

SMALL AND MEDIUM ENTERPRISES: ENERGY EFFICIENCY KNOWLEDGE SHARING

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SAMEEEKSHA

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NEWSLETTER

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VISION

SAMEEEKSHA envisages a robust and competitive SME sector built on strong foundations of knowledge and capabilities in the development, application, and promotion of energy-efficient and environment-friendly technologies.



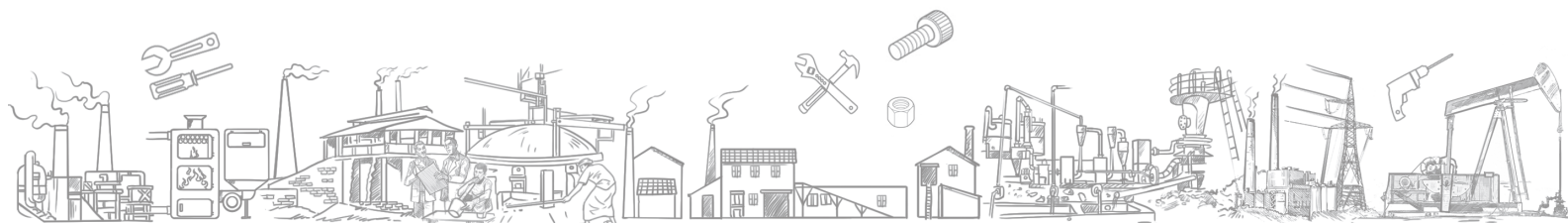
A PLATFORM FOR PROMOTING ENERGY EFFICIENCY IN SMEs

IN THIS ISSUE...

The focus of this issue remains on decarbonization of the Indian iron & steel sector. The first article summarizes the proceedings of an Awareness Workshop on 'Green Technologies & Practices for Steel Industries', organized on 29th November, 2023 at Durgapur by TERI in association with Durgapur Steel Plant (SAIL), EEPC India, and Durgapur Chamber of Commerce & Industries, with the aim of strengthening the capacity of steel industry stakeholders on the benefits of low-carbon (green) steel technologies and practices. The event helped to elaborate, and provide knowledge and insights on, the key strategies and actions for decarbonization of the steel industry, namely: increase the adoption of energy efficiency and/or renewable energy technological options; increase scrap usage and scrap recycling; support R&D on green steel technologies; create market demand for green steel; and establish and strengthen policy frameworks to support the demonstration and widespread implementation of green steel technologies.

The second article presents a brief profile of the Durgapur secondary steel cluster, including the types of industries, the technologies being deployed and patterns of energy usage, and some of the potential energy saving options identified based on energy assessment studies in a few representative industrial units. The last article summarizes the outcomes of a round-table discussion on the steel sector that was organized by Climate Catalyst, TERI, and Mission Possible Partnership during the COP28 conference held in Dubai in November-December 2023.

SAMEEEKSHA Secretariat



AWARENESS WORKSHOP ON GREEN TECHNOLOGIES & PRACTICES FOR STEEL INDUSTRIES

The steel industry accounts for about 12% of India's CO₂ emissions. Hence, decarbonization of the steel sector is vital for India to be able to achieve the target of becoming a net-zero economy by 2070. In order to strengthen the capacity of steel industry stakeholders on the benefits of low-carbon (green) technologies and practices, TERI in association with Durgapur Steel Plant (SAIL), EEPC India, Durgapur Chamber of Commerce & Industries (DCCI), and West Bengal Sponge Iron Manufacturers Association (WBSIMA), organized an Awareness Workshop on 'Green Technologies & Practices for Steel Industries' at SAIL Centre for HRD, Durgapur, on 29th November, 2023. The workshop was attended by about 85 participants, including senior management personnel of SAIL, office bearers of the participating industry bodies like EEPC India, DCCI and WBSIMA, owners/managers of MSMEs, research institutions, technology providers and consultants.



Mr Prosanto Pal, TERI, underscored the urgent need for decarbonizing the Indian steel industry, which currently accounts for almost 20% of the total carbon emissions from India's industry sector. He mentioned that TERI is a knowledge partner on seven of the 14 Task Forces set up by Ministry of Steel (MOS) to drive the decarbonization of the steel sector in India. He presented highlights of the low-carbon roadmap for achieving green steel in India prepared by TERI in 2022¹, which identifies the primary avenues for reducing emissions from steelmaking: namely, maximizing energy efficiency (EE) through the adoption of best available technologies (BAT) including RE options; increasing the utilization of steel scrap and establishing

¹ Will Hall, Sachin Kumar, Sneha Kashyap, Shruti Dayal. 2022. 'Achieving Green Steel: Roadmap to a net zero steel sector in India'. New Delhi: The Energy and Resources Institute (TERI).

an effective scrap recycling system; promoting R&D on green steel technologies such as green hydrogen-based steelmaking and carbon capture, usage and storage (CCUS); building strong policy and regulatory frameworks to spur the widespread adoption of these green technologies; and stimulating market demand for green steel.

Mr. B P Singh, Director-in-Charge, Durgapur Steel Plant, explained the imperative for 'greening' steel—coal-based melting processes that are currently used for making steel and steel alloys generate huge volumes of CO₂, and hence switching over to green steel technologies is critical to meet our net-zero commitments and combat climate change impacts; particularly when steel production is rising to meet the increasing demands of India's rapidly growing economy. India's steel production capacity will grow from about 150 million tonnes in 2021–22 to 300 million tonnes in 2030–31; and per capita steel consumption in India will increase from around 80 kg at present to 160 kg in 2030 (against the world average of around 240 kg). He underlined the importance of decarbonizing the blast furnace–basic oxygen furnace (BF–BOF) route for steelmaking that is followed by most steel plants in India, using coal-based direct reduced iron (DRI) as primary raw material. The emission levels from the BF–BOF route are currently around 2.5 t CO₂/t steel, which can be reduced to about 2.1 t CO₂/t steel through the adoption of BAT.



Mr Lalit Prasad Gupta, Convenor of EEPC India, Asansol Chapter, spoke on the EEPC India Technology Centre which focuses on providing necessary knowledge and training to the Indian engineering community, particularly in the context of the rapidly changing dynamics of global trade and the increasing focus on green technologies. Mr D J Basu, Director-Personnel and Administration, EEPC India, described



the various initiatives and activities of EEPIC India to help engineering exporters in demonstrating their capabilities in overseas markets.

The following technical presentations were made to guide the discussions during the workshop.

- Energy Audit & Energy Management— Dr Kalyan Kumar Mistry, Principal Scientist, Central Mechanical Engineering Research Institute (CMERI)
- Energy Monitoring & Analysis— Mr Nilesh Shedge, Consultant
- RE (Solar) Power—Mr Barun Kumar, Consultant
- Energy-Efficient Induction Furnace: Design & Practices—Mr Bikramjit Paul, AVP, Megatherm Group
- Green DRI production—Dr P K Sen, Prof. (Retd.), IIT Kharagpur
- ENERGIIRON and MIDA: technology for low carbon steel making—Mr. Abhisek Bhadra, GM – Sales and Marketing, Danieli India Limited

Salient points

A few of the key points from the presentations and discussions are summarized below.

- According to the MOS Task Forces on green steel, steel plants in India should aim to reduce emissions intensity of steelmaking by the BF–BOF route to below 2 t CO₂/t steel by 2030.
- At present, Indian steel plants using the BF–BOF route have specific energy consumption (SEC) levels of 6.5–7 Gcal/t steel, compared to the international levels of 4–5 Gcal/t steel. This clearly indicates significant potential to improve EE (and thereby reduce emissions) through the adoption of commercially available BAT such as waste heat recovery in sintering plant, beneficiation of coal, adoption of coal gasifiers in DRI plants, etc.
- The key strategies for decarbonization of the steel industry in the near term, i.e., till 2030, are: (1) increase the adoption of EE/RE technological options (BAT); (2) increase scrap usage and recycling; (3) support R&D on green steel technologies. Post-2030, suitable policy frameworks should be in place to support demonstrations of green steel technologies and their implementation across the steel industry.
- Effective from 1st October 2023, the EU has implemented a ‘Carbon Border Adjustment Mechanism’ (CBAM), which is essentially a tool for encouraging cleaner (low carbon) industrial production in non-EU countries by imposing additional tax on products that have carbon footprints above certain threshold limits. The impacts of CBAM will be severe on Indian steel makers, particularly small steel producers with export markets, underlining the urgent need for

India to develop and adopt green steel technologies on a wide scale.

- Very high levels of funding support are required for R&D on green steel technologies—USA and EU countries typically spend millions of US dollars on R&D efforts in this direction—making it a challenge for Indian steel industries to raise the required funds. On the other hand, if India does not develop green steel technologies indigenously, we will inevitably become dependent on imported, expensive green steel technologies—and this will make Indian steel prices uncompetitive and adversely affect the entire steel industry. Moreover, the (imported) green technologies would require adaptations to suit the smaller scales of operation prevalent in India as well as the poorer quality of raw material (iron ore). Such a situation is neither sustainable nor advisable in a core sector like steel. Hence, the government and international donors must support R&D efforts on green steel technologies as well as their scaling up.
- In India, research on green steel has been taken forward primarily by the steel industry itself—that too, by individual plants/entities—notably, Tata Steel, JSW Steel, and SAIL. The results of these efforts remain compartmentalized at company/plant level. The need, therefore, is for academia–industry collaborative RD&D projects towards developing green steel technologies that can be disseminated across the steel industry.
- A greener option for new steel plants, as well as existing steel plants undertaking expansion projects, is to adopt the DRI–electric arc furnace (EAF) route for steelmaking, with the DRI being produced by plants based on natural gas (NG). However, the availability and price of NG will pose challenges. Also, NG-based DRI production can only be an intermediate solution (as NG itself generates CO₂ and methane emissions). In the long term, green hydrogen-based DRI must be the solution.
- The World Bank and TERI are working together on a feasibility study of a green hydrogen-based DRI plant at Durgapur, in collaboration with a suitable industry partner.
- A number of international initiatives have already been launched to spur the market demand for green steel: e.g., ‘ResponsibleSteel’ (a standard and certification initiative); ‘International Deep Decarbonization Initiative’ (a global coalition of public and private organizations working to stimulate demand for low carbon industrial materials); and ‘First Movers Coalition’ (a coalition of member-companies with government partners—including India—aiming to accelerate the adoption of emerging climate technologies to decarbonize heavy-emitting sectors like steel).



PROFILE OF DURGAPUR SECONDARY STEEL CLUSTER

Under the SED Fund-supported project, TERI conducted a situation analysis of the secondary steel industries located in and around Durgapur. This article presents a brief profile of the Durgapur secondary steel cluster including the types of industries; the technologies being deployed and patterns of energy usage; and some of the potential energy saving options identified based on energy assessment studies in a few representative industrial units.

Overview

Durgapur is a major industrial hub of eastern India and one of the largest markets for iron and secondary steel products in the country. The city is located on the banks of the river Damodar in Paschim Bardhaman district of West Bengal, about 158 km from Kolkata and adjoining the coalfields of Raniganj. It is well connected to the rest of India by road, rail and air.

The growth of industries in and around Durgapur was spurred by the ready availability of coal and other mineral ores in the region, and received a boost when the Durgapur Steel Plant (DSP) was set up in the late-1950s with an initial crude steel production capacity of one million tonnes per annum (Mtpa). Since then, the production capacity of DSP has more than doubled to 2.2 Mtpa,^{1,2} making it one of the largest of the integrated steel plants under Steel Authority of India Limited (SAIL). Also located in Durgapur is the 1000 MW coal-based Durgapur Steel Thermal Power Station, commissioned in 2012 and operated by the public-sector Damodar Valley Corporation (DVC).

There are over 1000 mineral and metal-based industries in the Durgapur industrial belt, spread across areas like Angadpur, Andal, Bamunara, Jamuria and Raniganj. They include around 100 secondary steel units. These industries manufacture a wide range of steel and alloy products such as angles, thermo-mechanically treated (TMT) bars, channels, coils, pipes, rails, tubes, sheets, and wires that are used in sectors such as construction, household, industry, infrastructure, power, and railways. The main types of secondary steel industries are:

- **Direct reduced iron industries**, which use rotary kilns to process iron ore into direct reduced iron (DRI, also known as sponge iron), which is used by downstream industries.
- **Steel melting units**, which are of two broad types,

both using induction furnaces for producing molten (liquid) steel from sponge iron and scrap: (1) mini steel plants having integrated facilities for producing DRI, steel melting shops (SMS), continuous casting machines (CCMs) and rolling mills for producing long products; and (2) stand-alone steel foundries that produce steel from scrap and sponge iron to make ingots, which in turn are used as raw materials by steel re-rolling mills.

- **Steel re-rolling mills (SRRM)**, which preheat ingots and billets using fossil fuel (coal or coal bed methane)-fired reheating furnaces; and then use electrical rolling machinery to process the hot billets/ingots into rolled steel products.
- **Ferro alloy industries**, which melt iron ore along with mineral oxides, quartz and carbon-rich materials (e.g., coal, coke, charcoal), using submerged arc furnaces, to produce alloyed products like ferro manganese, silicon manganese, and ferro silicon.
- **Wire drawing industries**, which produce wires for different applications by drawing of rods using electrical wire drawing machines and furnace oil-fired annealing furnaces, galvanizing baths, etc.
- **Foundries**, which use electrical induction furnaces to produce castings for railways, pipes and fittings, and machinery components and spare parts.

The major industry associations in the region include:

- West Bengal Sponge Iron Manufacturers Association (WBSIMA)
- Durgapur Chamber of Commerce and Industry (DCCI)
- Durgapur Small Industries Association
- Jamuria Steel Industries Association
- Bamunara Steel Association
- Angadpur Industries Association



Rotary kiln, DRI industry

1 <https://archive.pib.gov.in/archive/releases98/lyr2002/rjul2002/09072002/r090720023.html>

2 <https://sail.co.in/en/plants/about-durgapur-steel-plant>





Continuous casting process

Technology

Table 1 summarizes the main energy-consuming technologies used by different types of secondary steel industries in Durgapur, as well as the raw materials used, energy sources, and products. As mentioned earlier, some of the secondary steel industries are composite units, having integrated facilities for different manufacturing steps/processes within the same plant.

Table 1. Technologies, raw materials and products of secondary steel industries in Durgapur cluster

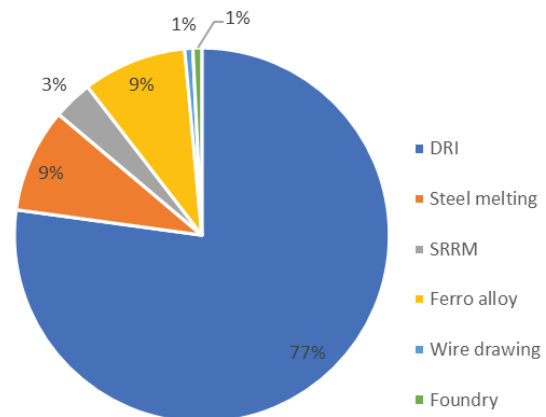
Industry	Technology	Raw materials	Energy sources	Products
DRI	Rotary kiln, water-cooled rotary cooler, waste heat recovery system	Iron ore lumps, pellets	Coal, electricity	Sponge iron
Composite Steel plants	Rotary kiln, Induction furnace, continuous casting machine (CCM), rolling machinery	Iron ore, scrap	Electricity	Rolled long products, billets
Steel foundry	Induction furnace	Sponge iron, scrap	Electricity	Ingots
SRRM	Reheating furnace, rolling machinery	Billets and ingots	Coal, Coal bed methane (CBM), electricity	Rolled products
Ferro alloy	Submerged arc furnace	Iron ore, mineral oxides, carbon-rich materials	Electricity	Ferro alloy products
Wire drawing	Wire drawing machinery, galvanizing baths, etc.	Wire rods, coiled wire	Electricity, furnace oil (FO)	Steel wires, coated wires
Cast iron foundry	Induction furnace	Pig iron, scrap	Electricity	Castings

Energy usage patterns

The annual cluster-level energy consumption is estimated at 2.18 million tonnes of oil equivalent (Mtoe), with thermal energy accounting for 82% (1.78 Mtoe) and electricity the remaining 18% (0.40 Mtoe) as shown in table 2, excluding the energy consumption from Durgapur Steel Plant. The DRI industries account for over 77% of total cluster-level energy consumption.

Table 2. Cluster-level energy consumption and emissions*

Industry type	Energy consumption (Mtoe/y)*			Emissions (MtCO ₂ /y)
	Thermal	Electricity	Total	
DRI	1.66	0.02	1.68	5.82
Steel melting	-	0.20	0.20	1.80
SRRM	0.034	0.040	0.07	0.49
Ferro alloy	0.066	0.129	0.20	1.41
Wire drawing	0.013	0.002	0.02	0.06
Foundry	0.011	0.006	0.02	0.08
Total	1.78	0.40	2.18	9.66



Category-wise shares of cluster-level energy consumption (%)



Shop floor; steel re-rolling mill (SRRM)





Rolled products: steel rods and plates

Potential energy conservation measures

The study helped identify a number of energy conservation measures (ECMs) for adoption by the Durgapur secondary steel industries in each category, as summarized below.

DRI

- Waste heat recovery (WHR) system for power generation
- Optimisation of coal combustion system
- Partial substitution of coal with gas
- Replacement of iron ore lumps with pellets



Ferro alloy industry

- Improved kiln lining
- Use of variable frequency drives (VFDs) for electrical motors such as pumps, fans, blowers, etc
- Improved control systems/digitalization
- Use of RE and cleaner energy sources

Steel melting units

- Improved quality of scrap
- Improve product yield and reduce rejections
- Improve cooling water management by maintenance of the cooling water circuit and cooling tower
- Improve tapping practices of molten metal

SRRM

- Adoption of CCM in place of reheating furnace
- Installation of PLC-based automation on rolling mill
- Renovation of furnace lining and surface insulation
- Application of heat resistance coating in the internal surface of reheating furnace
- Regular maintenance of the recuperator for optimum performance

Ferro alloy

- WHR system for power generation
- Adopt best operating practices in furnace operation

Wire industries

- Replacing FO-fired annealing furnace with induction heating system
- Replacing FO-fired zinc bath with induction heating system

Cast iron Foundry

- Adoption of energy efficient induction melting furnace
- Reduce temperature drop from tapping to pouring
- Adopt lid cover
- Optimize power curve of induction furnace
- Use properly sized pump, and adopt EE pumps

Common ECMs

Other significant ECMs that can be adopted by all categories of industries include:

- Adopting EE transformers
- Replacing inefficient air compressors with EE air compressors
- Adopting best operating practices in compressed air system such as arresting compressed air leakages, and optimizing the pressure setting in air compressor
- Replacing low-efficiency, rewound motors with EE (IE3/IE4) motors



GREEN MARKET INSTRUMENTS FOR INDUSTRY DECARBONIZATION – SPOTLIGHT ON STEEL IN EMERGING ECONOMIES



The decarbonization of hard-to-abate industrial sectors like steel and cement was recognized as being critically important in the battle against climate change during the discussions at the United Nations Climate Change Conference (COP28), held in Dubai from 30 November–12 December 2023. On December 5th, 2023, a roundtable discussion was organized by Climate Catalyst, TERI, and Mission Possible Partnership to examine cross-sectoral instruments that could strengthen the markets for green industrial products, encompassing policy, industry, and finance levers, with the focus on the rapidly growing steel sectors in emerging economies (particularly in Asia and the Middle East). The themes that were discussed included the role of technology transfer, financing for technology investments, demand-side instruments, and the importance of global supply chains for clean energy and green hydrogen. The event was jointly moderated by Ms Sakshi Balani (Climate Catalyst) and Mr Alasdair Graham (Mission Possible Partnership), and attended by around 65 participants including representatives from industry, academia, finance, youth, NGOs, philanthropies, think-tanks, and other stakeholders.

In her opening remarks Ms Balani outlined the work of Climate Catalyst which focuses on reducing emissions from high-carbon sectors like steel and aviation in Asia and Europe. In India, Climate Catalyst works on both demand and supply sides of steel decarbonization, and

has recently launched a multi-stakeholder platform, 'India Green Steel Network', to help build a shared vision for action across all stakeholder groups.¹ Mr Graham underlined the imperative to find industrial decarbonization solutions for India, considering that the nation remains on a path of rapid industrial and socio-economic development and expected to become a five-trillion-dollar economy by 2027 according to IMF estimates.

Mr Paul Bodnar (Bezos Earth Fund) elaborated on the three phases in which the markets for green steel should move towards decarbonization: (1) market inception, in which technologies are brought to commercial readiness and plans drawn up for transition; (2) market formation, in which the long-term business case is made for low-carbon products through instruments like financial incentives, regulatory measures, infrastructure planning and build-up, and standards & certification protocols for green products; and (3) market acceleration, in which the supply and demand sides for low-carbon products are connected at scale. "Good work has been done on the demand side by creating awareness and interest among buyers of steel, cement and aviation fuel to consider green products, even at initial premium prices; as well as on supply side, for example, with the setting up of first-of-a-kind green steel plants. The question is, how to bring the two sides together...what to put in the middle, between an emerging, fragile group of producers experimenting with new technologies, and the off-takers who are worried about prices, quality..."

Setting the context for decarbonization of the steel sector in emerging economies, Mr Arupendra Nath Mullick (Vice President of TERI Council for Business Sustainability) reflected on the key recommendations of the Green Steel Roadmap prepared by TERI and noted that by 2050 the steel demand in India would be around 450 million tons. "Two points that we believe would be important are (1) the rapid scale up of green steel technologies with progressive and effective phase out of conventional technologies, and (b) creating demand for green steel. While on the demand side

¹ For details on India Green Steel Network, please visit <https://greensteelworld.com/climate-catalyst-harnessing-the-power-of-collective-action>

more consistent standards for green steel are required, on the supply side we see that demonstration plants are needed to be created, which can serve as lighthouse projects for the steel industry in India. Financing from both public and private sources with the support from the multilateral development banks would steer the supply push for the Indian industry.”



A number of speakers shared their views and insights on the four instruments that are essential for creating a market and business case for low-carbon steel: (1) low-emissions standards & certification schemes (Mr Shivakumar, Responsible Steel); (2) green public procurement (Ms Jen Carson, Climate Group); (3)

infrastructure funding (Mr Wim van Gerven, Arcelor Mittal Steel); and (4) bridging the ‘green premium’ between low-emission products and their emissions-intensive counterparts (Mr Rajiv Mangal, Tata Steel, and Mr Vineet Mittal, Avaada Group).

Key messages

The following key messages emerged from the presentations and discussions at the event.

- The industrial transition towards low-carbon technologies is already underway around the world and green market instruments are helping drive it forward.
- A focus on emerging economies is essential for the industrial transition.
- If selected thoughtfully and adapted to the local context, green market instruments can speed up the industrial transition in emerging economies.
- In applying green market instruments, we cannot overlook other vital enabling conditions (such as transition finance and technology transfer from industrialized economies to emerging ones).
- Applying green market instruments and creating other necessary conditions will require whole-value chain thinking and collaboration. Industry, government, finance, and civil society should engage in this whole-value chain approach to accelerate the industrial transition in emerging economies.

SAMEEEKSHA is a collaborative platform aimed at pooling the knowledge and synergizing the efforts of various organizations and institutions—Indian and international, public and private—that are working towards the common goal of facilitating the development of the Small and Medium Enterprise (SME) sector in India, through the promotion and adoption of clean, energy-efficient technologies and practices.

SAMEEEKSHA provides a unique forum where industry may interface with funding agencies, research and development (R&D) institutions, technology development specialists, government bodies, training institutes, and academia to facilitate this process.

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