SMALL AND MEDIUM ENTERPRISES: ENERGY EFFICIENCY KNOWLEDGE SHARING

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SAMEEEKSHA NEWSLETTER

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Inside...

- Case studies on implementation of energy-efficient technologies in secondary steel MSME units
- Training program on concentrated solar thermal (CST) systems

Promoting Energy Efficiency in SMEs
SAMEEEKSHA

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.

Bureau of Energy Efficiency

The Energy and Resources Institute
Creating Innovative Solutions for a Sustainable Future

MSME
Micro, Small & Medium Enterprises

A PLATFORM FOR PROMOTING ENERGY EFFICIENCY IN SMEs

IN THIS ISSUE...

This issue has, as its theme, the varied work being undertaken by TERI towards improving energy efficiency and reducing carbon emissions in the Indian steel sector under the project titled 'Decarbonizing industries in India'. Apart from large-scale steel plants, the project focuses on MSMEs, which make up a significant proportion of secondary steel producers in sub-sectors such as direct reduced iron (DRI), electric arc furnace (EAF), electric induction furnace (IF), and steel rerolling mills (SRRMs). TERI's initiatives comprise deep dive interventions on secondary steel units in various clusters to identify energy-efficient (EE) technological options; and on providing technical support to MSMEs for their implementation. The technical support comprises energy assessment studies, technical assistance, and post-implementation surveys. TERI has covered 60 secondary steel MSMEs and identified a large number of EE options, of which implementations by MSMEs have resulted in annual coal savings of 16,460 tonnes, electricity savings of 8100 MWh, and reduction in CO_2 emissions of 35,100 tonnes. The theme article summarizes a few case studies on the implementations of EE options.

The issue also presents highlights from a training program on concentrated solar thermal (CST) systems organized in Pune on 23 April, 2026, by TERI and Mahratta Chamber of Commerce, Industries and Agriculture (MCCIA), under an ongoing project supported by the Ministry of MSME, Government of India in collaboration with UNIDO.

SAMEEEKSHA Secretariat

CASE STUDIES ON IMPLEMENTATION OF ENERGY-EFFICIENT TECHNOLOGIES IN SECONDARY STEEL MSME UNITS

Backdrop

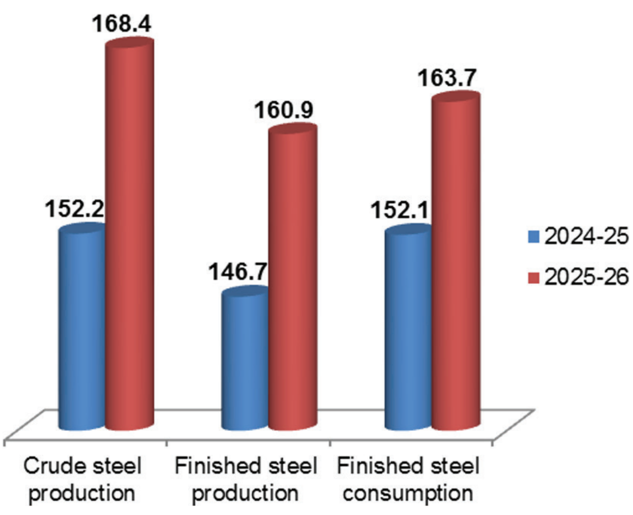
TERI has been engaged in various initiatives towards improving energy efficiency and reducing carbon emissions in the Indian steel sector, as reported in a number of earlier issues.[1] The importance of decarbonizing this energy intensive sector is underlined by the fact that the steel industry accounts for about 12% of India's total CO_2 emissions and almost 25% of the total industrial carbon emissions in India. Furthermore, the production as well as consumption of crude steel and finished steel products is increasing rapidly, keeping pace with the growth trajectories of various sectors of India's economy such as construction, infrastructure, and manufacturing. Crude steel production grew by 10.7% between the financial years 2024–25 and 2025–26; from 152.2 million tonnes (MT) to 168.4 MT respectively. Likewise, finished steel production increased by 9.7% during the same period, from 146.7 MT to 160.9 MT. Interestingly, finished steel consumption outpaced indigenous production in terms of quantity during the same period, increasing from 152.1 MT to 163.7 MT (a growth of 7.6%), and India remains a net importer of finished steel.[2,3]

Snapshot of steelmaking

The steelmaking process essentially involves the following stages:

- Iron is extracted from iron ore, mostly using coal-based technologies like blast furnace (BF), smelting reduction (Corex process) or direct reduction (DR). Both BF and Corex produce iron in molten state; while DR produces iron in the solid state known as sponge iron or direct reduced iron (DRI).
- The iron (either in molten or solid form) is mixed with steel scrap and processed in steelmaking furnaces which remove impurities such as phosphorous, silicon, sulphur, etc., and produce steel in molten state, i.e. liquid steel. The main steelmaking furnaces are basic oxygen furnace (BOF); electric arc furnace (EAF); and electric induction furnace (IF).
- After further refining. including the addition of other elements to make alloy steels, the liquid steel is cast into forms such as ingots, billets, blooms and slabs. These are further processed in downstream operations such as casting, hot and cold rolling, re-rolling, forging, wire-drawing, etc., to make finished steel products such as bars, beams, castings, forged components, rods, strips, wires, and so on.

Apart from large-scale steel plants, TERI's work focuses on MSMEs, which make up a significant proportion of secondary steel producers in sub-sectors such as direct reduced iron (DRI), electric arc furnace (EAF),



Steel production and consumption, FY 2024–25 and 2025–26 [Source: Ministry of Steel, PIB Press Note dated 5 May 2026]

1 For instance, see SAMEEEKSHA issues 14(3), September 2023; 14(4), December 2023; 15(2), June 2024.

2 Ministry of Steel; PIB Press Note dated 5 May 2026. See https://www.pib.gov.in/PressReleasePage.aspx?PRID=2258028&reg=3&lang=1

3 Ministry of Steel; Annual Report, 2025–26.

electric induction furnace (IF), and steel rerolling mills (SRRMs). These small and medium-scale secondary steel producers face the same challenges that make it difficult to introduce and scale up energy-efficient (EE) technologies throughout the Indian MSME sector: primarily, the continuing dependence on low-efficiency technologies and operating practices; low awareness levels regarding improved technologies and best operating practices (BOP); difficulties faced in accessing adequate, affordable and timely finance for upgrading technology even when EE options are available off-the-shelf (which is often not the case); inability to access clean fuels at affordable costs; and lack of avenues to upgrade the skills of operators, plant personnel, and local service providers (LSPs) on new/improved technologies and operating practices.

TERI's initiatives aim at overcoming these challenges through conducting deep dive interventions on secondary steel units in various clusters to identify EE technological options; and on providing technical support to MSMEs for their implementation. The technical support comprises energy assessment studies, technical assistance, and post-implementation surveys, as summarized below.

Energy assessment studies

- Undertaking studies to assess the baseline energy consumption and operating practices.
- Conducting performance assessments of the technology and equipment currently being used.
- Identifying process areas for EE improvements including energy conservation measures (ECMs), and recommending suitable EE options including best available technologies (BATs) with cost–benefit analyses.

Technical assistance

- Identifying suitable vendors/OEMs for the EE technology/equipment, and connecting them with the MSMEs.
- Engaging with the vendors/OEMs to provide technical specifications for the various systems/equipment.
- Analysing and grading the best matching options in terms of technical parameters.

Post-implementation surveys

- Conducting impact assessment surveys after implementation of BATs and ECMs.
- Determining the actual energy savings and CO_2 emission reductions achieved.
- Conducting periodic reviews on BATs to explore the potential for implementing new/improved EE options and further improving energy efficiency.

In the past few years, TERI has covered 60 secondary steel MSMEs comprising 21 DRI plants, 14 IF units and 25 SRRMs. During 2023–25, the studies in these 60 MSMEs identified EE options with a total annual energy saving potential of 27,596 tonnes of oil equivalent (toe). Of these EE options, implementations by MSMEs have resulted in annual coal savings of 16,460 tonnes, electricity savings of 8100 MWh, and reduction in CO_2 emissions of 35,100 tonnes.

60 secondary steel units
- 21 - DRI
- 14 - IF
- 25 - SRRM

Annual production
- DRI - 1.8 million tonnes sponge iron
- IF - 0.92 million tonnes steel
- SRRM - 2.12 million tonnes rolled products

Annual energy consumption
- 1.05 million toe

Annual CO_2 emissions
- 4.8 million tonnes

Energy saving potential identified
- Fuel - 8636 toe/year
- Electricity - 18,960 toe/year

Project highlights

Case studies

The following sections summarize a few case studies on the implementation of EE options by secondary steel MSMEs, with technical support provided by TERI.

Secondary steel unit installs a recuperator for reusing waste heat and saves Rs 38 lakhs annually; recovers investment in three months

A steel rolling unit in Raipur cluster has a coal-fired pusher hearth reheating furnace with an installed capacity of 8 tonnes per hour (tph). The furnace was not equipped with any system to recover and reuse the heat in flue gas. During the energy audit, the monitored temperature of flue gas at the furnace outlet was 672°C, indicating significant potential for heat recovery. The unit was advised to install a compatible recuperator to recover heat from flue gas and use it to preheat combustion air. The unit was also advised to provide insulation for the combustion air distribution pipeline, to minimize the temperature drop of the preheated air.

Based on the recommendations, the unit installed a recuperator system for the reheating furnace, and provided insulation for the preheated combustion air supply header as well as the onward distribution pipeline to the pulverizer. During post-implementation survey, the average temperature of the preheated combustion air at recuperator outlet was measured at about 200°C. The implementation of these EE measures has resulted in annual coal savings of 376 tonnes, equivalent to annual monetary saving of Rs 38 lakhs and emission reduction of 786 tCO_2/year. The cost of the recuperator system was Rs 8.5 lakhs, giving a simple payback period on investment of less than three months.

Benefits of the EE technology

Parameter	Baseline	Post-implementation
Flue gas temperature at chimney inlet	672°C	300°C
Combustion air temperature	Ambient	200°C
Annual coal saving	–	376 t
Annual monetary saving	–	Rs 38 lakhs
Investment cost	–	Rs 8.5 lakhs
Simple payback period	–	<0.25 years
Emission reduction	–	786 tCO_2/year

Reheating furnace before implementation

Recuperator system installed

Unit saves Rs 86 lakhs annually by replacing old induction furnace with new, EE induction furnace

A secondary steel unit in the Raipur cluster has installed two silicon rectifier controlled (SCR) electric induction furnaces (IFs), each of 5000 W rating and 12 tonnes capacity per batch. During the energy audit, the evaluated specific energy consumption (SEC) of one of the furnaces was 842 kWh/t of liquid metal, much higher than the recommended SEC value of 750 kWh/t. The unit was advised to replace the inefficient SCR furnace with a new, EE induction furnace of the same rating and capacity.

Based on the recommendations, the unit installed a new SCR induction furnace of 12 tonnes capacity in place of the earlier low-efficiency furnace. During post-implementation survey, the SEC of the new furnace was calculated at 792 kWh/t, which is a significant improvement over the earlier furnace. The implementation has resulted in annual electricity savings of about 14.4 lakh kWh, equivalent to monetary saving of Rs 86 lakhs/year and emission reduction of 1138 tCO_2/year. The cost of the new SCR induction furnace was Rs 180 lakhs, with a simple payback period on investment of just over 2 years. Work is currently under way to replace the remaining low-efficiency induction furnace with a new EE furnace.

Benefits of the EE technology

Parameter	Baseline	Post-implementation
Type of control	SCR*	SCR
SEC	842 kWh/t	792 kWh/t
Annual electricity saving	–	14.4 lakh kWh
Annual monetary saving	–	Rs 86 lakhs
Investment cost	–	Rs 180 lakhs
Simple payback period	–	2.1 years
Emission reduction	–	1138 tCO_2/year

*SCR—silicon controlled rectifier

Old SCR induction furnace

New EE induction furnace

Installation of a scrap shearing machine saves Rs 2.4 crores annually, investment cost recovered in nine months

A secondary steel unit in the Raipur cluster has installed five induction furnaces, each having the designed capacity of 8 tonnes. Scrap and sponge iron are the major raw material used in the induction furnaces. The average energy consumed per heat cycle was calculated at 944 kWh/t liquid metal, much higher than the recommended value for the induction furnaces. The primary reason for the low energy efficiency was that scrap materials of different shapes and sizes were being fed directly into the induction furnaces, leading to longer heat cycle durations. The unit was advised to install a scrap shearing machine to chip down the scrap materials into small, relatively uniform-shaped pieces.

Unsized scrap feed

Based on the recommendations, the unit has installed a scrap shearing machine to process the scrap materials into optimum sizes and shapes for feeding into the induction furnaces. As a result, the average heat cycle duration has been reduced by 15 minutes, and the overall energy efficiency of the induction furnaces has improved to 561 kWh/heat. This implementation has resulted in electricity saving of about 40 lakh kWh/year and emission reduction of 3173 tCO_2/year. The annual monetary saving is Rs 240 lakhs (2.4 crores) against an investment cost of Rs 180 lakhs (1.8 crores) on the scrap shearing machine, giving a simple payback period of nine months.

Benefits of the EE technology

Parameter	Baseline	Post-implementation
Average scrap melting time	37 minutes	22 minutes
Energy consumption per heat cycle	944 kWh	561 kWh
Annual electricity saving	–	40.1 lakh kWh
Annual monetary saving	–	Rs 240 lakhs
Investment cost	–	Rs 180 lakhs
Simple payback period	–	0.75 years
Emission reduction	–	3173 tCO_2/year

Scrap shearing machine

Sized scrap

Continuous casting machine eliminates need for coal-fired reheating furnace; saves Rs 1.5 crores annually

A secondary steel unit in the Raipur cluster has two electric induction furnaces for ingot making through bottom pouring and a coal-based reheating furnace in the rolling section. The annual production is around 15,000 tonnes of rolled products. During the energy audit, it was observed that the hot ingots from the induction furnaces underwent cooling to ambient temperature, and were later reheated for processing in the rolling section. This practice led to additional thermal energy consumption as well as CO_2 emissions from coal combustion in the reheating furnace.

The unit was advised to install a continuous casting machine (CCM), which would produce hot billets for direct charging to the rolling mills. The CCM would thereby eliminate the need for a reheating furnace and save overall energy costs as well as avoid emissions from coal combustion.

New continuous casting machine (CCM)

As recommended, the unit has installed a new CCM of capacity 10 tonnes per hour and also adopted hot charging of the billets produced by the CCM to the rolling mills, thus eliminating the need for the coal-fired reheating furnace. The new technology has resulted in significant improvement in SEC and reduced overall emissions by 3180 tCO_2/year. The annual monetary saving is about Rs 150 lakhs (1.5 crores) against an investment cost of Rs 400 lakhs (4 crores), with a simple payback period of just over 2.5 years.

Benefits of the implementation

Parameter	Baseline	Post-implementation
Production route	IF + reheating furnace	CCM
Annual production	15000 t	15000 t
Annual coal consumption	1500 t	–
Annual monetary saving	–	Rs 150 lakhs
Investment cost	–	Rs 400 lakhs
Simple payback period	–	2.5 years
Emission reduction	–	3180 tCO_2/year

Micro integrated steel plant replaces old, inefficient blowers for mini blast furnace with an EE blower; saves Rs 26 lakhs annually

A micro integrated steel plant in Rourkela cluster operates a mini blast furnace (MBF). During energy audit, it was observed that the hot blast air for combustion in the MBF was being supplied using two old positive displacement (PD) blowers. The evaluated operating efficiency of the PD blowers was less than 35%.

As recommended, the unit has replaced the old PD blowers with a single high-efficiency centrifugal blower. The design efficiency of the new EE blower is over 80%. This implementation has resulted in energy saving as well as increase in production. The annual monetary savings are about Rs 26 lakhs against an investment cost of Rs 50 lakhs, giving a simple payback period of less than two years.

Benefits of the implementation

Parameter	Baseline	Post-implementation
Electricity consumption	138 kWh	79 kWh
Annual electricity saving	–	4.27 lakh kWh
Annual monetary saving	–	Rs 26 lakhs
Investment cost	–	Rs 50 lakhs
Simple payback period	–	<2 years
Emission reduction	–	310 tCO_2/year

Old PD blowers

New EE centrifugal blower

TRAINING PROGRAM ON CONCENTRATED SOLAR THERMAL (CST) SYSTEMS

A training program on concentrated solar thermal (CST) systems was organized in Pune on 23 April, 2026, by TERI and Mahratta Chamber of Commerce, Industries and Agriculture (MCCIA), under an ongoing project supported by the Ministry of MSME (MoMSME), Government of India in collaboration with UNIDO, with TERI serving as the knowledge partner. The event was attended by about 65 participants comprising entrepreneurs and operators from a range of industry sub-sectors, solar technology experts, consultants, researchers, and representatives from academic institutions, R&D institutes and government agencies.

Opening session

In his welcome address, Mr M A Tejani, Managing Director, Gits Food Products Pvt. Ltd., underlined that the adoption of CST systems can provide long-term value to industries, especially if supported by favourable cost structures and subsidy mechanisms. He dwelt on the applicability of CST systems as an alternative to conventional boilers. Mr. Debajit Das, National Project Coordinator, UNIDO, briefly outlined the training course, in which the sessions were designed to cover case studies, operational challenges, maintenance requirements, and practical implementation aspects. Mr. Shirish S. Garud, Consultant, TERI, noted that despite efforts toward electrification, the demand for thermal heating and cooling in industrial processes will continue to persist, reinforcing the relevance of CST systems for meeting such requirements.

Technical sessions

A number of presentations were made to guide the interactive technical sessions that followed:

- Detailed presentation on the UNIDO-GEF-MoMSME incentive scheme under the project—Mr Debajit Das, National Project Coordinator, UNIDO
- Introduction to solar thermal technologies & technology selection criteria for specific end-use applications—Mr Shirish S Garud, Consultant, TERI
- Fundamentals and applications of solar thermal systems—Dr Pankaj Kalita, Associate Professor, School of Energy Science and Engineering, IIT Guwahati
- Installation and commissioning of CST—Mr Jaiprakash Karna, EMSOL
- Solar thermal solutions for sustainable industrial energy— Mr Harsh Gor, CEO, Taylormade Renewables Ltd (TRL)
- CST System Feasibility—Dr N K Ram, Senior Fellow, TERI
- AGNi69— Mr Siddhesh Sawant, CEO, ARS Glass Tech Pvt. Ltd
- Concentrating solar thermal systems— Mr Rohit Chalwale, Project Director, Energy Guru (Sharpersun)

Salient points

A few of the important points that emerged from the presentations and the discussions are summarized below.

- Solar thermal technologies are mature, versatile, and highly relevant for industrial decarbonization. Government incentives and subsidies are key enablers for their large-scale adoption, particularly among MSMEs.
- It is essential to select the best-suited CST system based on temperature requirements, process integration, and local climatic conditions. Common process integration points include boiler feed water preheating, direct steam generation, and hot air supply for drying applications. Hybrid systems, where solar energy is complemented by conventional fuels or biomass, can ensure continuous operation during non-sunshine hours.
- Flat plate collectors are cost-effective for domestic use with shorter payback periods, while compound parabolic collectors (CPCs) offer a balance between cost and performance for medium-temperature industrial applications. Parabolic trough systems, although capable of higher temperatures, involve higher capital costs and longer payback periods. However, cross compound parabolic concentrators (XCPC) can utilize both direct and diffuse solar radiation, allowing them to maintain high efficiency even under cloudy or dusty atmospheric conditions. With a collector efficiency typically ranging between 65–72% and its ability to operate at temperatures up to 350°C and pressures up to 30 bar, the XCPC is suitable for a wide range of industrial applications.
- Emerging innovations in the design of CST systems reveal a notable shift away from the conventional approach of attempting to generate steam continuously in real time, toward a model focused on maximizing heat capture and storage. In this

innovative approach, solar energy is first stored in thermic fluid reservoirs, which act as heat banks, and then released in a controlled manner to meet process demands. This decoupling of heat generation from heat utilization improves system stability, ensures consistent input to heat exchangers, and enhances overall efficiency.

- Additionally, innovations in materials and design of CST systems—such as the use of high-reflectivity mirrors, advanced coatings to prevent oxidation, and optimized absorber geometries—are key factors in improving system durability and performance. An example is the design innovation in the parabolic trough system through the use of lightweight and modular components. Unlike conventional systems that rely heavily on glass mirrors, this technology utilizes reflective film laminated on to aluminium sheets. This approach offers several advantages, including reduced weight, easier transportation, faster installation, and lower risk of breakage. The modular nature of the system allows most fabrication work to be completed off-site, with only assembly required at the installation location, thereby reducing project timelines. Additionally, the system has been engineered to withstand high wind speeds, making it suitable even for challenging environments such as coastal regions.
- Numerous real-world case studies demonstrate the technical feasibility as well as the adaptability and scalability of CST solutions in diverse industrial and other applications, such as effluent treatment plants achieving zero liquid discharge (ZLD), solar-assisted steam generation in leather and sugar industries, desalination systems in arid regions, large-scale cooking, lignite drying, and tea processing.
- For scaling up the adoption of CST systems, a strategic approach based on the concept of 'lighthouse projects' can be explored. In essence, CST demonstration projects in key industrial clusters could serve as reference points for other industries, thereby facilitating wider adoption. Clusters such as those in Hyderabad, Mumbai, Baddi, and Visakhapatnam present significant opportunities for large-scale promotion and adoption of CST systems, due to the concentration of similar industries in these clusters and favourable solar conditions. This approach will also help CST manufacturers for whom economies of scale remain a challenge, because limited demand leads to higher CST system costs. By aggregating demand and promoting cluster-based adoption, it was suggested that CST system costs could be reduced and market penetration improved.

Post-training engagement

As part of the UNIDO program, Expression of Interest (EOI) forms for the adoption of solar thermal technology solutions tailored to industrial heat requirements were shared with the training participants. Upon receiving the completed forms, UNIDO will collaborate with designated knowledge partners to develop a Comprehensive Solar System Study Report (CSSR). Subsequently, the assigned entity will engage directly with industries and industrial associations to brief them on the incentive schemes and project framework, highlighting both the technical and economic advantages of adopting concentrated solar thermal technologies for industrial heating needs.

Furthermore, UNIDO will assist in the preparation of tender documents to invite competitive bids from qualified suppliers; facilitate discussions and negotiations with shortlisted bidders to support MSME units in finalising purchase orders; and provide recommendations to MSME units for vendor selection based on the enterprise's preferences. To ensure smooth implementation, UNIDO will appoint a technical agency to supervise the installation and commissioning of the solar thermal systems at the vendor's premises, ensuring quality and adherence to project specifications.

ABOUT **SAMEEEKSHA**

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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