AIIFA SUSTAINABLE STEEL MANUFACTURERS ASSOCIATION

(FORMERLY KNOWN AS ALL INDIA INDUCTION FURNACES ASSOCIATION)

Voice of Indian Sustainable Steel Manufacturers

AIIFA News

VOL. No. XXVI
ISSUE No. 1, Jan. 2025

What's Inside

हमारे सभी सदस्यों को
नया साल 2025
और
76वाँ गणतन्त्र दिवस
की हार्दिक शुभकामनाएँ

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Global Commitment to Climate Action: The Paris Agreement and Its Implications for Steel-Producing Countries

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Introduction: Greenhouse gases, primarily carbon dioxide (Co_2), methane, and nitrous oxide, are major contributors to climate change. These gases, generated from the burning of fossil fuels, play a crucial role in maintaining Earth's average temperature at around 14°C by trapping heat in the atmosphere, much like the glass walls of a greenhouse. Without this natural greenhouse effect, global temperatures would plummet to -18°C, making Earth uninhabitable. However, human activities have significantly altered the natural balance, leading to a dramatic increase in greenhouse gas emissions. Scientists unanimously agree that these emissions are driving global warming and climate change. Among the proposed solutions, transitioning to green steel production is recognized as a critical step in combating these challenges and preserving the planet.

Heat, a fundamental energy source since primitive times, drives Earth's internal processes and influences its thermal and mechanical behaviour. The thermal structure of the planet plays a pivotal role in its evolution and geothermal systems. Currently, heat accounts for 50% of global energy consumption, with the majority being derived from fossil fuels such as coal, natural gas, and fuel oil. To address this, there is an urgent need to replace fossil fuels with clean and renewable heat solutions for industrial and domestic applications.

In iron-making blast furnaces, fossil fuels are burned at extreme temperatures of around 1600°C to melt raw materials like coke, limestone, and iron ore. This process purifies iron ore into metallic iron, where coke acts as a reducing agent. Unfortunately, this process also releases significant amounts of carbon dioxide, contributing to greenhouse gas emissions. The resulting molten iron, known as pig iron or hot metal, typically contains 4-4.5% carbon, 0.6-0.8% silicon, 0.03% sulphur, 0.7-0.8% manganese, and 0.15% phosphorus. This hot metal is then further processed in basic oxygen furnaces (BOFs) by mixing it with ferrous scrap and limestone and blowing supersonic jets of oxygen to produce liquid steel. This remains the most cost-effective method of steel production but also one of the most carbon-intensive. Transitioning to low-carbon or green steel production methods is essential for reducing the environmental impact of the steel industry.

Green Steel: Concept and Cost Analysis

Green steel refers to steel produced through sustainable and environmentally responsible methods. This involves utilizing renewable energy sources, reducing carbon dioxide emissions, and incorporating waste recycling into the production process. The goal of green steel production aligns with major international standards, protocols, initiatives, and government policies aimed at achieving low-carbon steel production and decarbonizing the steel industry. To ensure clarity and actionable insights, it is essential to outline whether a specific standard, initiative, or policy focuses on:

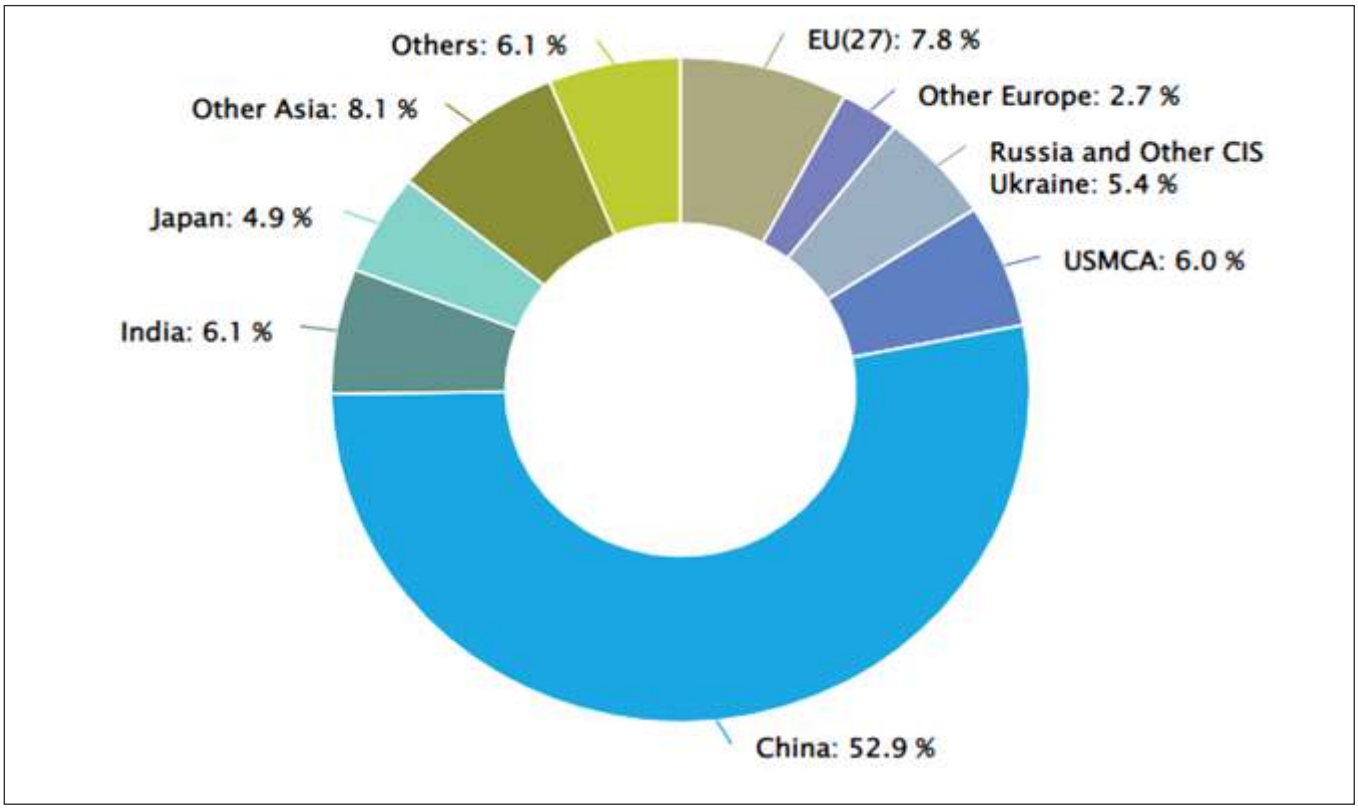
1. **Steel Producers:** Encouraging the adoption of green technologies and processes.
2. **Demand-Side Steel Procurement:** Promoting sustainable sourcing practices among consumers and industries.
3. **Finance and Funding Sectors:** Providing financial mechanisms and incentives to drive decarbonization.

The adoption of green steel production must also consider country-specific standards and certifications, such as the Responsible Steel

Standards & Certifications. With global urbanization and infrastructure expansion, the demand for steel remains insatiable. However, the steel industry is responsible for nearly one-third of total global CO2 emissions, necessitating urgent and transformative action. For example, Europe's largest steelmaker, ArcelorMittal, estimates that decarbonizing its operations to meet EU targets could require investments of up to $140 billion. Similarly, China, which produces nearly half of the world's steel, has committed to achieving carbon neutrality by 2050. This goal demands significant reductions in emissions across its steel industry, coupled with massive investments in clean hydrogen production and renewable energy infrastructure.

Key Insights and Tools

1. **Cross-Comparison Matrix:** A detailed matrix consolidating currently fragmented standards, protocols, initiatives, and policies. This tool will enable industry stakeholders, governments, non-government organizations, and academia to compare essential features and key information efficiently.
2. **Emissions Boundary Analysis:** A visual representation comparing the emissions boundaries defined by various standards and initiatives, providing a clear understanding of their scope and focus.



China's Dominance and the Global Steel Industry's Environmental Challenge

China currently produces over 50% of the world's total steel output, according to the World Steel Association (WSA). Steel, as the backbone of developed economies, remains one of the most essential, multi-functional, and adaptable materials, significantly influencing our daily lives. However, iron and steel manufacturing is among the most energy- and carbon-intensive industries globally.

The global steel industry emits approximately 3.6 billion tons of carbon dioxide (CO2) annually, accounting for about 7% of global greenhouse gas (GHG) emissions and 11% of total CO2 emissions. Over the past decades, rising steel production has

directly contributed to increased energy demand and CO2 emissions. With global steel demand expected to rise further, driven by population growth and economic expansion, the challenge of reducing the industry's carbon footprint becomes ever more critical.

Paris Climate Agreement: A Framework for Action

To meet the goals of the Paris Climate Agreement and limit global warming to “well below” 2°C, substantial reductions in energy demand and CO2 emissions in the steel industry are required by 2030 and beyond. The Paris Agreement, adopted by 196 parties at the UN Climate Change Conference, establishes a legally binding framework for climate action. Through nationally determined contributions (NDCs), countries have committed to progressively ambitious climate targets, submitting updated plans every five years.

Recognizing the urgency of rising global emissions and the visible impacts of climate change, COP24 in 2018 provided guidelines for implementing the Paris Agreement. These efforts underscore the need for significant economic and social transformation to combat climate change.

Primary vs. Secondary Steel Production

The primary steel production route—Blast Furnace/Basic Oxygen Furnace (BF/BOF)—dominates global steel production, accounting for 72% of total output. This method relies heavily on fossil fuels such as coal and coke, which are major sources of CO2 emissions. In contrast, secondary steel production, which uses electricity (e.g., Electric Arc and Induction Furnaces), emits negligible amounts of CO2, making it a critical pathway for decarbonization.

Decarbonizing the Steel Industry

Efforts to decarbonize the global steel industry have led to the development of various standards, protocols, initiatives, and government policies aimed at reducing emissions. These include:

- **WRI's GHG Protocols for Steel**
- **Climate Bonds Initiative's Criteria for the Steel Industry**
- **Industrial Deep Decarbonization Initiative (IDDI)**
- **Science-Based Targets Initiative for Steel (SBTI)**
- **First Movers Coalition**
- **Steel Zero Initiative**

Major steel-producing nations such as China, India, the EU, the U.S., Japan, South Korea, and Canada have also implemented policies to address these challenges.

Addressing Complexity and Building Cohesion

While numerous standards and initiatives exist, they vary significantly in terms of focus, target audience, assessment boundaries, and implementation pathways. This complexity often creates barriers to cohesive action. Moreover, these efforts address different aspects of the steel value chain—producers, procurement, financing, and beyond—without an integrated framework to align industry, government, and stakeholders.

To achieve the ambitious decarbonization goals of the steel industry, there is an urgent need for a consolidated and cohesive approach. A unified report compiling all standards, protocols, initiatives, and policies would provide a critical resource to guide stakeholders toward meaningful and coordinated climate action.

Figure 1Primary Steel Production Using Fossil Fuel

In-Depth Review: Decarbonization Standards, Protocols, and Initiatives for the Global Steel Industry

This in-depth review examines global standards, protocols, and initiatives focused on decarbonizing the steel industry, alongside an analysis of market focus areas. The report highlights the significant efforts aimed at reducing the carbon intensity of steel production and provides a detailed discussion of key frameworks, numerical targets, and innovative approaches.

Emissions Intensity Targets for Steel Production

A considerable number of standards and initiatives, such as **ResponsibleSteel**, the **Science-Based Targets Initiative (SBTi)**, and the **International Energy Agency (IEA)**, have set specific numerical targets for CO2 emissions per ton of steel produced (emissions intensity). These initiatives propose a **sliding scale for emissions intensity** based on the proportion of scrap utilization and tiered product rankings. For instance, ArcelorMittal's **Low Carbon Steel Proposal** aligns closely with these frameworks.

To achieve alignment with the **Paris Agreement's 1.5°C target**, the global weighted average CO2 emissions intensity of primary steelmaking should fall below **0.9 tons CO2/ton crude steel by 2040**- and 0.1-tons **CO2/ton crude steel by 2050**.

Green Steel: A Path to Low-Carbon Production

Traditional primary steel production using the **Blast Furnace-Basic Oxygen Furnace (BF-BOF)** route significantly contributes to climate change by emitting substantial greenhouse gases. Producing one ton of steel via this method generates approximately **1.8 to 2.2 metric tonnes of CO2 emissions**. In contrast, alternative methods, such as **Electric Arc Furnaces (EAF)** and **hydrogen-based steelmaking**, significantly reduce emissions to **0.4–0.8 metric tonnes** and **0.1 metric tonnes** per ton of steel, respectively.

The steel industry is responsible for approximately **3 billion tonnes of CO2 emissions annually**, accounting for **9% of global emissions**. According to the **World Steel Association**, the average carbon emissions per ton of steel in 2020 were **1.89 metric tonnes**. Transitioning to green steel production is critical for addressing these challenges and aligning with global climate targets.

Global Best Practices in Decarbonization

Several countries have emerged as leaders in sustainable practices and renewable energy initiatives, setting benchmarks for decarbonization:

1. **Bhutan**: Recognized as the world's most carbon-negative country.
2. **Costa Rica**: Achieved **99% renewable energy generation** in 2023-24, continuing to prioritize sustainability.
3. **United States**: Certain states, such as Colorado, have passed laws mandating the **elimination of coal-fired power plants by 2025**.
4. **Germany**: The introduction of a **bike superhighway** is estimated to reduce car usage by **50,000 vehicles daily**.
5. **Scotland**: Officially declared **coal-free** as part of its transition to renewable energy.
6. **Nicaragua**: Pledged to achieve **90% renewable energy by 2020** and continues to implement ambitious sustainability goals.

Challenges and Opportunities

The steel industry faces a complex set of challenges in its transition to low-carbon production, including the high cost of decarbonization technologies, reliance on traditional fossil fuel-intensive processes, and the need for cohesive global standards. Despite this, innovations such as hydrogen-based steel production and increased reliance on renewable energy present significant opportunities for transformation.

Top Carbon Dioxide (CO_2) Emitting Countries and Their Reduction Efforts

1. China

China, the largest emitter of CO_2 globally, released **11,397 million metric tons** of carbon dioxide in 2022. The primary contributor to these emissions is the country's heavy reliance on **coal**, which accounts for **58% of China's total energy generation**. Additionally, China's significant **oil imports** contribute to emissions through extensive use of motor vehicles.

Actions Taken for Reduction:

- Plans to **reduce dependence on coal** by transitioning to cleaner energy sources such as **nuclear power**, **renewable energy**, and **natural gas**.
- Implementing measures to **reduce pollution in urban centers** by promoting alternative energy solutions and enhancing public transportation infrastructure.

2. The United States

The United States is the second-largest emitter of CO_2, with **5,057 million metric tons** of emissions in 2022. Key sources of CO_2 include the **transportation sector**, **electric power generation**, and **industrial activities**.

- **Transportation**: Heavy reliance on petroleum fuels for trucks, ships, trains, and planes, as well as gasoline and diesel for personal vehicles.
- **Industry**: Significant use of fossil fuels for energy, along with emissions from chemical processes in manufacturing.
- **Electric Power**: Despite efforts to reduce reliance on coal, the U.S. remains a significant producer of crude oil.

Actions Taken for Reduction:

- Transitioning to **renewable energy** and phasing out **coal-fired power plants**.
- Promoting the adoption of **electric vehicles (EVs)** and investing in sustainable public transport systems.
- Increasing efficiency and sustainability in industrial processes through innovation and green technologies.

3. India

India ranks as the third-largest CO_2 emitter, with **2,830 million metric tons** of emissions in 2022. The country's energy mix is heavily dominated by **coal**, which supplies **44% of its energy needs**, followed by **petroleum and other liquids (24%)**, and **natural gas (6%)**.

Actions Taken for Reduction:

- Ambitious plans to increase the share of **natural gas** in the energy mix from 6% to **15% by 2030** to promote cleaner-burning fuels.
- Expanding investments in **renewable energy** sources, including solar and wind power, to decrease dependency on coal.
- Implementing policies to **reduce air pollution** and improve energy efficiency across industries.

4. Russia

Russia is the fourth-largest emitter of CO_2 globally, releasing **1,652 million metric tons** of carbon dioxide in 2022. The country's energy mix is heavily dependent on its vast **natural gas reserves**, which are the primary source of energy and power generation. **Coal**, used extensively in the chemical and basic material industries as well as for power generation, is another significant contributor to Russia's CO_2 emissions.

Russia has traditionally been a major **supplier of natural gas** to Europe. However, the geopolitical situation, particularly the **invasion of Ukraine**, has led to European countries reducing their reliance on Russian gas, with Russia also limiting its gas exports to Europe.

Actions Taken for Reduction:

- Russia has yet to fully commit to large-scale decarbonization initiatives, but ongoing discussions around energy diversification and cleaner technologies are evolving.
- Efforts to increase the use of **renewable energy** and improve energy efficiency, especially in non-industrial sectors, are being explored.

N.B: Contribution from industry / basic industry mentioned in all the countries is Iron & Steel.

5. Japan

Japan is the fifth-largest emitter of CO2, contributing **1,054 million metric tons** of carbon dioxide in 2021. The country's **energy fuel mix** underwent significant changes after the **2011 Fukushima nuclear disaster**.

- **Oil** remains Japan's largest energy source, comprising **38%** of its energy consumption in 2021.
- **Coal** still represents a considerable portion of Japan's energy needs, accounting for **25%** of the energy mix.
- **Nuclear power** plays a critical role, contributing **23%** of the country's energy consumption as of 2021.

Japan's **Energy Plan** (2018) targets **increased nuclear power production** by 2030 to reduce dependence on **hydrocarbon fuel imports** and decrease CO2 emissions.

Actions Taken for Reduction:

- Promoting **renewable energy** initiatives, especially solar and wind power, to reduce reliance on fossil fuels.
- Expanding **nuclear energy** production as part of efforts to meet sustainability and energy security goals.
- Enhancing energy efficiency in both industrial and residential sectors to lower emissions across the board.

CO2 Emissions from the Steel Industry in Major Countries

Steel production is a significant contributor to global CO2 emissions, with different countries exhibiting varying levels of emission intensity. A 2022 study by the European Commission reveals that steel production in Europe generates approximately 2.6 tons of CO2 per ton of finished steel (tcs), which is 20-25% higher than China, the world's largest emitter. The International Energy Agency (IEA) highlights that Europe's Green Steel initiatives aim to reduce emissions by adopting advanced technologies and alternative energy sources, marking a shift from traditional methods.

- **China – The World's Leading Emitter**
  China's steel industry is the largest carbon emitter in the country's manufacturing sector,

accounting for 15% of national CO2 emissions. Approximately 90% of steel production in China relies on blast furnaces, a high-emission method. In response to growing environmental concerns, 15 major Chinese steel companies have signed the "Declaration on Green Development of Chinese Steel Enterprises," committing to an energy transition through new technologies. China has also set a target to achieve 35% renewable energy in its steel sector by 2030.

- **India – Reducing Emissions, Moving Toward Sustainable Growth**

  India, the second-largest producer of steel, has made significant progress in reducing its carbon footprint. Specific CO2 emissions from India's steel industry decreased from around 3.1 tcs in 2005 to 2.5 tcs in 2020, surpassing the 2020 reduction target. The reduction from 2.65 tcs in 2015 to 2.5 tcs in 2020 demonstrates ongoing efforts in adopting more energy-efficient technologies. With continued advancements and the adoption of green initiatives, India is well-positioned to meet its 2030 CO2 reduction target, which aligns with the global push for more sustainable industrial practices.

- **Europe – Aiming for a 32% Reduction by 2030**

  Europe's steel industry has set ambitious targets to reduce CO2 emissions by 32% by 2030. The region's efforts to transition to Green Steel, using low-carbon technologies and renewable energy, are in line with global objectives. The European Union's commitment to reducing emissions is reflected in its strong push for innovation and investment in cleaner steel production methods, helping Europe stay at the forefront of global sustainability initiatives.

- **United States – Significant Contributor to National Emissions**

  The U.S. steel industry is responsible for 24% of the nation's carbon emissions, with only the cement industry contributing more. Efforts to reduce emissions are underway, focusing on modernizing production processes and adopting cleaner technologies.

- **Japan – A Carbon-Intensive Manufacturing Sector**

  In Japan, the steel industry dominates national emissions, making it one of the most carbon-intensive manufacturing sectors. Japan's commitment to reducing emissions in this sector includes adopting innovative technologies and aiming for a transition to greener methods.

Fossil Fuel-Free Steelmaking: Transforming Steel Production with Hydrogen and Renewable Energy

The steelmaking industry is undergoing a revolutionary transformation aimed at reducing carbon emissions and advancing toward a more sustainable future. Hydrogen-based steelmaking, a pioneering technology, offers a path to CO2-free steel production by replacing carbon with hydrogen in the reduction of iron ore. Instead of producing CO2 as a by-product, this method generates water, a significant advancement in decarbonizing steel production.

Hydrogen Steelmaking: A Path to Low-Carbon Steel Production

As the world transitions to a low-carbon economy, rethinking the way iron and steel are manufactured is crucial. There is no single solution to achieving CO2-free steelmaking, but a combination of innovative technologies can be deployed based on local conditions and needs. This fact sheet explores various key technologies for reducing CO2 emissions in the steel sector, with a focus on hydrogen-based methods.

The Role of Carbon in Traditional Steelmaking

In conventional steelmaking, carbon combines

with oxygen from iron ore to produce metallic iron and carbon dioxide as a by-product. The simplified reaction is:

$2Fe_2O_3+3C \rightarrow 4Fe+3CO_2$;

However, hydrogen can be used as a cleaner alternative to carbon. In this process, the waste gas produced is water instead of CO_2, as seen in the following reactions:

$Fe_2O_3+3H_2 \rightarrow 2Fe+3H_2O$; $FeO+H_2 \rightarrow Fe+H2O$

There are three main types of hydrogen: *green hydrogen*, produced from renewable energy through electrolysis; *blue hydrogen*, generated from fossil fuels with carbon capture and storage (CCS); and *grey hydrogen*, produced from fossil fuels without carbon capture.

Current Steelmaking Methods and Their Environmental Impact

The Basic Oxygen Furnace (BOF) steelmaking method is widely used in the metallurgical industry, where slagging reactions help remove impurities. In the Blast Furnace (BF) process, iron oxide is heated with hydrogen instead of coke or natural gas, producing metallic iron in a liquid state. While this approach significantly reduces carbon emissions, the production of hydrogen remains energy-intensive, primarily relying on natural gas.

The use of synthesis gas (syngas), which can be derived from biomass, plastic, CO2 electrolysis, or the Reverse Water Gas Shift (RWGS) reaction, further reduces coke consumption and lowers overall carbon dioxide emissions in steelmaking. However, the high cost of electricity and hydrogen storage presents challenges in scaling these methods, limiting their widespread adoption.

Challenges and Opportunities in Hydrogen-Based Steelmaking

Although hydrogen-based methods and electrolysis show significant promise for low-carbon steel production, challenges such as the high cost of electricity, hydrogen storage, and transportation barriers remain. Furthermore, while syngas can be used to replace some of the carbon in the steelmaking process, its implementation is not yet widespread due to high operational costs.

The RWGS reaction, a key technology for utilizing CO2, is also being explored to enhance the efficiency of hydrogen-based steelmaking. This reaction involves coupling carbon dioxide with hydrogen to produce synthetic gas and other valuable by-products.

Electric Arc Furnaces (EAF) and Induction Furnaces: Sustainable Alternatives

Electric Arc Furnace (EAF) steelmaking, which accounts for about 50% of global steel production, uses electric currents to melt steel scrap and iron ore. This method supports recycling, reducing the need for virgin raw materials and lowering the carbon footprint. In some regions, molten metal is added to EAFs to further reduce energy consumption. Additionally, Electric Induction Furnaces (EIF) use ferrous scrap and Hot Briquetted Iron (HBI), which produce no direct CO2 emissions, offering a sustainable alternative.

The Current State of India's Steel Industry

The steel industry is a major contributor to global CO2 emissions, making it a key focus in the fight against climate change. In India, the steel sector is one of the most carbon-intensive industries, with significant environmental impacts due to pollutants released during production processes.

Integrating Renewable Energy for Green Steel Production

The future of steelmaking hinges on the integration of renewable energy sources such as wind, solar, and hydropower into steel production processes. By replacing coal with green energy, electric arc furnaces and hydrogen-based production methods can reduce carbon emissions by up to 95% compared to traditional methods. For context, traditional steel production emits approximately 1.8 tonnes of CO2 per tonne of steel, and if the steel industry were a country, it would rank as the 5th largest emitter of carbon globally.

The Role of Carbon Capture and Storage (CCS) in Green Steel

In addition to hydrogen-based methods, the incorporation of Carbon Capture, Utilization, and Storage (CCUS) technology is essential for further reducing emissions in the steel industry. This combination of innovations will significantly reduce the carbon footprint of steel production, paving the way for a sustainable, low-carbon future for the global steel industry.

By embracing these cutting-edge technologies and reducing reliance on fossil fuels, the steel industry can take a major step towards sustainability, minimizing its impact on the environment while continuing to meet global demand for steel.

The Future of Green Steel Production: A Path Toward Sustainability

Steelmaking, an essential process that underpins modern life, comes with a significant environmental cost. The burning of fossil fuels in blast furnaces, which operate at extreme temperatures of up to 1600°C, results in the release of massive amounts of greenhouse gases. The core chemical reactions in a blast furnace during iron extraction from hematite are as follows:

- $2Fe_2O_3 + 3C \rightarrow 4Fe + 3CO_2$
- $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

In these reactions, carbon monoxide generated by burning coke removes oxygen from iron ore, producing carbon dioxide. Additional CO_2 is released when the molten iron is purified with coke, and further emissions occur during the steel-making process as pig iron is refined, removing excess carbon and alloying with elements such as chromium or titanium.

The cumulative effect of these emissions is alarming, as the greenhouse gases emitted during steel production can surpass the weight of the steel itself. With global steel production nearing 2 billion tons annually, the steel industry is responsible for about 7% of human-induced greenhouse gas emissions—surpassing the emissions of the entire European Union or Russia. To address this issue, the U.S. Department of Energy (DOE) has committed to driving change, with $1.5 billion in grants announced in March for low-carbon

ironmaking technologies. In addition, the Advanced Research Projects Agency – Energy (ARPA-E) allocated $28 million to explore innovative, forward-thinking approaches.

Iron ore naturally contains iron bound to oxygen, forming iron oxide (rust). Traditionally, coke has been used in blast furnaces to remove oxygen from the iron ore. The carbon monoxide produced by burning coke binds to the oxygen, forming carbon dioxide. As Christina Chang, a former DOE official and chemist, notes, the basic chemistry of steelmaking has remained unchanged for over 2,000 years. However, this long-standing process is now under scrutiny as the industry faces increasing pressure to innovate.

A promising breakthrough comes from Electra, a low-carbon iron start-up, which uses renewable energy and advanced chemistry to produce nearly pure iron. This novel process significantly reduces the environmental impact of steelmaking and contributes to global decarbonization goals. Companies such as Interfer are already utilizing Electra's clean iron to reduce their Scope 1, 2, and 3 greenhouse gas emissions by 42% by 2030.

Meanwhile, the Vedanta Group is exploring hydrogen as an alternative to coke in steelmaking, marking a revolutionary step towards producing "green steel." This hydrogen-based process eliminates the need for carbon-intensive coke, dramatically reducing carbon emissions. Vedanta is partnering with IIT-Bombay to develop hydrogen-based technology for manufacturing pig iron, a crucial milestone in the transition to more sustainable steel production. The company's commitment to sustainability is reflected in its triple bottom line—people, planet, and prosperity—with a focus on “zero harm, zero waste, and zero discharge” for the communities it serves.

The need for sustainable practices in the steel industry has never been more urgent. As global energy demands continue to rise, the lack of environmental awareness and protection has exacerbated the problem of greenhouse gas emissions. However, with innovative approaches such as hydrogen-based steelmaking and low-carbon iron production, there is hope that the industry can reinvent itself, reduce its environmental footprint, and contribute meaningfully to global sustainability.

CO2 Emission Control Plans by Major Indian Steel Producers

- **TATA Steel**: TATA Steel has set ambitious targets to significantly reduce its CO2 emissions. The company aims to reduce emissions by 40% by 2030 and achieve CO2-neutral steel production by 2045. Key steps include transitioning from coal to natural gas by 2030 and, eventually, to hydrogen as a long-term solution when commercially viable. This shift is expected to reduce annual CO2 emissions by 5 million tons, offsetting the emissions of approximately 385,000 people in the Netherlands.
- **SAIL (Steel Authority of India Limited)**: SAIL has formed a strategic partnership with global mining giant BHP to integrate hydrogen and biochar into its blast furnaces and Basic Oxygen Furnace (BOF) steel production units. The company is also investing in local R&D to explore additional carbon reduction technologies and enhance the sustainability of its operations.

Climate Change Mitigation and Industrial Decarbonization Strategy

The urgency of mitigating climate change has grown over the past two decades, especially for Indian steel plants that have traditionally relied on fossil fuels for energy. Currently, about 80% of energy consumed by India's steel sector is derived from conventional fossil fuels. According to the International Energy Agency (IEA), global CO2 emissions from the energy sector reached 33.8 billion tons in 2022, marking a 2-billion-ton increase from the previous year.

India has committed to reducing emissions by at least two-thirds by 2035 and more than 90% by 2050 to meet global climate targets. This will

involve developing financing mechanisms for carbon capture, utilization, and storage (CCUS), establishing hydrogen infrastructure, and promoting resource efficiency and material substitution. Fuel substitution technologies, particularly in steel production, will play a crucial role in meeting these targets.

The global steel industry contributes approximately 5% of global energy consumption and 7% of global human greenhouse gas emissions annually. The production of one ton of crude steel generates an average of 1.9 tons of CO2. Traditional blast furnace and BOF routes account for about 90% of the sector's CO2 emissions, but alternative methods such as Direct Reduction Iron (DRI) offer a more sustainable solution by using hydrogen and methane as reducing agents.

MIDREX Technology: A Sustainable Alternative

MIDREX Technology is one such innovative solution. It enables the flexible use of hydrogen and carbon monoxide from natural gas reforming in steel production. In standard MIDREX plants, the syngas produced has a hydrogen-to-carbon monoxide ratio of 1.5, significantly higher than that of traditional blast furnace steel plants (0.37 to 0.56). In some plants, the hydrogen ratio has been increased to 3.3–3.8, enhancing the sustainability of the steelmaking process and improving its ability to accommodate fluctuations in renewable energy availability.

By adopting technologies like MIDREX and hydrogen-based reduction processes, Indian steel producers are making significant strides toward reducing their carbon footprint and contributing to global sustainability.

Hydrogen: The Key to Clean Steelmaking

Hydrogen is seen as one of the most promising clean energy sources of the 21st century, offering versatility, high calorific value, excellent thermal conductivity, and rapid reaction rates. It is produced from various sources and serves as an ideal substitute for carbon-based reducing agents in industrial processes.

In steel production, hydrogen offers a dual benefit. It not only significantly reduces CO2 emissions but also reduces the steel industry's reliance on fossil fuels. Direct Hydrogen Reduction (DHR) is one of the key technologies leveraging hydrogen in steelmaking. In this process, hydrogen can replace traditional carbon-based reductants, and hydrogen accounts for 55–85% of the reductants used. This sets the stage for the potential use of 100% hydrogen in the DRI process.

Replacing natural gas with hydrogen in the DRI process could reduce CO2 emissions by up to 91%, underlining hydrogen's transformative potential in decarbonizing the steel industry and contributing to global sustainability goals.

Conclusion: Embracing the Green Steel Revolution

The transition to green steel is one of the most important industrial transformations of the coming years. Steel-producing nations are actively working to meet the ambitious targets set for 2030, with industries engaging stakeholders, supply chains, and governments to ensure the necessary resources and support.

Hydrogen, as a reductant, has the potential to revolutionize steelmaking by replacing carbon monoxide with water vapor, significantly reducing CO2 emissions. Hydrogen-Direct Reduction (H-DR) technology is widely recognized as a leading solution to reduce emissions in ironmaking, and several global programs are advancing its development.

The success of H-DR will depend on the widespread availability of hydrogen and the compatibility of existing Direct Reduced Iron (DRI) processes. While progress is being made, additional support is needed to scale up clean steel production, particularly through induction furnaces using clean scrap. Policy frameworks that ensure affordable power and further incentivize the green steel transition will be crucial to achieving these goals and driving the decarbonization of the steel industry.

Government Plans Merger of KIOCL with NMDC to Address Operational and Financial Challenges

17/01/2025

Union Steel Minister H.D. Kumaraswamy has announced that the government is actively considering merging KIOCL (formerly Kudremukh Iron Ore Company Limited), a public-sector pellet manufacturer, with NMDC, India's leading iron ore producer. This proposal is part of the government's strategy to address the pressing operational and financial difficulties faced by KIOCL, which has been grappling with significant losses and operational inefficiencies.

Speaking at a press conference that also unveiled a ₹11,440 crore revival package for Rashtriya Ispat Nigam Ltd (RINL), the Minister highlighted the critical situation at KIOCL. He noted that the company's challenges have been compounded by limited cooperation from the Karnataka state government, further hindering the functioning of the Mangaluru-based enterprise.

KIOCL currently operates a 3.5 million tonnes per annum (MTPA) iron oxide pellet plant and a blast furnace unit with an annual pig iron production capacity of 2.16 lakh tonnes. Despite its substantial infrastructure, the company has struggled to maintain financial viability. The proposed merger with NMDC aims to synergize the capabilities of both organizations, enabling KIOCL to overcome its challenges while enhancing NMDC's value chain and operational efficiency.

As a key player in India's steel industry, NMDC fulfills approximately 20% of the country's iron ore demand and possesses extensive raw material resources and an established market presence. By integrating KIOCL's pellet-making capabilities with NMDC's iron ore production, the merger is expected to deliver improved cost efficiencies, streamlined operations, and a sustainable business model for the future.

This initiative aligns with the government's broader vision of optimizing public-sector enterprises in the steel sector, a critical component of India's industrial and infrastructure development. A successful merger could not only strengthen KIOCL but also advance India's ambition of achieving self-reliance in steel production and reducing reliance on imports.

The move underscores the government's commitment to revitalizing struggling state-owned enterprises and creating a more competitive and resilient steel industry. If implemented effectively, this merger could serve as a benchmark for resolving challenges faced by other public-sector undertakings, ensuring the long-term sustainability of India's steel sector.

Source: The Economic Times

Budget 2025: Steel ministry seeks $1.7 bn to help mills cut emissions

17/01/2025

India's steel ministry has asked for 150 billion rupees ($1.74 billion) from the budget to offer mills incentives to produce low-carbon steel, two government sources with direct knowledge of the matter told Reuters.

Finance Minister Nirmala Sitharaman will present the federal budget for the 2025-26 fiscal year on Feb. 1.

India, the world's biggest steel producer after China, has been working on a green steel policy aimed at decarbonising production of the alloy, part of a wider push towards cutting greenhouse gas emissions under a 2070 net-zero target set by Prime Minister Narendra Modi.

The steel ministry plans to offer incentives to reduce emissions, boost research and development and increase raw material efficiency, as well as encourage banks to offer lower interest rates on renewable energy loans, said the sources, who wished to remain anonymous as deliberations are not public.

The steel ministry did not respond to an email seeking comment.

Once funds are allocated to the ministry, a proposal for the incentives to be offered to steel mills would be sent for cabinet approval, the sources said.

The government last month defined steel produced with carbon dioxide emissions of less than 2.2 metric tons per ton of finished steel as 'green'.

The incentives would remain in place until 2030, the sources said. India is also considering the use of green steel in government projects.
Steel producers in India, the world's fastest-growing major economy, generate 2.55 metric tons of carbon dioxide per ton of crude steel produced, 38% higher than the global average of 1.85 tons, according to Global Energy Monitor.

Source: The Economic Times

Domestic steel demand to outpace other economies with 8-9% growth in 2025; safeguard duty may help steel price hike

17/01/2025

In 2025, global steel demand is expected to inch up by 0.5-1.5 per cent on the back of easing financing conditions and pent-up demand from some key steel consuming economies. India will continue to lead the pack in the of demand.

India will witness more demand for steel in comparison to other major steel consuming economies in the calendar year 2025, with a growth of 8-9 per cent, stated a report by CRISIL. The growth, it added, will be driven by a shift towards steel-intensive construction in the housing and infrastructure sectors along with better demand from engineering, packaging and other segments.

In 2024, global steel demand is estimated to have declined by approximately 1 per cent. In terms of different economies, China, which is the largest steelproducer and consumer, saw a demand decline of around 3.5 per cent led by declining steel demand from the real estate sector, despite conducive policy changes and release of support packages. Steel demand from Europe, Japan and the US also reported a demand degrowth of 2-3 per cent. However, per the report, demand growth in developing economies such as India and Brazil kept global demand from declining steeply. While the demand in India is estimated to have increased by 11 per cent, Brazil saw an increase of 5.6 per cent and other steel consuming economies are estimated to have clocked a rise of 2.7 per cent.

Now in 2025, global steel demand is expected to inch up by 0.5-1.5 per cent on the back of easing financing conditions and pent-up demand from some key steel consuming economies, which will support manufacturingactivities. With economies such as the EU, US and Korea expected to see a recovery in residential construction, and with easing of financing conditions, the demand is anticipated to grow. India will continue to lead the pack in terms of demand.

Domestic supply, however, remains a point of concern, stated CRISIL. Sehul Bhatt, Director-Research at CRISIL Market Intelligence and Analytics, said, “In 2024, supply growth from India's mills was benign at 5.2 per cent, with extended periods of planned and maintenance shutdowns. Aggregate crude production by the top seven players increased 0.05 per cent, while finished steel production increased 0.5 per cent. However, crude and finished steel production from medium and small players increased 14 per cent and 11.3 per cent, highlighting the consistent demand growth from long steel end-users.”

Competitive imports, declining exports

Further, competitive imports and decline in exports also played a role in weaker production growth in 2024. While finished steel imports increased 24.5per cent, exports declined 6.4 per cent, leading to additional availability of 3.2 million tonnes of finished steel apart from domestic production. This additional material availability accounted for around 2 per cent of the total finished steel demand.

It is worth noting that finished steel imports from all key exporters to India have increased significantly in the past few years. For instance, China has traditionally been an exporter of value-added products and speciality steel such as galvanised and coated steel, alloy steel and stainless steel to India, with minimal share of hot-rolled coil and strips (HRC), cold-rolled coils and strips (CRC). However, between 2022 and 2024, while finished steel imports from China increased 2.4-fold, imports of HRC jumped 28-fold. Notably, HRC is used as feed material to produce various value-added downstream products, and these imports are often at a discount to domestic HRC prices, creating price pressure on domestic steel.

Similarly, the overall finished steel import from Japan increased 2.8-fold in 2024 from the base of 2022, while HRC imports increased 16.6-fold. Finished steel imports from Vietnam increased 8-fold, while HRC imports jumped 27-fold. Import growth from South Korea was relatively modest, bringing down its share in India's finished steel import basket.

Steel prices

Impacted by additional material availability due to increase in net imports, CRISIL stated that the domestic steel prices declined in 2024. HRC prices declined 9 per cent and CRC prices declined 7 per cent, thereby slowing topline growth of domestic mills. That said, falling coking coal prices, along with low volatility, have helped reduce margin pressure somewhat. Coking coal spot price for the Premium Low Volatility grade, Australia-origin, declined 12 per cent in 2024, whereas iron ore prices are estimated to have increased by 9-10 per cent during the period. Notably, China HRC export prices declined 12 per cent in 2024 and are still trading at a discount to domestic mill prices.

According to CRISIL, the imposition of a safeguard duty proposed by the industry could be positive here. With the same anticipated to be implemented by the end of February, CRISIL said, steel prices in 2025 would be much higher than 2024, with the impact more prominent in the first half.

Vishal Singh, Director-Research at CRISIL Market Intelligence and Analytics, said, “Domestic prices are under pressure due to global steel price decline and are expected to remain soft in 2025. Prices have a 4-6 per cent upside potential hinged on implementation of the safeguard duty. As mills ramp up production volume from the newly commissioned capacities, increase in supply will reduce flat steel prices but will still be higher than average price of 2024. That said, intense competition among mills to gain market share could limit the upward movement.”

Source: Financial Express

"Consider the Taxpayer's Perspective": Supreme Court Addresses Fake GST Invoicing and its Impact on Genuine Purchasers

16/01/2025

The Supreme Court of India has raised serious concerns over the recurring issue of fake GST invoicing, which adversely impacts genuine purchasers. The Apex Court criticized the Goods and Services Tax (GST) Department for failing to effectively address this malpractice, which allows fraudulent suppliers to evade crediting the due GST while leaving genuine buyers to bear the burden.

A Bench comprising Chief Justice of India (CJI) Sanjiv Khanna and Justice Sanjay Kumar heard an interlocutory application filed by the GST Department. During the hearing, the CJI questioned the Department's approach, emphasizing the plight of genuine purchasers who make payments, including GST, only to later discover that the suppliers issuing the invoices were fictitious. The Court noted that fraudulent suppliers exploit this loophole to avoid remitting GST, leading to unwarranted liability being shifted to unsuspecting buyers.

The CJI remarked:

"This is a recurring issue in GST matters. People purchase materials, make payments for those materials, including GST, and receive invoices. Later, the Department claims that the suppliers are fictitious. How can a genuine purchaser, who has already paid for the goods or services along with GST, be held accountable? What more can they reasonably do?"

Justice Khanna issued a stern warning to the GST Department, urging it to take proactive measures to resolve the issue. He also hinted at the need for an intensive investigation into the Department's functioning if the matter continues to persist.

When the Counsel for the GST Department referred to the directives issued by the Additional Solicitor General (ASG) to implement an online mechanism to prevent fake invoicing, Justice Khanna expressed scepticism about its feasibility. He pointed out that even with such measures, the problem could persist if suppliers manipulate GST registrations or provide false information.

Ultimately, the Bench allowed the withdrawal of the interlocutory application and advised the Department to approach the issue from the taxpayer's perspective. The CJI highlighted the plight of genuine buyers, who, despite fulfilling their obligations by paying for goods or services and GST, later discovered that the payments were routed to benami entities.

The Court's remarks underline the urgent need for robust systemic reforms to prevent fraudulent practices while safeguarding the interests of honest taxpayers.

Source: Tax Scan

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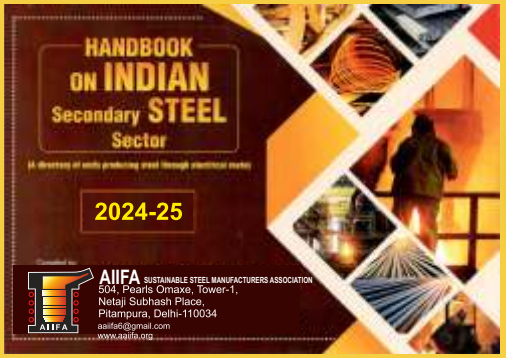

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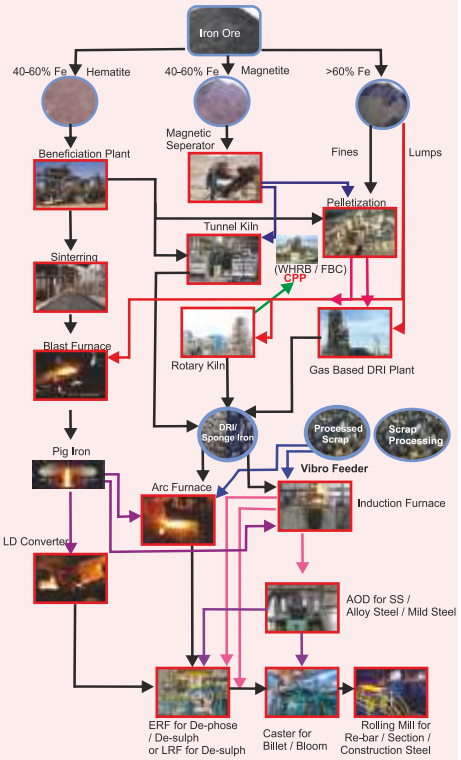

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