel is fundamental to our modern way of life and essential to economic growth. The rate of global steel demand has been increasing rapidly. In the 1950s world crude steel production was at 200 mmt and has increased more than six-fold since then to 1,343.5 mmt in 2007. Demand is expected to grow annually by 3-5% worldwide to meet society’s needs, driven by demand in developing countries such as China, India and Russia, where the steel industry is expected to grow 8-10% annually.

The Intergovernmental Panel on Climate Change (IPCC) presented its fourth assessment report at the 2007 Bali climate change conference. The scientific consensus is that to prevent irreversible damage to the planet, global greenhouse gas emissions must peak in the next 10 years and be cut by 50% by mid-century.

The implications for steel are fundamental. If the per capita use of steel in developing countries such as China and India becomes comparable to levels in OECD countries, then the greenhouse gas emissions from the steel industry could more than double from present levels by 2050.

The greenhouse gas of most relevance to the world steel industry is carbon dioxide (CO₂). On average, 1.7 tonnes of carbon dioxide are emitted for every tonne of steel produced (see p. 29).

According to the International Energy Agency (IEA), the iron and steel industry accounts for approximately 4-5% of total world CO₂ emissions.⁴

CO₂ generated by the steel industry results mostly from the chemical interaction between coal and coke (carbon) and iron ore in a blast furnace. This process is called ore-reduction and produces hot metal which is then converted to steel. No substitute for carbon in steel-making is available yet. Over 90% of steel industry CO₂ emissions come from iron production in nine countries or regions: Brazil, China, the EU, India, Japan, Korea, Russia, Ukraine and the US.

Our challenges:

• Reduce worldwide CO₂ emissions from the steel sector, for each tonne of steel produced.
• Maximise the emission reduction benefits offered by steel-using products over their life cycle.

Taking action

Steel companies are actively working to address these challenges by:

• developing a global steel sector approach by 2010 to reduce the CO₂ intensity of steel
• enabling transfer of technology to revamp and improve the energy efficiency of outdated steel plants
• investing in breakthrough technologies for long-term solutions
• working with customers and industry partners to maximise the contribution of new steels in reducing life cycle CO₂ emissions, particularly in high impact applications such as transport and construction.
A global sector approach to reduce CO₂ emissions

Steel companies are committed to reduce CO₂ emissions per tonne of steel produced worldwide. By 2010, worldsteel members will deliver a steel sector approach that:

• involves collection and reporting of intensity-based (per tonne of steel) CO₂ emissions data by steel plants in all major steel producing countries, based on methodology verified by an external party
• will require reporting and setting targets for improvements in CO₂ emissions on a national and regional basis for implementation during the post-Kyoto period
• is supported by its members in both the developed and developing countries including China, which accounts for nearly 50% of total steelmaking CO₂ emissions.

The current situation

Technological advancements over the past 25 years have enabled substantial reductions in CO₂ emissions from steel production. These advancements include:

• enhanced energy efficiency in the steelmaking process
• improved recycling rates and use of steel products
• increased recycling of by-products from steelmaking
• better environmental protection techniques.

Further medium-term improvements will be made through technology transfer. Long-term substantial improvements will come from new breakthrough technologies in steelmaking.

Technology transfer

The efficient technologies used in modern steelmaking sites go a long way towards lowering the industry’s CO₂ emissions. Developing new technologies and expanding the use of those already in use is one of the industry’s main aims. The steel industry remains committed to help transfer efficient technologies to speed up the revamping of outdated steel plants.

Steel companies are involved in international technology transfer schemes through initiatives such as the Asia-Pacific Partnership (APP) on Clean Development and Climate.

The countries that are party to APP (Australia, Canada, China, India, Japan, Korea and the US) account for over half the world’s CO₂ emissions and about 60% of world crude steel production. The APP encourages cooperation on the development and transfer of technology, to enable a reduction in CO₂ emissions. The APP Steel Task Force has established several projects including the publication of the State-of-the-Art Clean Technologies Handbook. It contains the latest energy-saving technologies and best practices in the steel industry and provides a reference for steel companies around the world.

worldsteel is an important platform for technology transfer information. Through our projects and working groups, members regularly exchange information on topics such as energy management and climate change (see p. 30).

Also at worldsteel.org:
• IISI position paper on the global sector approach
• The Life of Steel – how steel products contribute to sustainable development
• APP handbook – State-of-the-Art Clean Technologies (SOACT)
• Link to ulcos.org for more on breakthrough technologies
Breakthrough technologies

Today’s steelmaking processes have optimised energy use. Therefore, only fundamentally new processes and the next generation of steelmaking technology can make a significant further reduction in CO₂ emissions. The worldsteel CO₂ Breakthrough Programme is a platform for exchange on long-term research and development. As modern steelmaking is already highly energy and CO₂ efficient, ‘breakthrough’ refers to new technologies that will lead to major changes in the way steel is made. The time frame for the realisation of these technologies is 2020 and beyond.

The most promising breakthrough concepts to date include:

- recycling blast furnace top gas after decarbonising and further CO₂ storage (proposal of the ultra-low carbon dioxide steelmaking (ULCOS) programme)
- smelting reduction and direct reduction with oxygen use and CO₂ capture and storage
- electrolysis of iron ore
- use of hydrogen produced from CO₂-lean sources
- use of sustainable biomass.

Steel solutions provide product life cycle benefits

While the production of steel results in the emission of CO₂, steel products can also offer savings over the life cycle of a product that are greater than the CO₂ emitted during their production.

For example, over 20 years, a three-megawatt wind turbine can deliver 80 times more energy than is used in its production and maintenance. The steel can be 100% recycled at the end of its life.5

Steel also reduces product life cycle CO₂ emissions in other ways, including:

- Lightweighting – advanced high-strength steels (AHSS) allow for less steel to be used in cars, reducing their weight by 9%, fuel consumption during the use phase by 5.1%, and greenhouse gas emissions by 5.7% over the life cycle, without compromising safety (see p. 25).
- Long product life cycle – steel’s strength and durability allow for long product life cycles. For example, buildings and bridges made with steel last 40 to 100 years, or longer with proper maintenance.
- Recycling – steel is easily recovered with magnets and is 100% recyclable. It can be infinitely recycled without loss of quality. Recycling reduces emissions and the use of raw materials in the making of new steel.

Case Study

Energy conservation

Rautaruukki’s Finnish steelmaking sites have been party to the Ministry of Trade and Industry’s voluntary energy conservation agreement since 1992. Between 1992 and 2007, energy efficiency actions delivered implicit annual energy savings of 1.25 TWh. This is equivalent to the annual energy usage of 62,500 single-family homes. It also corresponds to a saving of CO₂ emissions of about 480,000 tonnes.

In December 2007, Rautaruukki signed a new energy efficiency agreement, valid from 2008 to 2016, between the Finnish government, the Confederation of Finnish Industries and sector associations. The goal is to achieve a 9% saving in the energy consumption of non-emission trading sites by 2016. Sites which are part of the EU emission trading scheme will set their energy efficiency targets during 2008.
Environmental protection

Steel manufacturing has a variety of impacts on the environment. The main impacts come from the use of energy and raw materials, which result in the emission of carbon dioxide (CO₂), sulfur oxides (SOₓ), nitrogen oxides (NOₓ) and dust to air, as well as water usage and associated emissions.

CO₂ emissions occur mainly in the iron ore reduction process in blast furnaces. Dust emissions occur at metallurgical processes and dispersoids used in iron and steel production. SOₓ emissions primarily originate from the sulphur contained in iron ore concentrates and coal. NOₓ emissions are formed mostly as a result of the combustion process in coking and sintering plants and rolling mill furnaces. Water is used mainly for cooling.

The steel industry is committed to act responsibly to minimise or prevent negative environmental impacts. We try to ensure that environmental regulations are met, continue to promote best practice and develop new technologies to prevent emissions at the source. Proper water management also plays a critical role in the viability of steel plants, especially in regions of water scarcity.

Taking action

Measures being taken by steel companies to protect the environment and minimise emissions include:

- environmental management system (EMS) implementation, for example, ISO 14001
- monitoring and reporting on air and water emissions to prevent limits being exceeded and taking corrective actions if they are exceeded
- investing in the development and implementation of clean technologies to prevent pollution at the source
- life cycle inventory (LCI) – worldsteel collects data from member companies on the environmental impacts of steel products for use in life cycle assessment studies and benchmarking improvement efforts.

Case Study

Environmental technologies for improved energy efficiency

Since 1975, the US steel industry has invested over US$60 billion in new technologies to improve energy efficiency and productivity. In a typical year, over 15% of the US steel industry’s capital expenditures (over US$2.3 billion in 2003 and 2004) are directed toward environmental facilities.

According to the American Iron and Steel Institute (AISI), in the last two-and-a-half decades, annual energy consumption by the US steel industry has been reduced by more than 60%. This is due mostly to an increase in EAF production and more steel recycling in BOFs (overall increases in scrap consumption), a move to almost 100% continuous casting, and hot charging of slabs in coil and plate production. Continuous casting and hot charging of slabs dramatically reduce energy consumption as they eliminate reheating during steel production.

![Energy consumption per tonne of steel shipped in the US steel industry](chart)

Also at worldsteel.org:
- Additional company case studies on air, water and energy management and biodiversity
- LCI data on steel products
- Steel and Energy fact sheet
Environmental management systems

An EMS enables an organisation to evaluate and continually improve its environmental performance and to increase its operating efficiency.

An organisation establishes an EMS by developing an environmental policy, implementing training and operation controls, monitoring progress, taking corrective actions where necessary and reviewing the EMS to make changes when applicable.

Steel plants may register to EMS standards such as ISO 14001 or EMAS. worldsteel member companies reported in 2006 that 85.5% of employees and contractors worked at registered production facilities (see p. 29). The number of ISO 14001 applications for the basic metal and fabricated metal products industrial sector went from 6,274 in 2005 to 7,521 in 2006.

Clean technologies

Steel companies continually invest in cleaner production solutions to prevent pollution at the source. Solutions can include changes in process or manufacturing technology, change of input materials (for example, using raw materials low in sulphur), reuse and recycling of materials onsite, improved housekeeping, and training. The *State-of-the-Art Clean Technologies Handbook* developed by the Steel Task Force of the Asia-Pacific Partnership on Clean Development and Climate details some of the best available technologies and solutions that can be implemented at steelmaking facilities to increase energy efficiency and improve environmental performance.

Life cycle inventory

worldsteel has been collecting life cycle inventory data from members worldwide since 1995. The LCI data quantifies ‘cradle to gate’ inputs (resource and energy use) and outputs (environmental emissions) of steel production from:

- extraction of resources and use of recycled materials,
- production of steel products to the steelworks’ gate and
- end-of-life recovery and recycling of steel.

This data is used worldwide in life cycle assessment studies to ensure informed material selection decisions and can contribute to identifying ways of improving the eco-efficiency of steel products by applying a life cycle perspective.

Case Study

Responsible water management

In South Korea, POSCO recycles approximately 98% of the water it uses in steelmaking, for reuse at the facility. This minimises their use of fresh water from nearby dams to about 310,000 tonnes per day. All the water it uses is treated at a waste water treatment plant (WWTP). Most of the water from this WWTP is recycled and reused and the remaining water undergoes advanced treatment at a second WWTP.

Some of this waste water is used for cleaning roads in the steelworks or is sprinkled at the materials yard to reduce dust. The rest is discharged into the sea nearby.

To minimise the emission of water pollutants (including COD, which is well below legal limits – see table), the WWTPs are equipped with activated carbon absorption facilities and state-of-the-art biological treatment facilities.

<table>
<thead>
<tr>
<th></th>
<th>1994</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
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</thead>
<tbody>
<tr>
<td>Concentration</td>
<td>10</td>
<td>6</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Legal limit</td>
<td>80</td>
<td>70</td>
<td>70</td>
<td>70</td>
</tr>
</tbody>
</table>

Chemical oxygen demands (COD) concentration in effluents (Unit: mg/l)
Responsible management of natural resources

The extraction, transport and production of energy and raw materials have an impact on the environment. Efficient use of these natural resources is critical to ensuring environmental sustainability.

Steelmaking is resource intensive, with about 0.4 tonnes of recycled steel and 1.6 tonnes of raw materials (e.g. iron ore, coal, limestone) needed on average to make one tonne of steel.6

The steel industry is already highly efficient in its use of energy and raw materials with the technology available today. Little waste is produced with high material efficiency rates. Nearly 100% of by-products are reused and recycled. The steel industry must continue to invest in new technologies to make even further improvements in steelmaking.

Steel’s most important contribution to conserving natural resources is its lightweight potential, durability and recyclability.

Steel products enjoy long lifecycles, minimising the need to replace them. At the end of a product’s life, steel’s recyclability ensures that the resources invested in its production are not lost and can be infinitely reused.

The steel industry has an important role to play in continuing to develop steels that will help products last even longer and to ensure that steel recycling is maximised.

Taking action

Steel companies are involved in conserving natural resources by:

• investing in process improvements and developing new technologies (see p. 27)
• developing new steels, like advanced-high strength steels (AHSS), that improve the eco-efficiency of steel-using products (see pp. 25 and 26)
• reporting material efficiency (see p. 29) and benchmarking for improvements; our goal is 100% efficiency, or zero-waste.
• reuse and recycling of by-products, already nearing 100%
• steel recycling – almost all available steel is recycled and worldsteel members are working to maximise steel recycling
• reporting energy use (see p. 29) and benchmarking for improvements.

Case Study
Sustainable uses of by-product gases

The rolling mill reheating furnace at the Gerdau Ameristeel plant in Canada is powered by methane gas from decomposing organic waste in a nearby landfill. Specialised technology extracts, pressurises, cleans and transports the gas through an 800 m pipeline. Used instead of natural gas, the methane provides 45% of the energy required to operate the furnace and results in an emissions reduction of 6,384 tonnes of CO2/year.

Ternium Mexico has developed a CO2 continuous sequestration and recuperation device which allows the company to sell about 50,000 tonnes of CO2/year emitted from their steelmaking plant to a nearby gas facility. It is delivered via a 1.5 km pipe, cleaned up to beverage quality standards, and then used in sparkling drinks. This means that the beverage industry does not have to burn fossil fuels to produce the required CO2.
Material efficiency

Material efficiency measures the amount of material not sent for permanent disposal, landfill or incineration, whether offsite or onsite, relative to crude steel production.

The steel industry’s material efficiency rate was 97.2% in 2006 (see p. 29). Our goal is 100% efficiency, or zero-waste.

Synergies with other industries to maximise by-product value

Producing one tonne of iron for steelmaking via the blast furnace route generates around 600 kg of by-products such as slag, dust, gases and sludge. These materials can be recycled back into the steelmaking process or used in other industries.

Blast furnace slag is the main steelmaking by-product. It contains mainly lime and hydrated silica and is almost 100% utilised. A key market for slag is cement. Slag can reduce CO₂ emissions in cement production by around 50%. In some countries, up to 80% of the cement contains granulated blast furnace slag.

Dust and sludge consist primarily of iron and can mostly be used again in steelmaking. Some are rich in zinc oxides, which can be removed and sold to non-ferrous metal refining companies as a raw material.

Gases produced during the steelmaking process can also be fully reused. They provide fuel for heating steel furnaces or energy in power generation plants within steelworks. Electricity generated through this method contributes to the energy efficiency of a steelworks and saves valuable fossil fuel resources.

By-products from steelmaking can also be used in roads (slag substituting aggregates), as fertilizer and soil improvement agents (slag rich in phosphate, silicate, magnesium, lime, manganese and iron), rock wool for insulation, glass, ceramics, pigments, magnets, plastics (such as polystyrene), electrodes for aluminium and steel plants, and cosmetics. In some countries, the recycling rate for by-products is as high as 98%.

The most recycled material in the world

The recyclability of steel is extraordinary. Steel is 100% recyclable, and can be easily and infinitely recycled without loss of properties. It is one of the few magnetic metals, which makes it easy to separate from waste streams and other metals.

About 80% of post-consumer scrap steel is recycled. The industry works closely with customers and designers to create products that are easy to reuse or recycle at the end of their life to help maximise steel recycling in the future.

More steel is recycled worldwide annually than all other materials put together, with an estimated 459 mmt being recycled in 2006, about 37% of the crude steel produced that year. Recycling this steel:

- avoided 827 mmt of CO₂ emissions,
- saved 868 mmt of iron ore, and
- saved the energy equivalent of 242 mmt of anthracite coal.

Also at worldsteel.org:
- Synergies with the zinc industry
- Recycling of waste plastics by the Japanese steel industry
- Steel packaging: the sustainable solution
- Steel and Raw Materials fact sheet
Employee safety and health

Employee safety and health is fundamental to sustainability. All injuries and work-related illness can and must be prevented. Management is responsible and accountable for the safety and health performance of a company. Employee training and engagement is essential to ensure that accidents are prevented.

Accidents still occur at steel plants around the world. However, they are consistently decreasing in proportion to man-hours worked. One of the most common indicators of safety is lost-time injury frequency rate (LTIFR). A lost-time injury is an industrial injury causing loss of time from the job on which the injured person is normally employed beyond the day or shift on which the injury occurred. Worldsteel members reported an LTIFR of 8.8 injuries per million hours worked in 2006 (see p. 29). However, there is no area, process or type of work that cannot be accident-free.

Taking action

To prevent work-related accidents, steel companies implement safety policies to improve employee training and awareness.

Worldsteel supports its member companies to achieve an accident-free workplace. Worldsteel has a working group on safety and health. There is also a handbook called Accident-Free Steel available.

Accident-free steel

A safe working environment for all employees is the number one priority for every steel company. Safety requires a permanent 100% commitment from everyone in a steel plant. Most importantly, safety requires commitment from the top.

The senior management of a company sets the culture in which everyone knows that safety is the number one priority and it must not be compromised for any other objective.

Many steel companies are improving their safety performance and some have gone without any lost-time injuries for a considerable period.

These companies know that such performance requires excellence in all aspects of their operations. This excellence also produces better business performance. The most successful steel companies are also the safest.

Case Study

14.9 million hours without a lost time injury

The Australian Steel Institute’s 2007 Site Occupational Health and Safety (OH&S) Excellence Award was presented to BlueScope Steel’s Port Kembla Steelworks. The award was for the site’s achievements in working 14.9 million hours without a lost time injury. This represents approximately 6,000 employees and contractors who worked on average 13 million hours a year.

Safety at Port Kembla is recognised as best practice within the steel industry internationally. Jason Lashmar, Operations Manager at BlueScope Lysaght’s Archerfield site, won the Individual OH&S Excellence Award for his contribution to building a new safety culture at Archerfield, and for leading the introduction of several safety initiatives on site.

Also at worldsteel.org:

- Accident-Free Steel, a worldsteel handbook
- Company case studies on measures taken to improve safety and health
- Worldsteel Safety poster
Attracting and retaining a talented workforce is a challenge faced by many steel companies around the world. In many regions today, there is a shortage of qualified employees. Knowledge management and transfer from an older to newer generation of the workforce is also a critical issue in a sector that relies on technical expertise and excellence.

Steel companies are working to attract the most talented people and enhance knowledge transfer by:

• providing employee training and opportunities for educational advancement and career development
• investing in educational partnerships
• developing knowledge management resources, like steeluniversity.org
• making workplaces more attractive and improving working conditions
• monitoring and improving employee satisfaction rates through company-wide surveys.

The steel industry is committed to offer employees the opportunity to further their education and develop their skills. Not only is this a way of enhancing quality of work and productivity but it also boosts employee satisfaction.

In 2006, the steel industry provided an average of 10.4 days of training per employee (see p. 29). This training may involve various delivery methods such as classroom instruction, computer-based training, or on-the-job instruction.

Manufacture advanced high-strength steels for an aircraft undercarriage, design a door panel for a car or calculate the design stress for the steel cable stays on a suspension bridge. Step inside a virtual steel plant, operate the equipment and produce and test your own grade of steel.

Steel companies around the world are investing to provide a good working environment and create opportunities for their current and potential employees. They are also investing to strengthen educational partnerships and provide undergraduate scholarships, sponsoring joint research and development projects, and offering summer jobs and training positions for students.

The aim of steeluniversity.org is to inform and excite students about steel and to provide practical examples of metallurgical and scientific principles. It also supports the continuing professional development of employees in the steel industry supply chain.

Steeluniversity.org is used in more than 50 universities worldwide. The website is available in English, Chinese, Spanish, Korean, Russian and German.

Also at worldsteel.org:
• Company case studies on education and training
• Working in the Steel Industry fact sheet
Case Study

Further education and new opportunities

Tenaris University is a corporate university with an annual budget of over US$29 million. The university ensures uniformity of quality and skills regardless of whether the Tenaris employee works in the US, Brazil, Romania, China or elsewhere.

The courses are customised to the needs of employees at every stage of their careers. Courses mix e-learning and on-site classroom teaching with off-site training, through agreements with universities and other providers.

Tenaris University also runs the Roberto Rocca Education Program, a global scholarship and fellowship programme for engineering and applied science students. Each year, approximately 500 scholarships and 15 fellowships are awarded in nine countries. In 2007-2008 this amounted to over US$ 2.5 million.

In Italy, Riva Group is involved in a master’s course offered at the Turin Polytechnic and at the University of Genoa through Altaformazione Siderurgica, an advanced school of iron and steel metallurgy established by Riva Group.

In the short-term, the course aims to recruit a new generation of highly-skilled technicians. In the long-term, it secures business continuity and helps to transfer expertise of key human resources between different generations of employees.

Attracting talent

The LIFE programme of the voestalpine Group aims to attract people to join the company. A key challenge is to improve the work-life balance and to relieve health-related stresses in the workplace. voestalpine offers all employees the opportunity to spend 2% of their annual working time on further education. In some areas of the company, employees are free to choose their weekly working schedules. The programme also aims to reduce shift-work pressures by replacing the 4-shift rhythm with a 5-shift rhythm in some areas. Work that is not time-critical is done during day shifts.

Over the last few years, employee satisfaction surveys have shown increased employee motivation. Other benefits of this programme include better health and fewer accidents.
Our communities

An essential aspect of social sustainability is achieving mutual respect and appreciation between industry members and the communities in which they operate. This can be fostered through company engagement in dialogue with community representatives and through a variety of other initiatives.

The steel industry seeks to add value to local communities by being a reliable partner for their development.

Taking action

Steel companies around the world not only bring value to the local economy by providing jobs and taxes, but also through numerous social initiatives. These vary from one region to another, and depend on the local culture. They include:

- investing in community education, culture and the arts
- company sponsorship and employee participation in volunteer programmes
- providing housing and healthcare services
- engaging in dialogue to better understand and respond to community concerns and priorities.

Case Study

Sustaining steel production in Western Europe: a holistic approach to a new blast furnace

In January 2008, ThyssenKrupp Steel inaugurated BF8, its newest blast furnace in Duisburg, Germany, 110 years after its first blast furnace was built there.

At a high-cost location, economic considerations are critical, but steel production is still a major contributor to economic welfare, even in post-industrialised countries. The new blast furnace’s concept provides some 5,000 jobs, directly and indirectly. BF8 is in a residential area, so community acceptance is essential. The furnace was constructed to be socially responsible in every respect. Unusually for an industrial plant, design played an important role, to make it an integrated part of the city skyline. The working environment was an essential consideration, and the conditions at BF8 mirror the high-tech equipment that the workers operate.

BF8 also sets new global environmental standards, approaching zero-emissions for dust and noise. €80 million, almost a third of the €250 million total investment for BF8, was spent on environmental and social aspects alone.
Case Study

Education for underprivileged children

Apart from making steel, the Bhilai Steel Plant (BSP), a unit of Steel Authority of India Limited, also runs a number of schools in its township. Recognising that education is integral to human development and accepting the constitutional right of every Indian to education, BSP has been contributing to increasing the literacy rates in the areas of its operations.

BSP provides education facilities for more than 34,000 children of its employees and non-BSP children, up to senior secondary level. There are more than 40 schools and 900 teachers.

The company is now focusing on education for people who live below the poverty line. Many students cannot pursue their studies due to lack of infrastructure in their villages. Also, the cost of fees, books, stationary, uniforms, meals and transport are unaffordable for these families. As a result, children are forced to work in the informal sector.

The challenge is to attract students to schools and to provide a standard of education that matches that of the other schools supported by BSP. BSP has started an independent English primary school to provide state-of-the-art schooling without any financial burden to their families. Education is provided for 175 children free of cost, along with school supplies, meals and transport.

The beneficiaries of the initiative are the children of contract and daily labourers, canteen and other auxiliary workers. Educating their children will have a cascading impact in the community, with more and more families joining the school.

The project has created awareness among the people residing in and around the Bhilai township about the company’s social commitments and will result in immense long-term benefits to society. It has also given a sense of pride to families who have traditionally been neglected.

Community education

The ArcelorMittal Foundation works with the company’s regional operations to bring about a more coordinated, strategic approach to its community activities. The Foundation’s three priority areas are education, health and social promotion.

The Foundation supports a number of projects across the world. The Science Centre in the Sedibeng district of Gauteng, South Africa, promotes scientific studies to encourage youngsters to embark on science-related careers. It offers state-of-the-art facilities, helping to foster a high-performance science and technology culture amongst teachers and over 1,800 students. The centre’s qualification and training activities are focused mainly on mathematics, sciences and English.

Also at worldsteel.org:
• Company case studies on community development
Economic performance

Over the last five years, the steel industry has seen a renaissance in profitability and growth to economically-sound levels. This is has been triggered by increased steel use in China and other emerging economies. Today’s steel businesses are managed for value creation, profitability and growth.

Mergers and consolidations have aided in this rebirth, leading to improved operating efficiency and profitability. Consolidation helps to keep prices and returns stable and the industry and its developments more predictable.

However, consolidations also bring integration challenges and affect local communities in which facilities have been closed. Price and availability of raw materials also affect the profitability of steelmaking today. The increase in prices of iron ore and coking coal are well above their real economic cost.

Taking action

Steel companies are ensuring consistent returns in the long-term in a number of ways, including:

- mergers and consolidations to improve profitability and long-term returns
- focusing on special products and exploring technical advantages
- more self-sufficiency or other supply securements in raw materials
- investment in the education of current and potential employees
- on-going development of new steel products.

Performance indicators

Steel companies must be profitable in the long-term to ensure economic sustainability. A few key indicators, provided by worldsteel members, are presented here as weighted world average values to demonstrate the industry’s economic performance and ability to attract investors (see p. 29).

Operating margin is an indication of a company’s earning power from its ongoing operations. In 2006, worldsteel members reported an operating margin of 15.3% of revenue.

Return on capital employed (ROCE) measures how well a company utilises capital to generate revenue, useful in determining effectiveness in earning sufficient returns to attract investors. worldsteel members reported a ROCE value of 19.6% of capital employed in 2006. That is, for every US$100 of capital employed, the companies realised a return of US$19.60.

Economic Value Added (EVA) calculates the creation of shareholder value by a company. A positive EVA value means that the company is creating value for its shareholders, while a negative value means it is destroying value. In 2006, worldsteel members reported a value added figure of 7.6% of revenue.

Case Study

Supporting the economic regeneration of communities

Corus is committed to minimising the impact on the communities in which it operates, where redundancies and plant closures are unavoidable to maintain competitiveness. UK Steel Enterprise (UKSE), a subsidiary of Corus, is supporting the economic regeneration of communities affected by changes in the steel industry. Since its establishment in 1975, UKSE has invested over €977 million in new and expanding businesses and €43 million in managed workspaces. It has supported over 4,400 small businesses and helped create 67,000 new jobs.

Over the years, the business has been able to attract additional external funding of over €450 million for its clients.

Through these developments, new innovative companies have been brought into steel areas. Hartlepool Innovation Centre is the latest of eight such developments. It opened in 2006 and now houses 33 businesses and more than 120 people.
Adding value

The steel industry’s greatest value contribution is providing society with steel products that are indispensable in sustaining and improving our modern world and standard of living.

Steel is all around us. There is hardly any object that we use that does not contain steel or that was not created with equipment made of steel. From common kitchen utensils to automobiles and wind turbines, steel’s durability and strength add value to society.

The steel industry must continue to work with its customers to maximise the benefits of steel to society. It is also important that the industry make a fundamental shift in its focus from volume (increasing the amount of steel used) to value, as a long-term strategy.

Two markets with great potential to further enhance the added value of steel to society are transport and construction, where steel has the potential to provide lighter and more intelligent structures.

Taking action

Steel companies are cooperating on a global level to enhance the added value of steel to society by:

• providing more sustainable housing solutions, through the Living Steel consortium, worldsteel’s project on innovative and responsible housing design and construction
• developing strong, safe and sustainable automotive solutions through WorldAutoSteel, the automotive group of worldsteel.

Living Steel

Living Steel is a worldwide collaborative programme designed to stimulate innovative and responsible housing design and construction. It was launched in February 2005 in response to the need for more efficient and effective housing solutions.

Living Steel aims to help address the unprecedented pressure on infrastructure, communities and the quality of people’s lives stemming from growing urban populations. worldsteel has committed more than €14.25 million to this five-year programme.

Currently underutilised in the residential sector, steel allows for faster construction, durability in structural strength and flexibility in designing solutions for the world’s growing urban population.

Using advanced high-strength steel in construction reduces the need for heavy load-bearing beams. Beams can be made thinner, saving energy and greenhouse gas emissions as less material needs to be produced in the construction of a building. Lighter and fewer components also means lower emissions during transport to the building site.

Steel withstands severe weather, earthquakes and fire more easily than other construction materials. Steel construction elements can also be designed for reuse. Instead of recycling the steel, walls, structures and even entire buildings can be taken down and re-assembled elsewhere.

Case Study

Living Steel international architecture competition

Central to the Living Steel initiative is the international architecture competition. The competition presents architects from all over the world with an opportunity to bring to life their vision for innovative and responsible housing design and construction. The first competition focused on housing solutions in India and Poland. These constructions are now underway.

The second competition featured projects in Brazil, China and the UK. The third competition is about building sustainable steel housing in the extreme climactic conditions of Cherepovets, Russia (see illustration above).
Case Study
Advanced high-strength steels reduce vehicle life cycle greenhouse gas emissions

A lighter weight vehicle results in reduced fuel consumption and consequently reduces use phase greenhouse gas (GHG) emissions. Material choices that result in the lowest mass vehicle may be preferred if one considers only a vehicle’s use phase. However, to fully assess a vehicle’s environmental footprint, all vehicle life phases must be considered. This includes the GHG emissions resulting from materials production, the manufacturing of the vehicle, the use phase and the end-of-life phase.

A case study based on a five-passenger compact vehicle and using a University of California, Santa Barbara (UCSB) model calculated the GHG reduction that is achieved by optimising the design with AHSS compared to conventional mild steel and compared to aluminium.

Placed in the context of a real-world five-passenger compact vehicle, the findings show that replacing former conventional steel designs with optimised AHSS designs, on average, results in 9% reduction in curb weight and reduced CO₂ equivalent GHG emissions in both the material production and use phase so that the vehicle’s total life cycle emissions are reduced by 5.7%.

AHSS is relatively new to the materials world, but its application in automotive structures has increased since the steel industry’s UltraLight Steel Auto Body (ULSAB), UltraLight Steel Auto Closures (ULSAC) and ULSAB-AVC (Advanced Vehicle Concepts) programmes successfully demonstrated weight savings and performance improvements at no cost penalty over similar applications using conventional steels. These projects help the world’s automotive industry to improve the safety, affordability and environmental impact of its products.

WorldAutoSteel

The WorldAutoSteel programme explores steel innovation that demonstrates and communicates the value of steel in automobiles. Its member companies pool global resources within and beyond the steel industry to deliver vital research that is central to effective steel automobile applications. WorldAutoSteel also compiles and disseminates global knowledge and experience in applying advanced high-strength steels (AHSS) to vehicle applications to meet weight reduction, safety, structural performance and manufacturing cost goals.
Investing in innovation

Innovation is at the heart of the steel industry. Over 75% of the steels in use today did not exist 20 years ago. Sixty percent of the steel grades used to manufacture automobiles today were introduced in the last 10 years. The steel industry must ensure the continued investment in the development of new steel products and production technologies, critical to meeting society’s growing demands and needs in a sustainable way.

Taking action

Innovation is being fostered by steel companies worldwide by:

- working with customers to develop new kinds of steels, like AHSS that improve the eco-efficiency of steel products
- making significant R&D investments; in 2006 worldsteel member companies invested 7.7% of revenue in new processes and products (includes capital expenditure and research and development, see p. 29), despite increased raw material cost
- cooperating internationally on the development of breakthrough technologies (see p. 11).

AHSS are reaching up to 40% usage in vehicles on the road today.

Ever-evolving steels

Steels are ever-evolving to meet customer requirements. For example, AHSS are designed to reduce density, improve strength and increase elongation. This leads to higher strength and lighter weight steel components for automotive, construction, and industrial machinery applications.

Nanotechnology is also increasingly employed in the creation of new AHSS to enhance formability and corrosion-resistance. One such class of AHSS from JFE Corporation, NANO HITEN (high-tensile), employs arrays of ultra-fine (nano-sized) particles to achieve lighter, high-tensile strength steels. In automotive applications, these steels contribute to longer vehicle life and improved fuel economy by enabling a 5-10% auto body weight reduction, while maintaining crashworthiness.

Steel in renewable energy applications

New and existing steels play an important role in renewable energy technologies. For example:

- **Solar**: stainless steels play a key role in converting solar energy into electricity or hot water. They are used as a base for solar thermal-panels and in pumps, tanks and heat exchangers.
- **Wave and Tidal**: a steel pile is the main component of a tidal turbine in tidal energy systems. Steel is also used to fabricate wave energy devices. The steel used is formulated to withstand the harsh marine environment.
- **Wind**: steel is the main material used in on-shore and off-shore wind turbines. Almost every component of a wind turbine is made of steel, from the foundation, to the tower, gears and casings.

Also at worldsteel.org:

- AHSS Application Guidelines at worldautosteel.org
- JFE and ThyssenKrupp Steel cooperate to develop a new AHSS
- ISSF publication: “Stainless Steel in Solar Energy Use”
Case Study
Innovative steelmaking technologies

Steel companies make significant research and development investments to develop new steelmaking technologies. Two examples of recent innovations include the Meros and Finex processes.

Meros - Maximised emission reduction of sintering

In Linz, Austria, voestalpine Stahl replaced its existing wet-type dedusting system with the dry-type Meros (maximised emission reduction of sintering) process. This was done to satisfy environmental regulations required for the expansion of its sinter production capacity to 2.8 millions tonnes a year.

It is the world’s first Meros plant at a sinter facility. Up to 1,000,000 m³ of sinter off-gas per hour can now be treated. In comparison with the previous wet-type system, the Meros process reduces emissions of dust, heavy metals, organic compounds and SO₂ far more effectively.

The Meros process not only satisfies current strict environmental emission regulations, but is also expected to meet the ever more stringent emission values anticipated for sinter plants in the future.

FINEX – New iron-making technology

FINEX is an innovative and eco-friendly iron-making process. As the world’s first commercialised smelting reduction technology, FINEX opens a new chapter in steel production.

With FINEX, the sintering and coke making steps are eliminated. This removes two steps compared to the conventional blast furnace (BF) method. The shorter process leads to lower costs and fewer pollutants.

FINEX lowers investment and manufacturing costs and eliminates the need for raw material processing. Up-front investment comes to about 80% of building a BF. Cheaper raw materials and the elimination of sintering and coking process lower operation costs to 85% of the costs in the BF method.

FINEX also lowers emissions. With the elimination of sintering and coke-making, the emission of sulphur oxides (SOₓ) and nitrogen oxides (NOₓ) fall to 19% and 10%, respectively, of the emissions from the BAT-equipped BF process. The levels of fugitive dust also fall sharply. Fewer emissions contribute to keeping POSCO competitive amid tightening environmental regulations.
The member companies of the World Steel Association report on 11 sustainability indicators, demonstrating their performance in the three key sustainability areas: economic (indicators 1-4), environmental (indicators 5-9) and social (indicators 10-11). They have been referenced throughout this report. The table above shows the weighted average results from 38 member companies and two industry associations (including a further 77 companies), as listed on p. 31, with a 70% BOF, 29% EAF and 1% OHF production route spread. Together, these companies produced 42% of the crude steel produced worldwide in 2006 (up from 38% reporting for the 2005 Sustainability Report).

The participating companies operate in more than 30 countries on all continents, except for Antarctica. As the mix of companies has changed since our 2005 Sustainability Report and the method of calculation for indicators 5-8 has been revised, it is not possible to compare the indicator data above with the data published in 2005 or 2004.

Notes:

1. Revenue (US$410.3 billion) does not include revenue from the extra 77 companies reporting through AISI and JISF.
2. AISI reported for 11 additional companies on indicators 5-7 and 9. JISF reported for 66 additional companies on indicators 5-7
4. The method of calculation for indicators 5-8 have been revised since the publication of the 2005 Sustainability Report. In addition to direct steel production burdens and by-product credits (e.g. slag used in road building), indicators 5 and 6 now also include burdens related to the production of major intermediate products (e.g. conversion of coal to coke). Indicator 7 now includes by-products. Indicator 8 is now presented in units of mmt rather than as a percent of world production. For details, see indicator methodology document on worldsteel.org.
5. Indicator 11 includes data from an additional 13 steel companies and two country steel industry associations (not listed on p. 31).

Also at worldsteel.org:
- Definitions and calculation methodology for the sustainability indicators
The World Steel Association (worldsteel) represents approximately 180 steel producers (including 18 of the world’s 20 largest steel companies), national and regional steel industry associations, and steel research institutes. Our members produce around 85% of the world’s steel.

worldsteel was founded in 1967. Its offices are in Brussels, Belgium and in Beijing, China.

**Aims and objectives**

**worldsteel’s mission is to:**
- provide a forum for the world steel industry to address the major strategic issues and challenges
- facilitate the benchmarking of best practice amongst its members in all aspects of the steel business
- promote steel and the steel industry to customers, the industry and general media, and the general public. It assists its members to develop the market for steel.

**worldsteel has projects in the following areas:**

**Automotive**
The WorldAutoSteel programme provides global information on automotive steel applications. See worldautosteel.org.

**Climate change**
worldsteel has issued a steel industry climate change policy on behalf of the global steel industry. The policy calls for a global, steel-sector specific approach to climate change. The industry is committed to reduce its impact on the climate and the document outlines seven ways this can be achieved.

**Construction**
Living Steel is a worldsteel initiative to stimulate innovation in the design, supply and use of steel in construction. See livingsteel.org.

**LCA/LCI**
Life cycle assessment involves assessing the environmental performance of a product throughout its whole life. worldsteel collects life cycle inventory data from its members. The data is disseminated to members, experts, consultants, industry and universities. worldsteel is the most authoritative source of LCA information for steel.

**Raw materials**
Supply of raw materials is a key issue for the world steel industry. worldsteel has projects which look at the availability of iron ore, coke and coal, freight and scrap.

**Safety and health**
worldsteel promotes a policy of zero harm to all employees and contractors. Our Safety and Health group shares information about best practice.

**Statistics**
worldsteel publishes iron and steel production statistics on the 20th of each month. World Steel in Figures and the Steel Statistical Yearbook are annual publications.

**Stainless**
The International Stainless Steel Forum (ISSF) serves the stainless steel industry. See worldstainless.org.

**Steel market trends**
worldsteel publishes information on future trends in the steel industry. Publications include the short-range outlook for steel demand and the medium-term forecast.

**steeluniversity.org**
steeluniversity.org is a free, award-winning e-learning resource for students and steel industry employees. It has interactive modules on steel processing, steel applications, sustainability and ferrous metallurgy.

**Sustainability**
worldsteel and its member companies have a policy on sustainable development. In 2004, worldsteel published its first sustainability report. This report is updated every two years.

**Technology**
worldsteel members are involved in technology-related projects such as benchmarking, CO₂ mitigation and energy use.
The world steel industry consists of individual steel companies which differ in many ways, from location, size, production processes, product mix, to their approaches on assuring their sustainability. The World Steel Association encourages readers seeking further information on the sustainability practices of the steel industry to consult the websites of the individual steel companies that contributed to this global sustainability report. Most of the contributing companies provide on-line access to their financial, environmental and sustainability reports.

In addition to the companies listed here, this report contains additional information from the American and Japanese iron and steel industries, kindly provided by:

- American Iron and Steel Institute (AISI)
  steel.org
- Japan Iron and Steel Federation (JISF)
  jisf.or.jp

* In 2006, Dofasco became a subsidiary of ArcelorMittal but submitted indicator data separately for this data.
** In 2008, SSAB divested parts of IPSCO to Evraz and TMK.
*** Part of the Techint Group.

### LIST OF PARTICIPATING COMPANIES

- Aichi Steel Corporation
  aichi-steel.co.jp
- ArcelorMittal
  arcelormittal.com
- Baosteel Group Corporation
  baosteel.com
- BlueScope Steel Limited
  bluescopesteel.com
- Böhler Uddeholm AG
  boehler-uddeholm.com
- China Steel Corporation
  csc.com.tw
- Corus Group Ltd.
  corusgroup.com
- Daido Steel Co., Ltd.
  daido.co.jp
- Dillinger Hüttenwerke AG
  dillinger.de
- Dofasco*
  dofasco.ca
- Erdemir
  erdemir.com.tr
- Georgsmarienhütte Holding GmbH
  gmh-holding.de
- Gerdau S.A.
  gerdau.com.br
- IPSCO Inc.**
  ipsco.com
- Isdemir
  isdemir.com.tr
- JFE Steel Corporation
  jfe-steel.co.jp
- JSW Steel Limited
  jsw.in
- Kobe Steel Limited
  kobelco.co.jp
- Nippon Steel Corporation
  nsc.co.jp
- Nisshin Steel Co. Ltd.
  nisshin-steel.co.jp
- Nucor Corporation
  nucor.com
- OneSteel Limited
  onesteel.com
- Outokumpu Oyj
  outokumpu.com
- POSCO
  posco.com
- Rautaruukki Oyj
  ruukki.com
- RIVA FIRE SpA
  rivagroup.com
- SAIL, Bhilai Steel Plant
  sail.co.in
- Salzgitter AG
  salzgitter-ag.de
- SABIC (HADEED)
  sabic.com
- Sumitomo Metal Industries, Ltd.
  sumitomometals.co.jp
- Tata Steel Limited
  tatasteel.com
- Tenaris***
  tenaris.com
- Ternium***
  ternium.com
- ThyssenKrupp Steel AG
  thyssenkropp-steel.com
- U.S. Steel Corporation
  ussteel.com
- USIMINAS
  usiminass.com.br
- VIZAG Steel
  vizagsteel.com
- voestalpine AG
  voestalpine.com

Also at worldsteel.org:
- Profile 2007/2008
- Full list of worldsteel projects
Basic oxygen furnace (BOF)
In the basic oxygen furnace, hot metal is made into steel. Oxygen is injected to drive out carbon and other impurities dissolved in the melt. This process generates a lot of heat, so that recycled steel is added to keep the melt at around 1700°C. The resulting crude steel can be either cast directly or after secondary metallurgy processes have been applied (for further adjustment of composition or formation of alloys).

Coke
In a blast furnace, carbon is needed for the reduction of iron ore. This is provided in the form of coal. Since the blast furnace requires that gases can move through, coal is made into coke, which is porous and strong. Coke is made by baking coal without oxygen at high temperatures to drive out the volatile compounds.

Direct reduced iron (DRI)
DRI is iron ore that has been reduced using natural gas. The product is solid and in pellet form.

Electric arc furnace (EAF)
The EAF produces steel through the melting of recycled steel or DRI using electricity.

Sinter
Efficient iron production requires iron ore to have specific properties such as strength or gas permeability. If the iron ore does not meet these requirements it can be processed in a sinter plant where iron ore is baked into lumps together with coke or coal. The sinter plant also recycles iron-containing dust and other residues from the steelmaking processes.

Glossary and Endnotes

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<th>Coke</th>
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<td>The blast furnace is the classical production unit to reduce iron ore to molten iron saturated with carbon, called hot metal. It operates as a counter-current shaft system. Iron ore and coke are charged at the top. While this charge descends, ascending carbon containing gases and coke reduce the iron ore to liquid iron. To increase efficiency and productivity, hot air often enriched with oxygen is blown into the bottom of the blast furnace. In order to save coke, sometimes coal or other carbon-containing materials are injected together with this hot air. The hot metal is tapped at the bottom. Modern blast furnaces can produce over 10,000 tonnes of hot metal a day. From this, steel is made.</td>
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The numbers on the map are the page numbers of the case studies.

For more definitions and explanations of steelmaking terms, visit the Glossary in the FAQ section of worldsteel.org