SMALL AND MEDIUM ENTERPRISES: ENERGY EFFICIENCY KNOWLEDGE SHARING

VOLUME 14 | ISSUE 1 | MARCH 2023

SAMEEEKSHA NEWSLETTER

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- 21st meeting of SAMEEEKSHA

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

The Energy and Resources Institute

MICRO, SMALL & MEDIUM ENTERPRISES

A PLATFORM FOR PROMOTING ENERGY EFFICIENCY IN SMEs

IN THIS ISSUE...

The theme of this issue is the secondary steel sector, which TERI studied under a project supported by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ). The project entailed studies and analyses of the energy performance of the main secondary steel sub-sectors at cluster/state levels across the country; and identification of clusters/ states in each sub-sector that present high potential for improving overall energy efficiency (EE) through deep-dive interventions. The studies covered six secondary steel sub-sectors: namely, foundry; forging; steel re-rolling (SRR); direct reduced iron (DRI, also known as sponge iron); electric arc furnace (EAF); and electric induction furnace (IF). As outlined in the theme article, the studies reveal significant levels of energy consumption and high specific energy consumption (SEC) levels in the secondary steel sector. In each of the six sub-sectors studied, two clusters/states have been identified for conducting deep-dive interventions aimed at introducing EE technologies and practices. Deep-dive activities have already been initiated in three sub-sectors—foundry, forging and SRR—with detailed energy audits (DEAs) being conducted on select units in clusters where TERI has worked in the past, in order to evaluate energy saving potential and assess investment requirements for EE improvements.

The second article summarizes the progress made by TERI and Institute for Global Environmental Strategies, Japan (IGES) under the 'JITMAP' initiative to promote high-efficiency environmental technologies (ETs) in India. The article includes key points from a hybrid-mode workshop on air pollution in Maharashtra, organized by IGES and TERI along with the Mahratta Chamber of Commerce, Industries and Agriculture (MCCIA) in Pune on 14th February 2023.

The issue concludes with a summary of the 21st Meeting of SAMEEEKSHA platform, held at Raipur, Chhattisgarh on 18th November 2022.

SAMEEEKSHA Secretariat

ENERGY MAPPING OF THE SECONDARY STEEL SECTOR

TERI has been working in the secondary steel sector in India under various projects, in order to help prepare a national-level strategic roadmap to improve energy efficiency (EE) and reduce emissions in this energy-intensive sector. One project was supported by the Children's Investment Fund Foundation (CIFF), and was undertaken in the broader context of decarbonizing Indian industry, particularly the hard-to-abate sectors like iron & steel, cement, etc. [see SAMEEEKSHA 13(2), June 2022, for more details]. Another project was supported by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), and focused specifically on energy mapping of the secondary steel sector to identify clusters for deep-dive EE interventions as summarized in this article. A related ongoing project around steel sector decarbonization is supported by Stichting SED Fund.

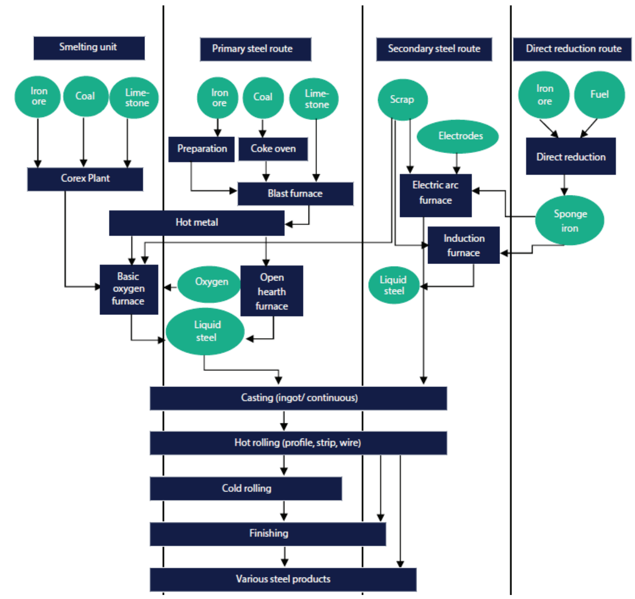
Overview

The Indian steel industry can be classified into two broad categories of steel producers: primary and secondary. The primary steel producers are large-scale industries categorized as Designated Consumers (DCs) under the Perform, Achieve and Trade (PAT) scheme, with energy consumption levels of 20,000 tonnes of oil equivalent (toe) or more annually. Most of these DCs are adopting measures to optimize their energy performance. The secondary steel producers too consume significant amounts of energy; but most of them are MSMEs that continue to depend on inefficient technologies and practices, and therefore present significant scope for improving EE through technology upgradation and energy conservation measures in process and utilities.

The steelmaking process essentially involves the following stages:

- Iron is extracted from iron ore, using 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). Coal is used to reduce iron ore in all cases, making this stage emissions-intensive.
- The iron (either in liquid or solid form) is mixed with recycled steel—known as steel scrap—and processed in steelmaking furnaces to 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 also in India, electric induction furnace (IF).
- After further refining as necessary—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 rolling and cold rolling, steel re-rolling, forging, wire-drawing etc. to make the final products such as bars, beams, rods, strips, castings, forged components, wires, and so on.

The figure depicts the main steelmaking routes in India, and provides an idea of the complex and iterative links between making iron and steel, and the downstream steel processing steps.



Steel production routes

Source: TERI. 2020. Towards Low Carbon Steel Sector.

The project

Reliable energy-related data is not readily available on the secondary steel sector. Also, earlier initiatives to improve energy and environmental performance were restricted to certain clusters/states, and as a result there is wide variance among clusters in levels of energy performance. The GIZ-supported project therefore aimed at: (1) studying and analysing the energy performance of the main secondary steel sub-sectors at cluster/state levels across the country; and (2) based on the analyses, identifying two clusters/ states in each sub-sector for improving overall energy efficiency and environmental performance through deep-dive interventions. The studies covered six secondary steel sub-sectors that are significant in terms of numbers of units, production capacities, and energy intensity:

- Foundry
- Forging
- Steel re-rolling (SRR)
- Direct reduced iron (DRI, also known as sponge iron)
- Electric arc furnace (EAF)
- Electric induction furnace (IF)

In each sub-sector, the studies involved collation and analyses of secondary data pertaining to the number of industries, production levels, energy usage patterns and energy consumption levels, performance in terms of specific energy consumption (SEC), and GHG emissions.

There are an estimated 8259 MSME units established in these six secondary steel sub-sectors, together accounting for energy consumption of 11.8 million tonnes of oil equivalent per year (Mtoe/y) and emissions of 58.2 million tonnes CO_2 per year (Mt CO_2/y). Snapshots of the study findings are presented in table 1, and in the sections that follow.

Table 1. Energy consumption and emissions in secondary steel sub-sectors[1]

Sub-sector	No. of units	Energy consumption (Mtoe/y)	Emissions (Mt-CO_2/y)
Foundry	5000	0.9	6.6
Forging	705	0.3	1.6
SRR	1257	1.4	6.5
DRI	223	7.4	30.0
EAF	37	0.1	1.0
IF	1037	1.5	13.4
Total	**8,259**	**11.6**	**59.1**

Foundry

Primary products: ferrous and non-ferrous castings

Main energy sources: electricity; coke

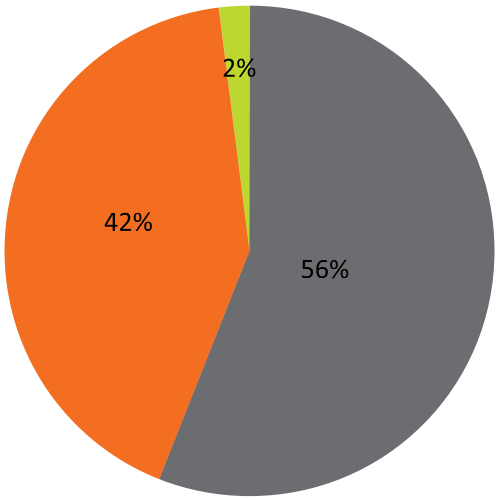
Study focus: 14 clusters

SEC range: 3.2–5.0 GJ/tonne product

Foundries underpin India's overall economic growth, with ferrous and non-ferrous castings being used for diverse applications in a vast range of industrial and manufacturing processes linked to virtually every sector of the economy. Foundries use coke-fired cupola furnaces (69%) as well as induction furnaces (31%) for producing liquid metal.

There are an estimated 5000 foundries in India, of which about 3680 are operational. The studies focused on 14 major foundry clusters across India: namely, Agra, Ahmedabad, Batala-Jalandhar-Ludhiana, Belagavi, Coimbatore, Faridabad, Indore, Kolhapur, Howrah, Jaipur, Rajkot, Samalkha, Shivamogga, and Saharanpur. These 14 clusters together consume nearly 0.4 Mtoe of energy each year, which is about 45% of the total annual energy consumption in the Indian foundry industry (0.9 Mtoe).

Raw material yard in foundry



Energy consumption by source - 14 foundry clusters

Forging

Primary products: forged steel and other alloy components

Main energy sources: electricity; oil (FO, HSD); natural gas (NG)

Study focus: 4 forging clusters

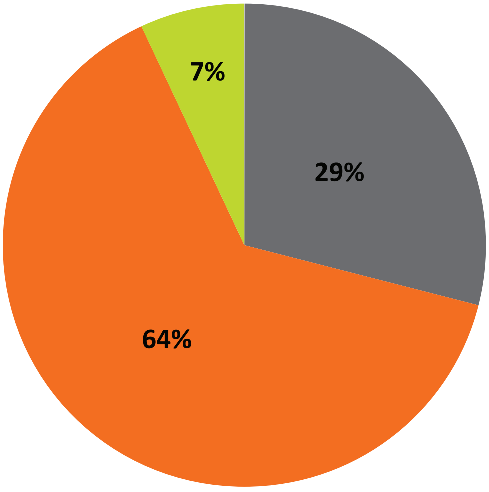
Cluster-level SEC Average: 5.9–7.1 GJ/tonne product

[1] Data for forging sub-sector is from four clusters— Chennai, Ludhiana, Pune and Rajkot—which together account for nearly 50% of total energy consumption in forging industry.

Forging industries produce forged components, for the automotive sector as well as for other diverse industrial and manufacturing enterprises. Almost 83% of forging units are micro-sized based on their production capacities. Forging units use electrical induction billet heaters as well as furnaces fired by furnace oil (FO), high-speed diesel (HSD) or natural gas (NG), to heat steel billets to semi-molten state prior to the forging steps.

The studies focused on four major forging clusters: namely, Chennai, Ludhiana, Pune, and Rajkot. These four clusters together host about 705 forging units and consume about 0.14 Mtoe of energy each year, which is about 46% of the estimated total annual energy consumption in the Indian forging industry (0.3 Mtoe).

Forging furnace



Energy consumption by source - 4 forging clusters

Steel re-rolling (SRR)

Primary products: rolled steel products

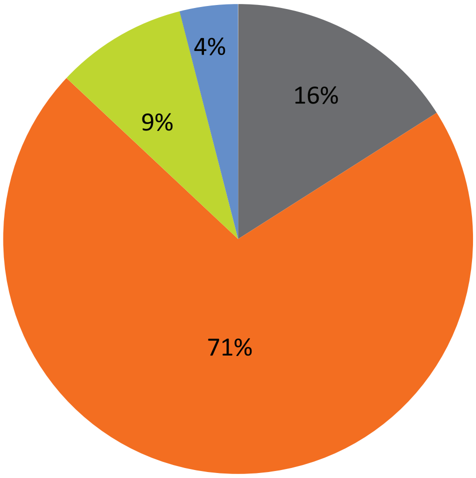
Main energy sources: electricity; coal; oil (FO); gas (NG)

Study focus: 9 clusters

Cluster-level SEC range: 1.6–2.7 GJ/tonne product

Steel re-rolling (SRR) mills contribute a major share of finished steel production in India. Most of the SRR mills are MSMEs that cater to the low-tonnage requirements of customers in sectors like automobiles, construction, infrastructure, telecom, transport, etc. SRR mills use reheating furnaces fired by coal, oil (FO) or gas (NG) to heat the steel ingots/billets for rolling, and electricity to drive the rolling machinery.

There are an estimated 1257 SRR mills in India, of which about 970 are operational. The studies focused on nine SRR clusters: namely, Bardhaman; Bhavnagar, Mandi–Gobindgarh, Indore, Jalna, Ludhiana, Mehsana, Raipur, and Tiruvallur. These 9 clusters together consume about 0.55 Mtoe of energy each year, which is about 39% of the total annual energy consumption in the Indian SRR industry (1.41 Mtoe).



Energy consumption by source - 9 SRR clusters

Direct reduced iron (DRI)

Primary products: sponge iron

Main energy sources: non-coking coal

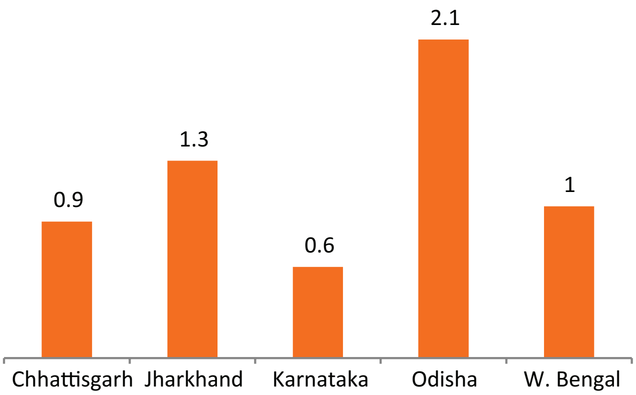
Study focus: 5 states

SEC Average: 22 GJ/ tonne product

DRI industries produce sponge iron, which is used as raw material to make steel. DRI plants use non-coking coal, as a fuel and as a reducing agent in rotary kilns. There are an estimated 223 non-DC DRI plants in India, of which about 180 are operational.

Rotary kiln in DRI plant

The studies focused on five states—Chhattisgarh, Jharkhand, Karnataka, Odisha, and West Bengal. The DRI plants in these states together consume about 5.9 Mtoe of energy each year, which is nearly 80% of the annual energy consumption in the Indian DRI industry (7.4 Mtoe).



Energy consumed by DRI plants in 5 states (Mtoe/y)

Electric arc furnace

Primary products: various grades of steel

Main energy sources: electricity

Study focus: 4 states

SEC Average: 1.9 GJ/ tonne liquid steel

EAF plants process pig iron, sponge iron and steel scrap to produce various grades of steel in molten form.

There are an estimated 37 non-DC EAF plants in India, of which 22 are operational. The studies focused on four states—Maharashtra, Odisha, Punjab and West Bengal. The EAF plants in these states together consume about 0.09 Mtoe of energy each year, i.e., 90% of the total annual energy consumption by EAF plants in India (0.1 Mtoe/y).

Induction furnace (IF)

Primary products: various grades of steel

Main energy sources: electricity

Study focus: 10 clusters

SEC Average: 2.4 GJ/ tonne liquid steel

IF plants produce various grades of steel in molten form, using pig iron, scrap steel and other alloys as the main raw materials.

There are an estimated 1037 IF plants in India, of which about 800 are operational. The studies focused on 10 major IF clusters: namely, Bardhaman, Mandi–Gobindgarh, Coimbatore, Dadra-Nagar Haveli, Ludhiana, Palakkad, Patna, Raipur, Seraikela, and Sundergarh. The IF plants in these 10 clusters together consume about 0.5 Mtoe of energy each year, i.e., 33% of the total annual energy consumption by IF plants in India (1.5 Mtoe/y).

Looking ahead

The studies reveal significant levels of energy consumption and high SEC levels in the secondary steel sector. Based on analyses of the study results, two clusters/states have been identified in each of the six secondary steel sub-sectors, in which to conduct deep-dive interventions aimed at introducing EE technologies and practices (table 2). Deep-dive activities have already been initiated in three secondary steel sub-sectors—foundry, forging and SRR. Detailed energy audits (DEAs) are currently being conducted on select units in clusters, in order to evaluate energy saving potential and assess investment requirements for EE improvements. Also, the SED Fund is expected to support the forthcoming initiatives in the secondary steel sector, in the larger context of improving energy performance and reducing emissions in hard-to-abate industrial sectors in India including the iron & steel industry.

Table 2. Clusters/states identified for deep-dive interventions

Sub-sector	Selected clusters
Foundry	Ahmedabad; Rajkot
Forging	Ludhiana; Rajkot
SRR	Mandi–Gobindgarh; Raipur
DRI	Jharkhand; Odisha
EAF	Maharashtra; Odisha
IF	Mandi-Gobindgarh; Raipur

This article is primarily based on the following report:

TERI, 2021. *Cluster mapping of secondary steel sector in India and identification of minimum two clusters per sub-sector for further deep dive activities.* New Delhi: The Energy and Resources Institute.

PROMOTING INDIA–JAPAN COLLABORATION ON ENVIRONMENT TECHNOLOGIES

Backdrop

TERI in partnership with Institute for Global Environmental Strategies, Japan (IGES), is implementing an innovative technology transfer model titled 'Japan-India Technology Matchmaking Platform' (JITMAP) to facilitate the dissemination of Japanese low carbon technologies (LCTs) in India [see SAMEEEKSHA 13(1), March 2022]. Since its launch in 2016, JITMAP has made steady progress in facilitating the adoption of Japanese LCTs by a number of Indian industrial end-users through its campaign of overcoming knowledge barriers, providing R&D and capacity building support for both LCT suppliers and end-users, and policy-level engagements. JITMAP conducts its various activities—such as feasibility studies, knowledge-sharing seminars and awareness workshops, and training programs for energy personnel— in close coordination with a number of relevant public and private sector agencies and organizations in both India and Japan.

Enter: environmental technologies

In 2018, the Ministry of the Environment of Japan (MOEJ) and the Ministry of Environment, Forest and Climate Change, India (MoEFCC) signed a Memorandum of Cooperation covering eight areas of cooperation including pollution control (air, soil, water) and climate change. To strengthen such cooperation between the two governments, JITMAP expanded its ambit in 2020 to include environmental technologies (ETs) as well. During 2020–2021, IGES and TERI in cooperation with the Embassy of Japan in India and the Japan Environmental Technology Association (JETA) organized two awareness workshops (webinars) on air pollution control measures for Indian stakeholders, including the Central and State Pollution Control Boards as well as energy intensive industries. These workshops underlined the importance of obtaining deeper understanding of the requirements of the Indian stakeholders and the challenges they face, in order to identify appropriate and effective emissions control solutions that could be provided by Japanese technology manufacturers/suppliers. Accordingly, IGES and TERI, with support from MOEJ, have taken up implementation of the Situational Analysis and Needs Assessment for the National Clean Air Programme in India.

As a further step towards promoting ETs, IGES and

TERI along with the Mahratta Chamber of Commerce, Industries and Agriculture (MCCIA), organized a hybrid-mode workshop in Pune on 14 February 2023, in order to understand the main barriers/challenges to solving the air pollution problems in Maharashtra, and discuss remedial measures. About 60 participants attended the workshop, included representatives from government bodies, industrial units, academic institutions, equipment suppliers and energy consultants. Among the key speakers who provided background and context to the event were Mr Girish Sethi, Senior Director, Energy Program, TERI; Mr Sudhanwa Kopardekar, Director, MCCIA; Mr Yasuo Takahashi, Executive Director, IGES; Dr Satoshi Kojima, Programme Director, Kansai Research Centre, IGES; and Mr Takeshi Kobayashi, Chairman, Overseas Committee, JETA.

Key takeaways from the presentations and discussions that followed are listed below.

- The feasibility studies conducted under JITMAP have already helped bring about significant energy savings and reduced emission levels among industrial end-users in Maharashtra through the adoption of LCTs. Also, the technical capabilities of the Indian partners as well as their awareness levels regarding energy efficiency have increased due to the interactions with Japanese partners.
- Feedback from the various public and private sector stakeholders during the workshop underlined that there is significant scope for introducing Japanese

ETs among large and mid-sized cities in Maharashtra, as well as among commercial and industrial end-users, to help reduce overall air and water pollution.

- Accurate monitoring of pollution is vital for corrective actions to be taken. In this context, the Japanese LCT/ET manufacturer HORIBA, Ltd.—with a presence in 27 countries including India and a technical centre in Pune—offers a range of ET products including monitoring and analytical devices for combustion stack gas, process gas, ambient air, and water quality.

Looking ahead

Building on the encouraging feedback from the workshop participants, IGES and TERI plan to implement the Situational Analysis and Needs Assessment for the National Clean Air Programme in India in full cooperation with Japanese and Indian stakeholders. The main objective is to prepare a concept note for further technical cooperation project that will aim at controlling emissions from energy intensive industries and implementing ambient air quality monitoring effectively across Maharashtra, through facilitating the adoption of Japanese ETs. The concept note will include information on the actual needs of the various local stakeholders, as well as a detailed plan of activities, including training programs.

Starting with the activities in Maharashtra in collaboration with local stakeholders, IGES and TERI will continue to contribute to environmental cooperation between the two countries by conducting activities for improving air pollution under JITMAP, and working closely with Indian industries and relevant local stakeholders.

21ST MEETING OF SAMEEEKSHA

The 21st Meeting of SAMEEEKSHA platform was held at Raipur, Chhattisgarh on 18th November 2022.

The meeting was attended by nearly 100 participants including representatives from BEE, MSME Development and Facilitation Office (MSME-DFO), Chhattisgarh Renewable Energy Development Agency (CREDA), Department of Commerce & Industries (DTIC), Government of Chhattisgarh, industry associations of different industry sub-sectors in the Raipur region, and entrepreneurs.

Welcoming the participants, Mr Girish Sethi, Senior Director, TERI outlined the history of SAMEEEKSHA platform and also highlighted TERI's ongoing energy efficiency initiatives in Raipur cluster focusing on secondary steel industries. Dr Sachin Kumar, Associate Director (Energy Efficiency), SSEF encouraged the participants to share their issues and ideas so that the relevant government departments at the central and state levels are made aware of ground level realities and are able to provide guidance and help as required.

Mr Rajeev Gyani, Superintending Engineer, CREDA, stressed the need for a policy on risk guarantee to promote new EE/RE technologies among MSMEs. Mr Amey Tripathy, Manager, DTIC, and Mr Rajiv S, Joint Director & HOO, MSME-DFO, spoke on policies and schemes of the state and central government respectively to support industries in adopting EE technologies. Mr Milind Deore, Director, BEE mentioned about the recently concluded 'Energy and resource mapping' initiative of BEE. He also shared information on the new 'Perform, Achieve and Earn' (PAE) scheme for SMEs, and on the introduction of a new 'Domestic Carbon Market' covering energy saving and emission reductions. Mr Sobhanbabu PRK, Senior Fellow, TERI made a presentation on 'Overview and De-carbonization options for Sponge Iron and Secondary Steel sector in Chhattisgarh'. Mr. C V K D Prabhu, AGM, Green Climate & Energy Efficiency Centre, SIDBI shared some of SIDBI's financing schemes for EE projects. Mr Bibek Ranjan Patnaik, Project Engineer, BEE provided further details on BEE's resource mapping study in the MSME sector, as well as the FLCTD Scheme for small-scale industries.

A few salient points from the discussions are summarized below.

- BEE has recently introduced 'Urja Mitra' concept aimed at sector/ technology specific experts addressing technology and services gap at local levels. Industries can avail of this facility.
- 'Hot charging' technology can eliminate the use of reheating furnaces, and is a good option for secondary steel industries.
- Setting up of a pilot centralized cluster-level solar photovoltaic (SPV) power system can be explored, to enable industries to switch over from grid electricity to solar power.
- A specific program may be launched to promote EE and RE (solar energy) among rice mill industries in Chhattisgarh, with financial support as needed. Separate training programs may be organized targeting entrepreneurs and shop-floor personnel. MSME-DFO offered to take this suggestion forward.

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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