Climate Change and the Production of Iron and Steel: an Industry View

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World Steel Association (worldsteel)

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worldsteel – who we are

The World Steel Association (worldsteel) is a non-profit organisation.

worldsteel represents steel producers, national and regional steel industry associations, and steel research institutes.

It has headquarters in Brussels, Belgium. A second office in Beijing, China, opened in April 2006.

Members represent around 85% of global steel production.
Today’s speaker

Åsa Ekdahl, Head, Environment and Climate Change.

Ms Ekdahl has been with worldsteel for 13 years, with previous experience at EUROFER, the European Steel Producers’ Association and Jernkontoret, the Swedish Steel Producers’ Association.

Ms Ekdahl holds a degree in Environmental Science from the Gothenburg University, Sweden.
Presentation outline

- State of play
- Part of the solution
- worldsteel’s 3-step approach
- A portfolio of technology options
- Partnerships and enabling framework
State of play
The Paris Agreement

• The Paris Agreement is a legally binding international treaty on climate change.
• It was adopted by 196 Parties at COP 21 in Paris, on 12 December 2015 and entered into force on 4 November 2016.
• Its goal is to limit global warming to well below 2, preferably to 1.5 degrees Celsius, compared to pre-industrial levels.
The debate has moved on

- Focus almost completely shifted to 1.5 degrees
- Spreading commitment to net zero by second half of the century
  - 2050 – EU, USA, South Korea, Japan, UK, Canada
  - 2060 – China, Brazil
  - 75% of 2021 global steelmaking capacity is in countries with net zero targets for 2050 or 2060
- “Decarbonisation of hard to abate sectors” in focus
  - After energy and transport
  - Steel, Cement, Chemicals, Aluminium, Heavy Transport
A call for industrial transformation

Decarbonizing industry will take time and money—but here’s how to get a head start

Decarbonising hard to abate sectors for the net-zero energy transition

The Hard-to-Abate sectors need innovation solutions to reach Net-Zero CO2 Emissions

How far off is the steel industry from decarbonising?

What is the best pathway to decarbonise the steel industry?
Steel companies' commitments

China's top steelmaker Baowu Group vows to achieve carbon neutrality by 2050

Tata Steel says edging towards carbon neutral goal in UK

United States Steel Corporation Announces Goal to Achieve Carbon Neutrality by 2050

POSOC Pledges to Achieve Carbon Neutrality by 2050 And Lead Low Carbon Society

Nippon Steel, Number Three Steeemaker Globally, Officially Commits to Carbon Neutrality

The JFE Group's Medium- to Long-term Vision

Aiming to Reduce CO₂ Emissions by 20% or More by FY2030 and To Be Carbon Neutral After 2050
In 2020, on average, every tonne of steel produced led to the emission of 1.85 tonnes of CO$_2$.

In 2020, the total direct emissions were of the order of 2.6 billion tonnes, representing between 7% and 9% of global anthropogenic CO$_2$ emissions.
Part of the solution
Part of the solution

Reducing our own impact

Promoting material efficiency and the circular economy

Developing advanced steel products to enable societal transformation
worldsteel’s 3-step approach
IEA scenario and our approach

Steel production, total CO₂ emissions and CO₂ intensity, 2019 - 2050 under the International Energy Agency (IEA) Sustainable Development Scenario (SDS)

- **Steel production**
- **CO₂ emissions**
- **CO₂ intensity**

Demand increase

Based on data provided in the IEA’s Iron and Steel Technology Roadmap, October 2020

1. **Step**: Increase in demand
2. **Increased scrap availability**
3. **Breakthrough technology (R&D Phase)** → **Breakthrough technology (deployment)**

IEA SDS ambition
1. step up

Industry programme that supports improvements in mill operations to efficiency levels in line with the steel industry’s top performers

- Optimal raw materials selection and use
- Increasing energy efficiency and minimising waste
- Improving yield
- Improving process reliability
2. Maximise scrap use

End-of-life scrap availability
- Rest of the world
- Other Asia
- China
- EU + North America + Japan

<table>
<thead>
<tr>
<th>Year</th>
<th>Million tonnes (Mt)</th>
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<td>2018</td>
<td>390</td>
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<tr>
<td>2030</td>
<td>600</td>
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<tr>
<td>2050</td>
<td>900 Mt</td>
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2030
600 Mt
2018
390 Mt
2050
900 Mt
3. Breakthrough technology

There are several promising approaches that could be taken to reduce iron ore at industrial scale without the release of CO₂.

These fall into three broad categories:

Using carbon as a reductant while preventing the emission of fossil CO₂, e.g. using CCUS and/or sustainable biomass.

Substituting hydrogen for carbon as a reductant, generating H₂O (water) rather than CO₂.

Using electrical energy through an electrolysis-based process.

Which breakthrough solution to deploy will be determined by availability of resources and policy support.
A portfolio of technology options
Breakthrough technologies in primary steel

Technology type:
- Biomass
- CCS
- CCU/CCUS
- Hydrogen reduction
- Hydrogen production
- Electricity
Breakthrough technology is becoming real

CCUS
Shougang operate a large-scale facility to convert steel plant process gases to ethanol.
ArcelorMittal are building a similar commercial facility in Belgium.

Hydrogen
HBIS is building a 1.2Mt capacity hydrogen metallurgy DRI demonstration project.
voestalpine’s SuSteel project is looking to apply hydrogen plasma reduction to ironmaking.

CCS
At Emirates Steel up to 800kt of CO₂ per year is captured from the CO₂-rich gas stream from the ironmaking plant and stored.
ArcelorMittal are part of the Norwegian “Northern Lights” CCS project.

Renewable energy
Evraz’s Rocky Mountain Steel in Colorado, USA, is transitioning from coal to solar.

Biomass
Aço Verde do Brasil is exclusively using sustainably grown biomass for their steel production.

Electricity
The Siderwin project (currently at TRL4), being led by ArcelorMittal, is looking at using low temperature electrolysis using a water-based electrolyte.
IEA estimates the additional cost of production to be between 10% and 50% compared to today, a cost increase significantly exceeding production margins.

Steel produced using low-carbon technologies will be competing with conventionally produced steel in the same market for a while.

This will create a first mover disadvantage and policy support will therefore be needed.

It is clear that low-CO₂ steel production is going to be more expensive than steel production today.
Partnerships and enabling frameworks
Partnerships are fundamental

Governments, the steel industry and other stakeholders will all need to collaborate to overcome the challenges involved in transforming our industry.
The steel industry’s role

The steel industry will:

- **Mitigate our own emissions**
  - Efficiency, scrap and breakthrough technology

- **Create partnerships for transformation**
  - Engage with governments

- **Be transparent**
  - Continue to measure and report our emissions
Governments to create frameworks that:

- Do not pick winners and losers among technologies
- Ensure availability and affordability of low carbon resources
- Enable access to finance for the transition
- Reduce first mover disadvantage by increasing the demand for low-carbon materials and create a market for low-carbon steel
- Take an innovative approach to the regulation of low-carbon processes and products
- Take a life cycle approach and support the circular economy
- Support collection and sorting of end-of-life steel products
Customers should:

**Demand** low-carbon steel and understand that this will come at an additional cost.

**Consider** the entire life cycle and design of steel-containing products suitable for remanufacturing, reuse and recycling.

**Support** collection and sorting of end-of-life steel products.
Restructured and expanded public website content in the new Climate Action section includes the policy paper and:

- Fact sheets detailing the suite of low-carbon breakthrough technologies currently under development.

- Examples of member initiatives in related areas, including new business practices encouraging low-carbon market development

- Work being carried out by other international organisations including the IEA and ResponsibleSteel
worldsteel contact

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