SMALL AND MEDIUM ENTERPRISES: ENERGY EFFICIENCY KNOWLEDGE SHARING

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SAMEEEKSHA NEWSLETTER

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Inside...

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 | SHAKTI SUSTAINABLE ENERGY FOUNDATION | teri THE ENERGY AND RESOURCES INSTITUTE Creating Innovative Solutions for a Sustainable Future | MSME MICRO, SMALL & MEDIUM ENTERPRISES | SED FUND

A PLATFORM FOR PROMOTING ENERGY EFFICIENCY IN SMEs

IN THIS ISSUE...

This issue has as its theme the studies undertaken by TERI on the secondary steel cluster in Sundergarh district of Odisha, under the project supported by the SED Fund. This project contributes to and synergizes with the larger ongoing initiative to find actionable pathways by which the Indian iron and steel sector can achieve energy transition away from fossil fuels towards low-carbon technological options.

The first article summarizes the findings of a cluster-level situation analysis of the Sundergarh secondary steel sector, including the various categories of units that are in operation; their primary technologies, raw materials, energy sources, and end-products; and the energy consumption levels by industry category. It also summarizes a number of energy conservation measures (ECMs) that can be adopted by the different categories of units.

The second article presents a number of these ECMs and their potential benefits in more detail, based on plant-level studies conducted by TERI in a total of 14 secondary steel units falling under three categories: (1) steel melting units using electric induction furnaces (EIF); (2) steel rerolling mills (SRRM); and (3) plants producing direct reduced iron (DRI). The article underlines that implementation of these ECMs can bring significant benefits to the units in terms of energy and cost savings, and that they offer attractive simple payback periods (SPP) on investments— in many cases, within a few months.

The issue concludes with a summary of the discussions during the 23rd meeting of SAMEEEKSHA platform held on 7th June 2024 at Pune.

SAMEEEKSHA Secretariat

PROFILE OF SUNDERGARH SECONDARY STEEL CLUSTER

Overview

The state of Odisha has vast mineral reserves including iron ore and coal, along with a significant number of operating mines. Considering the ready availability of these raw materials, a large number of iron & steel industries have been established in Odisha including public sector undertakings such as Steel Authority of India Limited (SAIL), Rourkela— an integrated steel plant. Odisha is also the leading steel producer among all Indian states: its steel production during 2021–22 was 23.72 million tonnes (MT), witnessing about 7.5% growth during 2017–2022. The Keonjhar district contributes about 31% of the total iron ore mined in the state, followed by Sundergarh district which contributes 20% of the total.

The Sundergarh district has a large cluster of secondary steel industrial units, most of which are situated in the industrial estates of Rourkela, Kalunga, Mandiakudar, Rajganjpur, and Sundergarh. TERI conducted a situation analysis of the secondary steel units in the Sundergarh cluster under a project supported by the SED Fund. There are about 87 registered secondary steel units operating in the cluster, of which about 40 are 'composite' units having multiple process steps integrated within the same plant, while the remaining 47 are 'stand-alone' units having a single process step. In composite units, the end-products from a process step are used as input raw materials in subsequent process steps; while in stand-alone units, they are marketed as the final products for use by other downstream industrial units. About 52 units, comprising large-scale plants as well as MSMEs, have energy consumption levels of 20,000 tonnes of oil equivalent (toe) or more annually and are categorized as Designated Consumers (DCs) under the Perform, Achieve and Trade (PAT) scheme of the Bureau of Energy Efficiency.

A number of industry associations are active at cluster and state levels in addressing issues pertinent to the Sundergarh secondary steel cluster, such as facilitating networking among members, providing technical support by organizing training programs and workshops, and so on. The prominent industry associations and other important stakeholders are listed below.

- Orissa Sponge Iron Manufacturers Association (OSIMA)
- Rourkela Chamber of Commerce and Industry, Rourkela
- Utkal Chamber of Commerce and Industry Limited (UCCIL), Bhubaneshwar
- District Industries Centre, Sundergarh
- MSME Development & Facilitation Office, Cuttack
- National Small Industries Corporation (NSIC), Rourkela

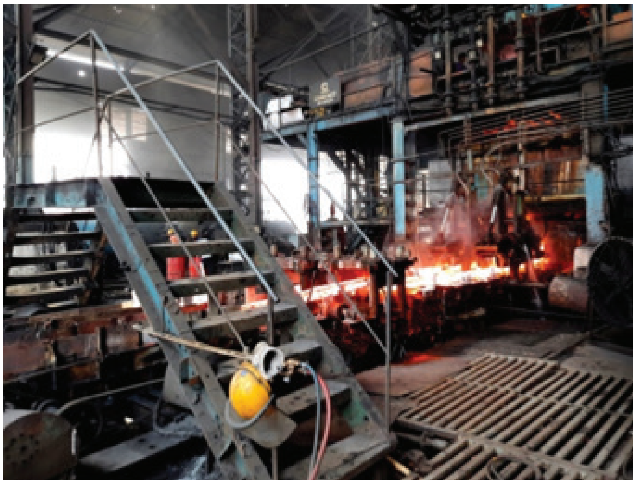
Technology

The following are the main categories of secondary steel industries in Sundergarh.

- Pellet plants, which use induration furnaces to process iron ore into pellets.
- Direct reduced iron (DRI) industries, which use rotary kilns to produce sponge iron from iron ore/ pellets.

Pellet plant, rotary type

Rotary kiln in DRI plant



Steel melting industry: continuous casting machine (CCM)

Ferro alloy industry

- Mini blast furnace (MBF) units, which produce pig iron or liquid iron from iron ore/pellets.
- Steel melting industries using electrical induction furnaces (EIF) for producing molten (liquid) steel from sponge iron and scrap. These units are of two types: (1) composite plants having integrated facilities for producing rolled steel products through hot charging route, using continuous casting machines (CCMs) for processing the liquid steel directly, and/or through cold charging route, using reheating furnaces for bringing ingots and billets to the required temperatures for rolling; (2) stand-alone plants that undertake bottom-pouring of the liquid steel to make solid billets and ingots, which are marketed for use as raw materials by downstream industries.
- Steel re-rolling mills (SRRM), which produce rolled steel products from steel ingots and billets using: (1) reheating furnaces to preheat the ingots and billets; (2) rolling machinery to make the rolled steel products from the heated billets/ingots.
- Ferro alloy industries, which use submerged arc furnaces to produce alloying elements such as ferro manganese, silicon manganese, ferro silicon, chrome alloys, etc. that are used in the production of alloy steels.

Table 1 summarizes the main categories of secondary steel industries.

Table 1: Categories of secondary steel industries in Sundergarh cluster

Category	Units (no.)	By process step(s)		By energy consumption	
		Stand-alone	Composite	DC	Non-DC
Pellets	1	–	1	1	–
DRI	41	29	12	25	16
MBF	2	–	2	1	1
EIF	25	9	16	16	9
SRRM	16	9	7	7	9
Ferro alloy	2	–	2	2	–
Total	**87**	**47**	**40**	**52**	**35**

Table 2 shows the primary technologies deployed by different categories of secondary steel units, along with the primary raw materials used, the sources of energy, and the end-products.

Table 2: Primary technologies, raw materials, energy sources, and end-products

Category	Primary technology	Raw materials	Energy sources	End-products
Pellets	Induration furnace	Iron ore, fluxing material, bentonite	FO, coal, coke, electricity	Pellets
DRI	Rotary kiln	Iron ore/ pellets, dolomite	Coal, electricity	Sponge iron
MBF	Blast furnace	Iron ore/ sinter/ pellets	Coal, electricity	Liquid iron, pig iron
EIF	EIF, continuous casting machine (CCM)	Sponge iron, scrap, alloying elements	Electricity	Ingots & billets
SRRM	Reheating furnace, rolling machinery	Ingots & billets	Coal, electricity	Rolled products
Ferro alloy	Submerged arc furnace	Mineral ores	Electricity	Alloying elements

Energy use

The total energy consumption by the MSME secondary steel units in the Sundergarh cluster is estimated at 1.86 million tonnes of oil equivalent per year (Mtoe/y), of which thermal energy from fossil fuels accounts for about 93% (1.73 Mtoe/y), and electricity the remaining 7% (0.13 Mtoe/y) as summarized in table 3. The DRI industries account for nearly 70% of the total cluster-level energy consumption.

Table 3: Energy consumption by MSME secondary steel units in Sundergarh cluster

Category	Energy consumption (Mtoe/y)		
	Thermal	Electricity	Total
Pellets	0.03	–	0.03
DRI	1.25	0.02	1.27
BF	0.44	0.01	0.45
Steel melting (EIF)	–	0.09	0.09
SRRM	0.003	0.005	0.01
Ferro alloy	0.003	0.009	0.01
Total*	**1.73**	**0.13**	**1.86**

* rounded off

Potential energy conservation measures

The study helped identify a number of energy conservation measures (ECMs) that can be adopted by the different categories of secondary steel industries, as summarized below. The next article in this issue describes a few ECMs and their potential benefits in more detail, based on plant-level studies conducted in three categories of secondary steel units: (1) DRI, (2) EIF, and (3) SRRM.

Pellets

- Adoption of circular grate technology for heat treatment
- Optimization of hearth layer height
- Oxygen enrichment in combustion air
- Switchover to coal gasification in place of solid coal firing
- Heat treatment using gas route, e.g., natural gas

DRI

- Waste heat recovery (WHR) system for captive power generation, and/or iron ore preheating
- Coal gasification for partial substitution of coal by gas in the rotary kiln
- DRI production using gas route, e.g. natural gas, hydrogen, etc.
- Improved insulation and use of better material in refractory lining in rotary kiln

Steel melting (EIF)

- Installation of scrap-bundling system
- Adoption of continuous casting and direct hot charging for rolling system

Steel rerolling mills

- Installation of coal gasification system
- PLC-based automatic fuel-firing system
- Adoption of waste heat recovery (WHR) system
- Switch over to gas-fired system, e.g. natural gas
- Electrification of reheating furnaces
- Adoption of continuous casting and direct rolling

Common ECMs

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

- Variable frequency drives (VFD) for variable motive loads (blowers, air compressors, etc.)
- Replacing inefficient (rewound) motors by energy-efficient (IE3 /IE4) motors
- Adopting best operating practices in compressed air systems such as arresting compressed air leakages, and optimizing the air pressure settings
- Installation of multi-stage centrifugal pumps for cooling water systems
- Installation of solar photovoltaic (SPV) systems

ENERGY ASSESSMENT STUDIES ON SECONDARY STEEL INDUSTRIES IN SUNDERGARH

TERI conducted energy assessment studies on a total of 14 secondary steel industrial units in the Sundergarh cluster, under a project supported by the SED Fund. This project contributes to and synergizes with the larger ongoing initiative to find actionable pathways by which the Indian iron and steel sector can achieve energy transition away from fossil fuels towards low-carbon technological options, through cluster-level interventions in selected secondary steel clusters across the country.

The units that were studied fall under three categories: (1) steel melting units using electric induction furnaces (EIF); (2) steel rerolling mills (SRRM); and (3) plants producing direct reduced iron (DRI), as shown in table 1. Detailed energy assessment studies were carried out on each of the units, in order to study the technologies and processes being used; assess the potential for reducing energy and resources consumption in different process areas; and identify and quantify the benefits of energy conservation measures (ECMs) that can be implemented by the units concerned. The studies also assessed the potential for installing rooftop solar photovoltaic (PV) systems for captive power generation in the steel melting units and SRRMs.

Table 1: Secondary steel units covered by the studies

Category	No. of units
Steel melting (EIF)	8
Steel rerolling mills (SRRM)	3
DRI (sponge iron)	3
Total	**14**

Snapshots of ECMs

The sections that follow describe, by industry category, a few of the important ECMs identified through the studies. These ECMs offer significant benefits in terms of energy and cost savings, as well as attractive simple payback periods (SPP) on investments— in many cases, within a few months.

Steel melting units (EIF)

The eight EIF-based steel melting units that were studied were of two types: (1) composite units that use continuous casting machines (CCMs) to process the liquid steel from EIF into hot billets, which are sent directly to the rolling section for making rolled steel products; and (2) stand-alone units that pour the liquid steel from EIF to make solid billets, ingots, castings, etc., which are then marketed for use by downstream steel rerolling mills (SRRMs) and other industries. Three of the important ECMs identified for the steel melting units are summarized below.

Energy assessment study under way

Water flow measurements being taken during study

1. Replace low-efficiency pumps with energy-efficient pumps in all cooling water systems

All the eight steel melting units studied have installed cooling water circulation systems for their melting furnaces (i.e. EIF), and in one case each, for the CCM section and rolling section as well. The studies showed significant potential for reducing energy consumption and costs in these cooling systems by replacing the existing low-efficiency pumps with energy-efficient (EE) pumps. In most cases the simple payback periods on investments are less than one year (table 2).

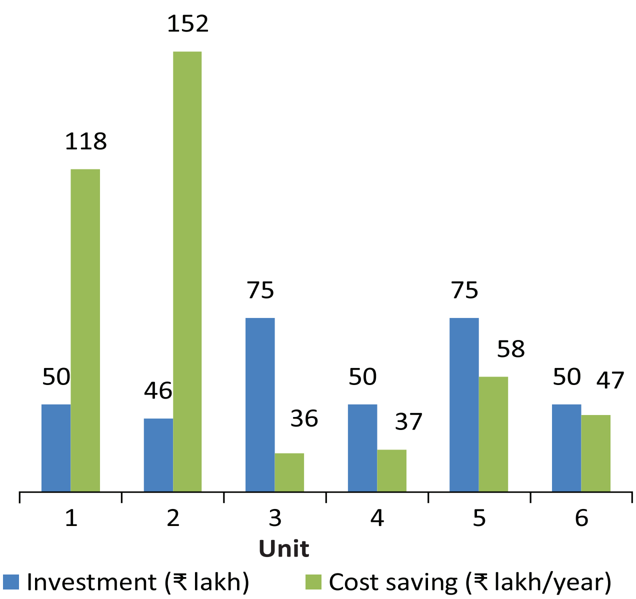
Table 2: Installing EE pumps in cooling water systems

Unit no.	Annual energy saving (million kWh)	Annual cost saving (Rs lakh)	Investment (Rs lakh)	SPP* (years)
1	0.02	1.3	2.3	1.8
2	0.27	16.4	16.5	1.1
3	0.22	12.6	9.5	0.7
4	0.04	2.4	2.0	0.8
5	0.08	4.2	2.8	0.7
6	0.48	28.0	22.5	0.8
7	0.06	3.6	1.7	0.5
8	0.02	1.7	2.5	1.5

*SPP—simple payback period

2. Install scrap shredder and scrap bundling machine

The studies found that in many units, the EIF was being charged with scrap materials of assorted sizes and shapes. This practice increased the heating cycle time of the EIF and lowered the overall efficiency of the melting process. It was recommended that the units install scrap shredders and scrap bundling machines which will reduce the scrap to uniform size and make it more compact, thereby reducing energy consumption and improving process efficiency. The chart depicts the potential monetary benefits of this ECM in six of the melting units. The payback time on investment varies from less than four months to just over two years.



Use lid for furnace crucible

The studies found that in two steel melting units, the crucible of the EIF was left open to the atmosphere during operation, leading to significant heat losses through radiation and convection. It was recommended that these two units install locally-fabricated, insulated mild steel lids on the crucibles to minimize the heat losses. For one unit, an investment of Rs 6 lakhs on the lid would save Rs 15 lakhs annually, with simple payback period (SPP) of less than 5 months; for the other unit, an investment of Rs 2 lakhs would save Rs 2.3 lakhs annually, with SPP of less than 11 months.

Lid for EIF crucible

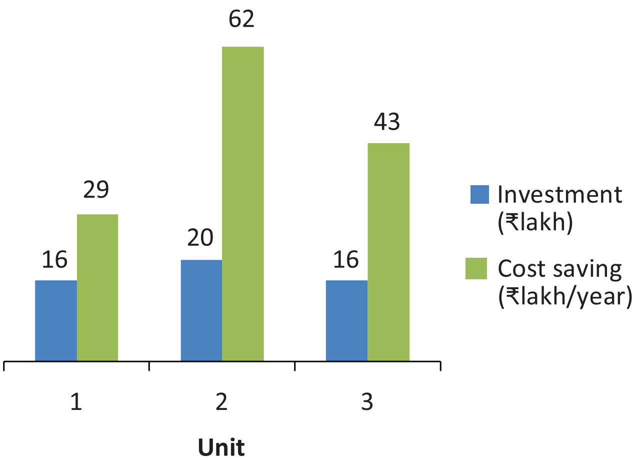
Steel rerolling mills

All three SRRMs studied use pusher hearth-type reheating furnaces based on pulverized coal to heat billets to the appropriate temperatures (1100–1150°C) for further processing into the finished products in the rolling sections. The reheating furnaces are equipped with waste heat recovery (WHR) systems to recover heat from flue gases (temperature 600–700°C) for preheating the combustion air. Two of the important ECMs identified for the reheating furnaces in these units are described below.

Replace recuperator in reheating furnace

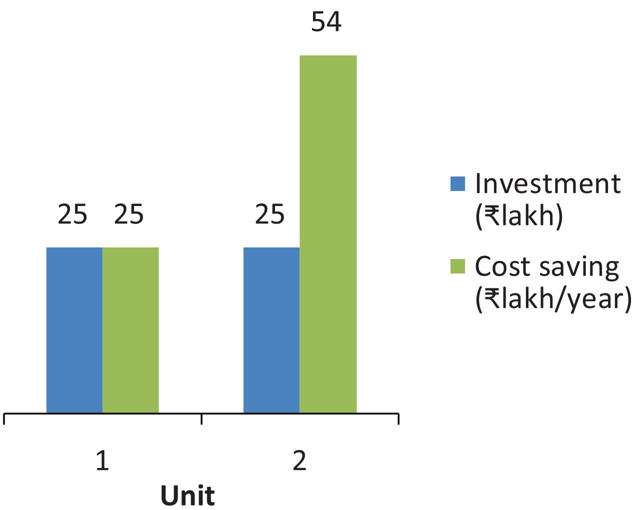
Temperature measurements during the studies showed that the existing recuperators were not effective in transferring heat from the hot flue gases to the combustion air. It was recommended that the units replace their existing recuperators with new compatible recuperator systems to achieve significant energy and cost savings as depicted in the chart, with quick payback on investments (within 4–7 months).

Recuperator for reheating furnace



Automation of reheating furnace, with installation of swirl burner

In two of the SRRMs, the draught in the reheating furnaces was being manually controlled, leading to improper pressure inside the furnaces. Also, the units were using locally-fabricated pipe burners which



did not allow mixing of air and fuel in optimal ratio. Both units were advised to install automatic furnace pressure control systems and also replace the existing burners with swirl burner systems, which would result in substantial energy and cost savings (see chart).

DRI units

Of the three DRI units studied, one is a large-scale plant and the other two are MSMEs. In both MSME DRI units, the studies found that the rotary kilns were using only about 32% of the total heat input, with a significant amount of useful heat being carried away by the waste gases that exited the kilns at a temperature of about 950°C. While the units had installed heat exchanger systems to cool the exhaust gases before expelling them to ambient through the chimney, the studies determined that a better option for the units would be to install power generation systems based on waste heat recovery boilers (WHRBs), which could use the heat from waste gases to generate power for captive use as well as export surplus power to the grid (table 3).

Table 3: Installing captive power plants using waste heat from rotary kilns

Unit no.	Annual energy saving (million kWh)	Annual cost saving (Rs lakh)	Investment (Rs lakh)	SPP (years)
1	22.3	893.1	3694.4	4.1
2	19.8	792.8	3901.2	4.9

Waste heat recovery boiler (WHRB)

Solar energy options

Among the steel melting units and SRRMs studied, significant potential exists in nine units to install rooftop solar PV systems to meet captive power requirements and export any surplus power to the grid.

23RD MEETING OF SAMEEEKSHA

The 23rd meeting of SAMEEEKSHA was held in Pune on 7th June, 2024, and attended by around 50 participants including representatives from BEE; Directorate of Industries, Pune Region; MSME Development and Facilitation Office (MSME-DFO); Maharashtra Energy Development Agency (MEDA); Small Industries Development Bank of India (SIDBI); Indo German Energy Programme of GIZ GmbH (IGEP-GIZ); Shakti Sustainable Energy Foundation (SSEF); Institute of Electrical and Electronics Engineers (IEEE), Pune; Mahratta Chamber of Commerce, Industries and Agriculture (MCCIA), Pune; entrepreneurs; and other stakeholders.

In their opening remarks, Mr Girish Sethi, Senior Director, TERI, and Mr Prashant Girbane, Director General, MCCIA, underlined the importance of organizing this regional SAMEEEKSHA meeting in Pune, which is a major industrial hub known for its automotive, engineering, and food processing industries. Dr Sachin Kumar, Director of Industry, Buildings, and Cooling, SSEF, pointed to the challenges posed to Pune's automotive component manufacturing industries by the market transition towards electric vehicles (EVs), and suggested that SAMEEEKSHA provides an ideal platform for discussions on how to address these challenges.

Mr Milind Deore, Secretary, BEE, outlined BEE's various initiatives for promoting energy efficiency (EE) in the MSME sector and cited examples to underline the effectiveness of cluster-level demonstration projects in spurring the widespread adoption of EE technologies. Mr Abhay Daptardar, Assistant Director, MSME- DFO, Mumbai, mentioned that Kolhapur cluster has been identified by BEE for pilot EE projects, and suggested that other engineering clusters such as Ahmednagar and Aurangabad be considered for future projects. Mr S G Rajput, Joint Director of Industries, Pune region, spoke on state supportive policies for industry.

The following presentations were made to guide the discussions that followed:

- Energy Efficiency in Industry and Data—Mr Ayan Shubhro Ganguly, Energy Advisor, IGEP-GIZ
- Energy and Resource Efficiency Action Plan (MSME Sector)— Mr Neeraj Naik, Project Engineer, BEE
- Promoting Energy Efficiency in the state of Maharashtra— Mr Abhijeet Hinge, Manager, MEDA
- SIDBI's financing schemes for energy efficiency and solar rooftop— Mr Rajiv Kumar, General Manager, Green Climate and Energy Efficiency Centre, SIDBI

A few salient points from the presentations and discussions are listed below.

- IEEE is willing to associate with MCCIA for awareness and training programs, including the development of course content for MSMEs.
- MCCIA is starting an initiative on sustainability for MSME industries in Pune region, with a target to support 100 MSMEs for pilot demonstrations.
- Participants suggested that: (1) the Energy Mapping Studies of BEE may be expanded to cover lean clusters, as Maharashtra alone has 94 lean clusters with nearly 900 units; (2) the Ichalkaranji textile cluster may be considered by BEE for any future EE project.

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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