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SAMEEEKSHA NEWSLETTER

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Inside...

- 'Deep dive' approach for cluster-wide energy efficiency—a case study in Rajkot engineering cluster

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.

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teri
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MSME

A PLATFORM FOR PROMOTING ENERGY EFFICIENCY IN SMEs

IN THIS ISSUE...

This issue carries, as its theme article, a brief account of an innovative strategy to promote energy efficient (EE) technologies on a large scale, known as 'saturation' or 'deep dive' approach. The article explains the key features of the deep dive approach, contrasting it with the elements that constitute the approach known as research, development, demonstration and dissemination (RDD&D). In essence, the deep dive approach focuses on promoting commercially available EE technologies such as EE motors, EE pumps and EE lighting among a large number of units within an MSME cluster, through conducting detailed energy audits on the MSME units to identify energy conservation measures (ECMs), and then providing technical assistance to the units for implementation of the ECMs. In contrast, the RDD&D approach focuses on developing and promoting new EE solutions through R&D, innovation and capacity building, in processes where there are no commercially viable 'off-the-shelf' cleaner solutions available to replace the existing traditional, low-efficiency technologies being used by the MSMEs.

By way of illustration, the article summarizes the deep dive initiative that was undertaken by the TERI–SDC partnership project in the Rajkot foundry cluster during 2015–17. Detailed energy audits were conducted on 110 MSME foundries, enabling the identification of 1040 ECMs, of which over 700 ECMs (67%) were in the nature of best operating practices (BOP) or improvements of existing plant/processes (retrofits) that required low or no investments and promised paybacks on investments in less than a year. By the end of the project, 757 ECMs (over 70% of the total) had been implemented by the foundries concerned—illustrating the effectiveness of the deep dive strategy. The article underlines the huge potential that exists for applying the deep dive approach to promote EE technologies extensively in hundreds of energy intensive MSME clusters across India.

SAMEEEKSHA Secretariat

'DEEP DIVE' APPROACH FOR CLUSTER-WIDE ENERGY EFFICIENCY—A CASE STUDY IN RAJKOT ENGINEERING CLUSTER

Backdrop

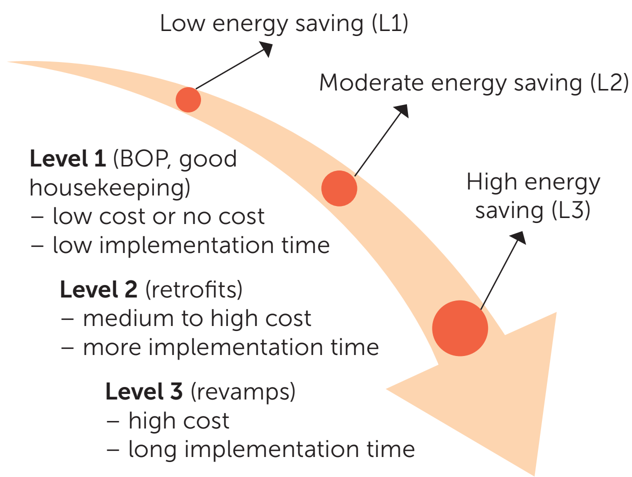
In general, there has been very little focus on R&D (innovation) of cleaner technologies for MSMEs in India. It is important to note that energy efficient (EE) designs of furnaces are not commercially available for many of the traditional energy-intensive MSME sub-sectors like glass, ceramics, grey iron melting, aluminum, brass, steel rolling, hand tools, and so on. In such situations, the design and replication of new plants requires R&D, demonstration and customization during each replication, adding to the implementation costs and time. Research, development, demonstration and dissemination (RDD&D) of cleaner technologies is effective in developing technological capacities and promoting EE technologies and practices, especially in processes where no commercially viable 'off-the-shelf' cleaner solutions are available to replace the existing traditional, low-efficiency technologies being used by MSMEs (see *SAMEEEKSHA*, March 2018). However, by its very nature, an RDD&D intervention necessitates a longer time period, higher capital and greater risks. As a consequence, this approach is preferred only when development of technological capacities through R&D on new EE solutions is intended.

Deep dive approach

On the other hand, there are several energy efficient technologies (EETs) like EE motors, EE pump sets, EE compressors and so on already available commercially in the market, but yet to be widely replicated among MSMEs. Industry has been slow to adopt these technologies either due to low awareness levels or the relatively higher cost of these EETs. In order to promote these technologies, an intervention built around detailed energy audits and subsequent technical assistance for implementation of the identified energy conservation measures (ECMs) within a selected MSME cluster could be followed. This approach, of promoting commercially available EETs among a much larger number of MSMEs in the cluster, could be called a 'deep dive' or 'saturation' approach to promote EETs. Deep dive projects help in identifying energy efficiency improvements at three levels:

- Level 1 (L1)—BOP and good housekeeping
- Level 2 (L2)—retrofits: major improvements in existing plant/process
- Level 3 (L3)—revamps: new plant/process

> A deep dive approach focuses on promoting EE technologies that are commercially available but not widely adopted in MSME clusters



Energy savings at different levels of deep dive

TERI–SDC's deep dive initiative in Rajkot foundry cluster

Rajkot, in Gujarat, is one of the largest engineering MSME clusters in the country comprising a range of energy-intensive sub-sectors such as aluminium, bearings, foundry, forging, investment casting, kitchenware, machine tool, pump sets, and plastics. There are close to 700 foundry units in the Rajkot cluster. Most of the units manufacture ferrous (iron) castings, mainly spheroidal graphite (SG) iron, cast iron (CI) and steel. The annual production of the cluster is estimated to be 460,000 tonnes. The foundry units cater to diverse engineering sectors such as agricultural machines, air compressors, automotive components, electric motors, electrical transmission, machine tools, pump sets, and others.

Induction melting furnace

Melting section in a traditional foundry

Floor moulding in a traditional foundry

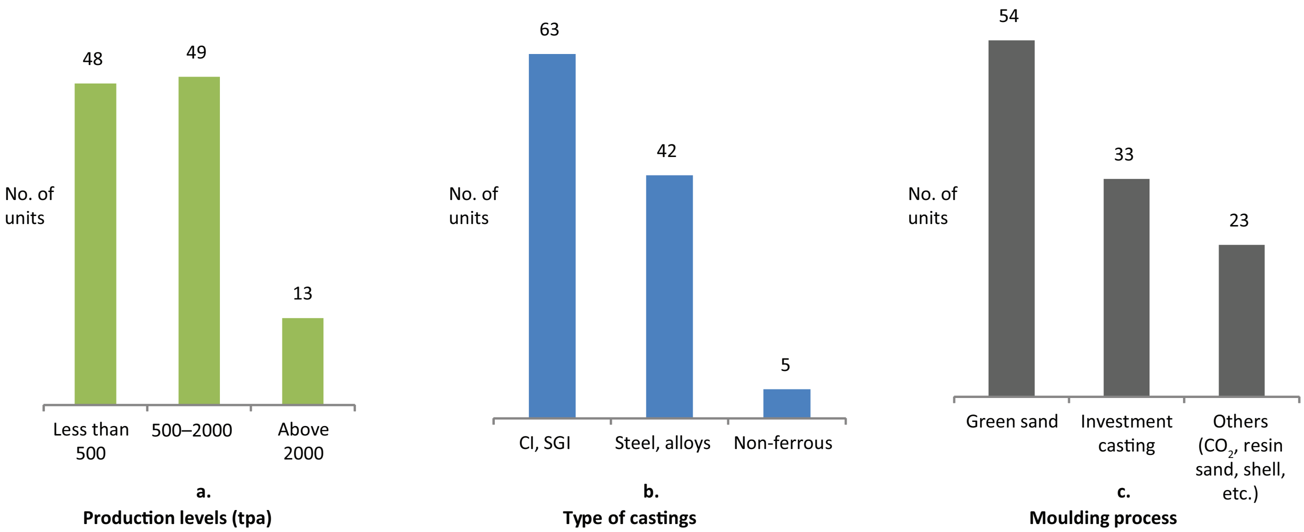
TERI had already worked in the Rajkot foundry cluster during the earlier phase of the TERI–SDC Partnership project, with the focus on promoting the divided blast cupola (DBC) among foundry units. TERI also strengthened the technical capabilities of local fabricators to promote and sustain the uptake of the DBC among foundries in the Rajkot cluster. Through these initiatives, and through its ongoing engagement with cluster-level associations such as the Rajkot Engineering Association (REA) and Institute of Indian Foundrymen–Rajkot Chapter (IIF-Rajkot), TERI had established its credibility among entrepreneurs and other stakeholders in the cluster—a key prerequisite for deep dive interventions.

Under the TERI–SDC Partnership project (2015–17), TERI shortlisted about 110 foundry units for detailed energy audits, in consultation with the cluster-level associations. These selected units varied widely in terms of production levels, castings produced, and moulding processes.

Energy audits

An energy audit (EA) is a study of the patterns of energy use in various sections of an industrial plant. The EA helps identify the areas in which energy saving opportunities exist, and provides the basis on which to develop and recommend energy conservation measures (ECMs). A preliminary energy audit, also called walk-through audit or diagnostic study, focuses on gathering energy-related data (through discussions with plant operators, questionnaires, review of utility bills, etc.) based on which general ECMs are recommended.

A detailed energy audit (DEA) is a much more comprehensive, accurate and actionable study of the plant's energy use. Portable instruments are used to monitor and analyse major energy-consuming equipment and systems such as motors, furnaces, boilers, pumps, blowers, HVAC (heating, ventilation and air-conditioning) systems, and the load and demand management of the plant. Each of the ECMs is supported by financial analysis of payback period on investment.



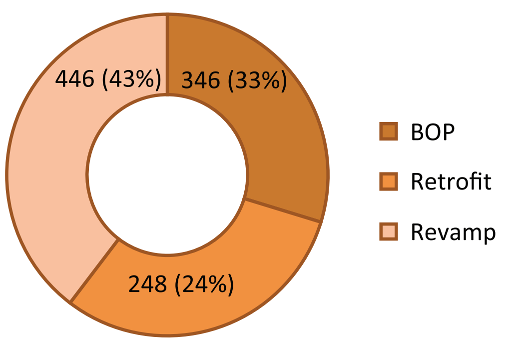
Targeted foundry units categorized by (a) production levels, (b) castings type, and (c) moulding processes

Detailed energy audits (DEAs) were conducted in each of the identified MSME foundries, with the focus on identifying techno-economically feasible ECMs. TERI prepared a comprehensive DEA report for each unit, listing techno-economically feasible ECMs. For most of the L2 and L3 ECMs, details such as specifications of the EE equipment/machinery, along with vendor quotations, estimates of the energy and cost savings, investment requirements and payback period were worked out. A total of about 1040 ECMs were identified through the DEAs, with 346 ECMs in L1 category, 248 in L2 category and 446 in L3 category. Among the ECMs, 242 (23%) required no investments at all and 463 ECMs (44%) offered payback on investments within one year—making them highly attractive for the MSMEs to implement.

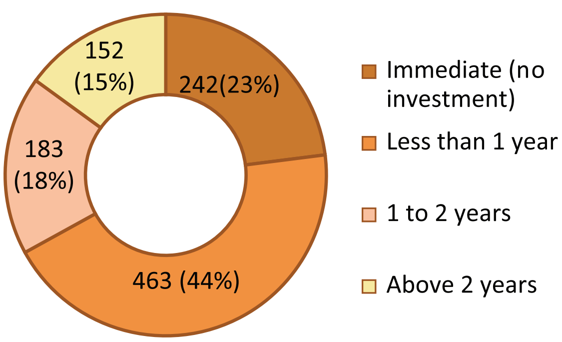
The energy saved by implementation of all the ECMs could supply the yearly electricity needs of 26,000 households!

The recommended ECMs have a total annual energy saving potential of 2464 tonnes of oil equivalent (toe). This amount of energy is equivalent to over 28,650 MWh of electricity—enough to supply the yearly electricity needs of over 26,000 households![1] The annual energy consumption of all the 700-odd foundries in the Rajkot cluster is estimated at 45,660 toe—which implies that the ECMs identified for just these 110 foundry units could potentially save over 5% of the entire cluster's annual energy consumption.

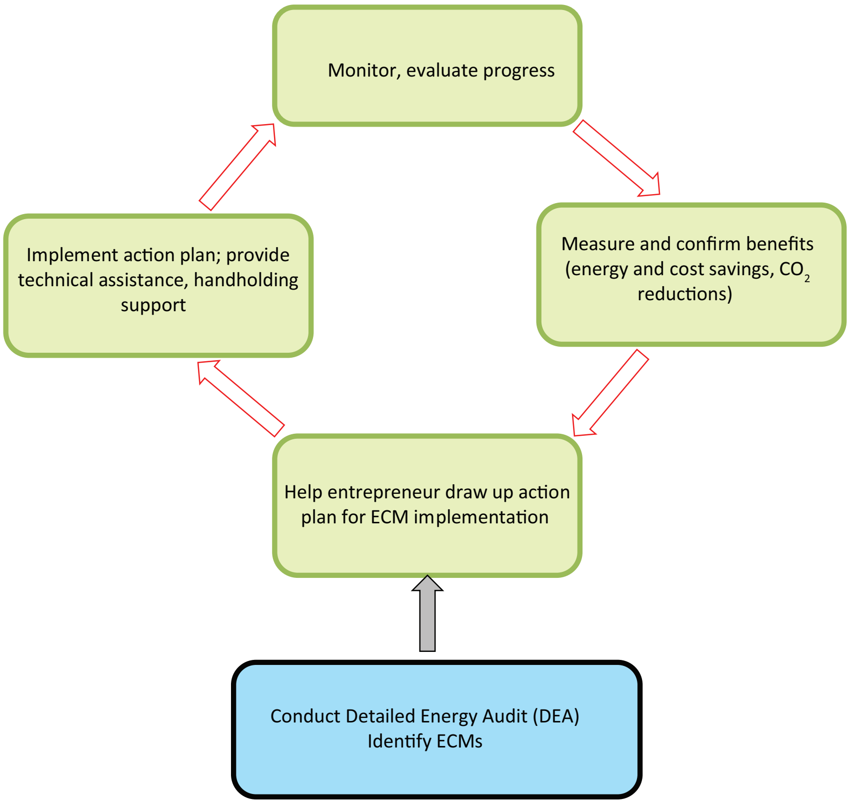
1 The Centre for Policy Research (CPR) estimates that an average electrified household in Maharashtra, Gujarat and Tamil Nadu consumes 80–90 units (i.e. kWh) per month. See http://www.cprindia.org/news/6519



ECMs categorized by type



ECMs categorized by simple payback period



Detailed Energy Audit—implementation cycle

Invertor based screw air compressor

Examples of ECMs

Some of the typical ECMs implemented are summarized in table 1.

Table 1. Typical ECMs identified and implemented

Level	ECMs identified
Level 1 - BOP and good housekeeping	▪ Arresting compressed air leakages ▪ Compressor pressure optimization ▪ Improved operating practices in induction melting furnace ▪ Switching off machines when not required ▪ Hand blowers instead of compressed air for cleaning purpose
Level 2 - Retrofits	▪ Lid mechanism for induction furnace ▪ Variable frequency drive (VFD) for air compressor ▪ Recuperator for waste heat recovery (WHR) ▪ Improved combustion system ▪ Power factor and demand controller ▪ Better lining of furnaces ▪ Soft starters for motor
Level 3 - Revamps	▪ Adoption of EE induction melting furnace ▪ Adoption of EE heat treatment furnace ▪ Use of EE air compressor ▪ Replacement of inefficient pump with EE pump ▪ Adoption of variable refrigerant flow (VRF) air conditioning system ▪ Adoption of EE motor ▪ Adoption of TERI DBC

EE implementations

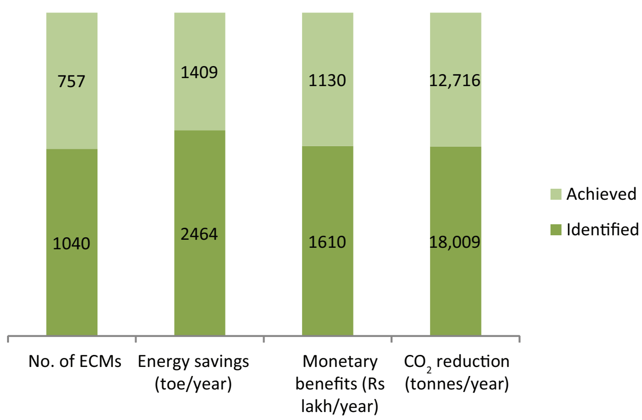
The DEA reports were discussed with the unit owners/operators, to encourage them to implement the recommended ECMs and to help them in drawing up concrete plans for implementation. Regular follow-up visits were undertaken to provide technical back-up support as and when necessary during and after the implementation of the ECMs. TERI established a project office in the Rajkot cluster to facilitate the audit follow-up processes, enable continuous interaction with the foundry owners/operators during and post- implementations, help in arranging tie-ups with equipment vendors/suppliers, and so on. Vendors were identified and recommended based on their abilities to meet the required technology specifications and on the quality of services they offered. As far as possible, multiple vendors were suggested for each technology so that unit owners could seek competitive quotations and have the room for negotiation.

Divided blast cupola (DBC) melting furnace

The photos that follow depict a few examples of the low-efficiency ('bad') practices and technologies that were earlier being deployed among the Rajkot foundries, along with the respective ECMs that have been implemented under the deep dive initiative.

Results

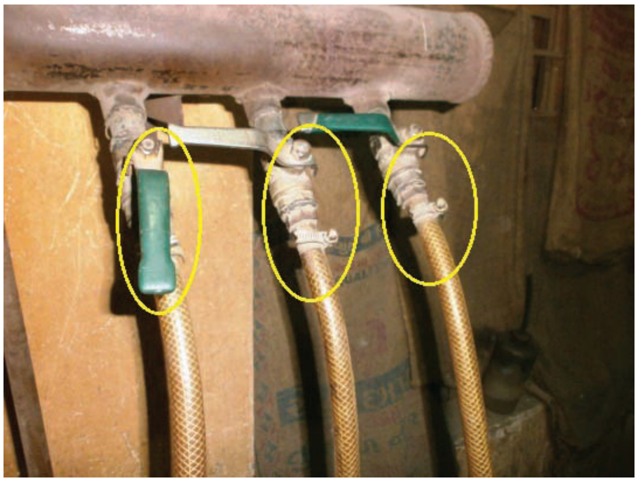
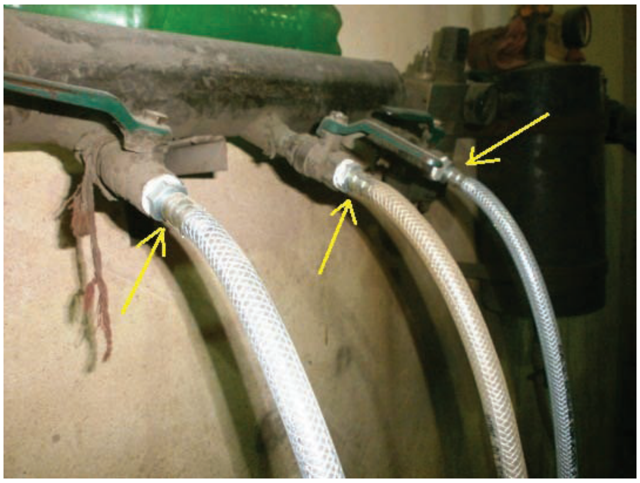
By December 2017, all the 110 targeted foundry units had fully or partly implemented the respective ECMs recommended. A total of 757 ECMs had been implemented, yielding annual energy savings of 1409 toe along with CO_2 reductions of over 12,700 tonnes.



Status of ECM implementations as of December 2017

Energy inefficient operating practice: large sized raw materials charged into induction furnaces


Induction furnace without lid (L) and with lid mechanism (R)

Arresting air leakages in compressed air system (L) by using crimped hose joints (R)


Relining shell baking furnace: (L) damaged lining; (R) repaired lining

Replacing reciprocating air compressor (L) with VFD-based screw air compressor (R)

Looking ahead

TERI's experience with the deep dive intervention in Rajkot foundry cluster has shown the effectiveness of this strategy in implementing commercially available EETs on a large scale to achieve significant energy savings and CO_2 reductions in a relatively short period. The key elements that determine the success of this approach are:

- Conducting DEAs on a large number of MSMEs in the cluster, in close consultation with local industry association(s)
- Identifying a set of implementable ECMs for each MSME unit, which promise quick paybacks on relatively low investments and are therefore attractive for MSMEs to adopt
- Remaining engaged with the MSMEs post-DEA: for supporting interactions with technology vendors/suppliers; and providing technical assistance during implementation
- Implementation and quantification of the benefits in a few units at the early stages, so as to encourage others to implement the technology

There are hundreds of energy-intensive clusters in India, some of which are mapped on the SAMEEEKSHA website. Undertaking deep dive interventions among them would not only bring about huge energy savings, but will also bring co-benefits such as improved productivity and reduced pollution in the much-neglected MSME sector.

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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