

SAMEEEKSHA

SMALL AND MEDIUM ENTERPRISES: ENERGY EFFICIENCY KNOWLEDGE SHARING

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NEWSLETTER

Inside...

- Promoting energy efficiency and renewable energy in selected MSME clusters: a GEF–UNIDO–BEE project
- Clean, energy efficient technologies introduced in Thangadh ceramic cluster



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...

This issue has, as its focus, the GEF-funded national project being executed by UNIDO in collaboration with BEE titled 'Promoting energy efficiency and renewable energy in selected micro, small and medium enterprises (MSME) clusters in India'. The aim of the project is to develop and promote energy efficient technologies (EETs) and to enhance the use of renewable energy technologies (RETs) in process applications in energy intensive MSME clusters representing five industrial sub-sectors: brass, ceramics, dairy, foundry, and hand tools. Thereby, the project improves the productivity and competitiveness of units; reduces CO₂ emissions and improves the local environment; and lays the foundations for introduction and scaling up of EETs and RETs in other MSME clusters. At present, the project is being executed in 12 MSME clusters across India.

The first article outlines the project strategy, activities and outcomes. The activities follow a holistic, iterative path in which the key elements include: energy audits and technology identification; capacity building and implementation assistance; training of vendors and technology demonstrations; documentation, dissemination and follow-up; and demand aggregation, price reduction and large-scale deployment of the improved technologies. In each cluster, experienced and dedicated 'Cluster Leaders' have been identified and provided with responsibility for implementation of project activities in consultation with the local industry association, consultants, and project team. Also, the project has established 'Energy Management Cells' (EMCs) within the respective industry associations in order to strengthen the ability of the cluster-level MSME owners/operators to undertake energy audits and identify energy saving measures on their own. The second article presents a few case studies on implementation of EETs/RETs from the Thangadh ceramic cluster, one of the clusters covered by the project, to showcase the benefits being brought about in terms of increased energy efficiency, improved productivity, and reductions in carbon emissions.

SAMEEEKSHA Secretariat



PROMOTING ENERGY EFFICIENCY AND RENEWABLE ENERGY IN SELECTED MSME CLUSTERS: A GEF–UNIDO–BEE PROJECT

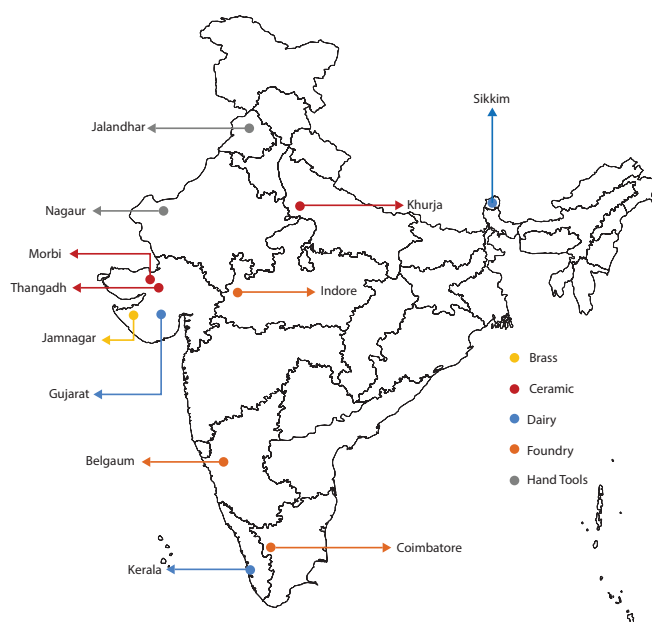
Backdrop

The United Nations Industrial Development Organization (UNIDO) has been engaged in projects aimed at the overall development of the Indian industrial sector for over 50 years; its first technical cooperation project in the country was launched in 1968. With the progressive liberalization and privatization of the Indian economy from 1991 onwards, UNIDO's interventions increasingly focused on enhancing productivity and efficiency and increasing avenues of investment for MSMEs. In recent years, UNIDO's initiatives in the MSME sector have focused on cleaner production through improved energy efficiency and environmentally sustainable technologies and practices.

One such initiative is the GEF-funded national project titled 'Promoting energy efficiency and renewable energy in selected micro, small and medium enterprises (MSME) clusters in India', executed by UNIDO in collaboration with Bureau of Energy Efficiency (BEE), Government of India. The following sections provide an outline of the project strategy, activities and outcomes. The next article in this issue presents a few case studies from one of the clusters covered by the project (Thangadh ceramic cluster) to illustrate the transformations that the project is bringing about in terms of increased energy efficiency and productivity, and reduced carbon emissions.

About the project

The GEF–UNIDO–BEE project works to develop and promote energy efficient technologies (EETs) and enhancing the use of renewable energy technologies (RETs) in process applications in 12 energy intensive MSME clusters representing five industrial sub-sectors, with possible expansion thereafter to cover more clusters. Thereby, the project improves the productivity and competitiveness of units, as well as reduces CO₂ emissions and improves the local environment. At present, the project is being executed in 12 MSME clusters (Table 1, map).



Project map showing 12 MSME clusters

Table 1. MSME clusters/sub-sectors in which the project is being executed

MSME sub-sector	Clusters	
	Number	Location
Brass	1	Jamnagar (Gujarat)
Dairy	3	Gujarat; Sikkim; Kerala
Ceramics	3	Khurja (U.P); Morbi and Thangadh (Gujarat)
Foundry	3	Belgaum (Karnataka); Coimbatore (Tamil Nadu); Indore (M.P)
Hand tools	2	Jalandhar (Punjab); Nagaur (Rajasthan)

Approach and action

The project has followed a holistic approach in promoting the large-scale deployment of EETs and RETs identified through energy audits, with its activities following an iterative path comprising the broad elements: (1) capacity building; (2) technology implementations; (3) scaling up of replications; and (4) strengthening of policy, institutional and decision-making frameworks.



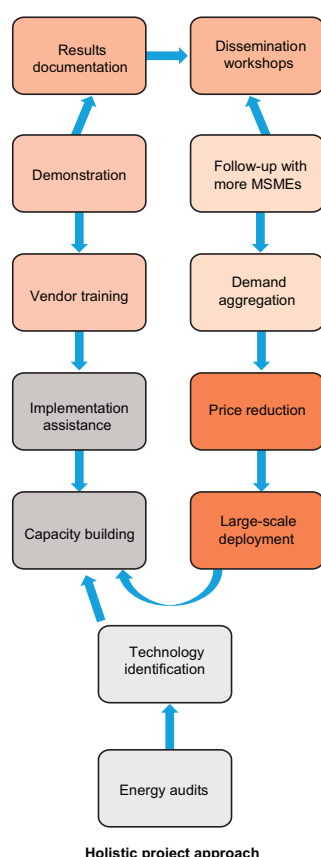
At cluster level, the project has established collaboration with local industry associations which anchor the activities on the field level, and also works closely with local service providers (LSPs), technology suppliers, and the individual MSME units. In each cluster, the project has identified an experienced and dedicated resource person as 'Cluster Leader', with primary responsibility for implementation of project activities in consultation with the local industry association, consultants, and BEE and UNIDO teams. Also, in order to strengthen the ability of the cluster-level MSME owners/operators to undertake energy audits and identify energy saving measures on their own, the project has established 'Energy Management Cells' (EMCs) within the respective cluster associations. Each EMC has been equipped with energy auditing equipment worth about ₹30 lakh such as power analysers, flue gas analysers, ultrasonic flow meters, anemometers, hygrometers, thermometers, lux meters and so on. The project has conducted regular training programs for Cluster Leaders and other stakeholders so as to enhance their skills in using the energy audit instruments to perform regular energy audits. The Cluster Leaders in turn provide training to supervisors, managers, and production/plant heads on how to make optimum use of the EMC facilities. The MSME units are thereby able to study and understand their own energy use; locate sources of inefficiency and quantify the energy losses; and thereafter, undertake technology improvements and monitor the results.

The key elements of the project activities are summarized below.

- **Energy audits; technology identification.** Initially, about 350 units were surveyed among the clusters to prepare baseline energy consumption data. Detailed energy audits (DEAs) were carried out on 10–20 representative MSME units in each cluster. The DEAs enabled the project to identify potential EET and RET options including

best operating practices (BOP), in consultation with the concerned MSMEs, technology consultants, vendors, and Original Equipment Manufacturers (OEMs).

- **Capacity building; implementation assistance.** Capacity building workshops/training programs were organized for entrepreneurs, managers and shop-floor workers to disseminate the possible EETs, RETs and BOP. Assistance was provided to the MSME units in selection of technologies and vendors, and in overseeing the implementation process. Partial financial assistance was provided for a few innovative EE and RE projects.
- **Vendor training; demonstration.** Cluster-level vendor data bases were developed; capacity building workshops were organized for LSPs on identification of EET and RET options; and business-to-business (B2B) interactions were facilitated between vendors and MSME entrepreneurs. The Cluster Leader, with the support of LSPs and vendors, provided assistance to MSME units for implementation of the EETs and RETs.
- **Documentation; dissemination.** With the help of the EMCs set up under the project, the Cluster Leaders continuously monitored the results of the EET/RET implementations. At regular intervals, dissemination workshops were organized to share the results of the implementations and to encourage other MSME units to adopt the concerned technologies.
- **Follow-up; demand aggregation.** Cluster Leaders followed up on the dissemination activities by interacting with entrepreneurs from other potential MSME units to adopt the identified EETs/RETs. Based on the characteristics of each cluster and the existing demand for the relevant EET/RET options, the Cluster Leader pooled the requirements of the different MSME units. Thereafter, with the help of the local industry association, quotes were invited from different vendors for procurement of the aggregated demand for EETs/RETs.
- **Price reduction; large-scale deployment.** In a number of cases, demand aggregation brought about price reductions in the EETs/RETs.



Holistic project approach





(L) Energy Management Cell (EMC); (R) Formal launch of EMCs during National Summit on Energy Efficiency in MSMEs, 2017



हैंड टूल्स इंडस्ट्री को बिजली के सदुपयोग के गुर बताए

» सही उपयोग से बिजली की बचत के साथ-साथ मशीनरी की आयु बढ़ाए



Project dissemination workshop in Jalandhar hand tools cluster

This, together with the dissemination workshops and shared success stories, spurred interest among other MSME units and paved the way for large-scale deployment of the identified EETs and RETs.

Results

Around 400 small-scale EET/RET projects have been implemented under the project, and documented as case studies. As of July 2018, these technology implementations have resulted in annual energy savings of 8162 tonnes of oil equivalent (toe), equivalent to 43,845 tonnes of avoided CO₂ emissions per year. An estimated one million tonnes of cumulative carbon emissions will be avoided through these EET/RET implementations in 15 years' time.

Other significant achievements of the project include the following:

- Around 220 DPRs prepared on various EETs
- Over 90 training workshops conducted for 2380 personnel
- Over 30 capacity building workshops conducted in 11 clusters, attended by 1100 LSPs as well as MSME entrepreneurs, managers and shop-floor technicians
- Around 27 "awareness-cum-training-workshops" held to disseminate BOP and Common Monitorable Parameters (CMP) in 9 clusters
- 10 in-house (three-day) residential training programs organized on 'Basic energy audit skills and handling of energy audit instruments' and 'Best Operating Procedures for Energy Management in MSMEs' at AIP-NPC Chennai
- Demonstration projects implemented on:
 - » compressed air system, in Coimbatore foundry cluster
 - » sand reclamation, in Belgaum foundry cluster
 - » energy performance data collection and analysis, in Belgaum and Coimbatore foundry clusters

- » parabolic trough for steam generation, installed at Amul, Gandhinagar (Gujarat dairy cluster)
- » automatic power factor controller, in Indore foundry cluster
- » 21 demonstration projects under implementation in 7 clusters through financial and technical assistance. More proposals are under review.
- » More than 14500 EE ceiling fans (28W) installed in Thangadh ceramic cluster, 1000 fans in Morbi ceramic cluster, and 500 fans in Jalandhar hand tools cluster
- » 100 energy audits and 120 technology-specific audits completed through energy auditing agencies



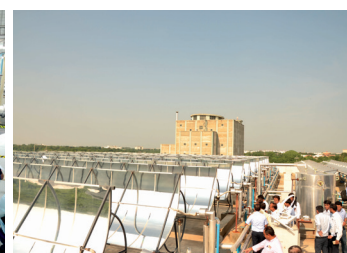
Inspection of pilot project on biomass gasifier at Belgaum foundry cluster



Undertaking detailed energy audit



MSME representatives being trained in best practices on burner



Concentrated solar thermal steam generation pilot project installed at Amul Dairy, Gandhinagar, Gujarat



CLEAN, ENERGY EFFICIENT TECHNOLOGIES INTRODUCED IN THANGADH CERAMIC CLUSTER

About the cluster

The Thangadh ceramic cluster, located near Rajkot (Gujarat), is one of the 12 energy-intensive MSME clusters covered under the GEF-UNIDO-BEE project titled 'Promoting energy efficiency and renewable energy in selected MSME clusters in India' (see *SAMEEEKSHA* vol. 8, issue 3, September 2017 for a brief cluster profile). The 225 ceramic units in the Thangadh cluster fall under three distinct types based on their primary products: pottery, insulators, and sanitary ware.

The following main steps are involved in the production process:

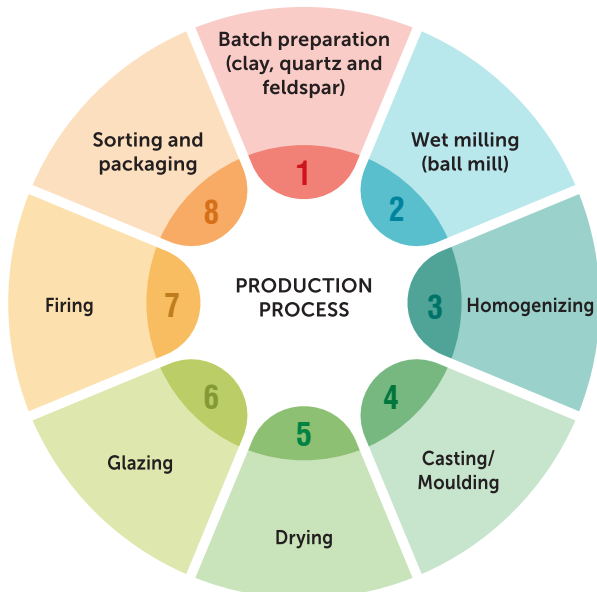
- The raw materials—clay, feldspar and quartz—are mixed together with water in the ball mill for a period of 5–7 hours.
- The materials are then transferred to the agitator tank for thorough mixing. With the help of a centrifugal mud pump, the mixture (slurry) is transferred to a sieve filter to remove water.
- The slurry is poured into mould dies made of plaster-of-Paris. Pressurized air is used to press

the slurry and ensure tight bonding in the moulds, leaving no scope for formation of cavities.

- The moulds are allowed to dry under ceiling fans for about 1-2 days, depending on atmospheric humidity.
- The moulded materials are glazed, painted and stacked on kiln cars for firing to obtain strength. The firing zone temperature in the kiln is maintained at 1180–1210^o C.
- After firing, the products are quality-checked, packed and dispatched.

The production processes are broadly similar in all three categories of units, the main differences being in the amounts and ratios of ceramic materials that are mixed in the ball mill, and the heating times in kilns required for each product.









Among the major energy consuming equipment are the tunnel kilns (which account for over 70% of total energy consumption), ball mills, glaze mills, agitators, and compressed air systems. Most of the kilns operate on pressured natural gas (PNG). Electricity is used to operate the air compressors, ball mills, and other equipment like jigger-and-jolly machines (used for making hollow-shaped ceramic objects).



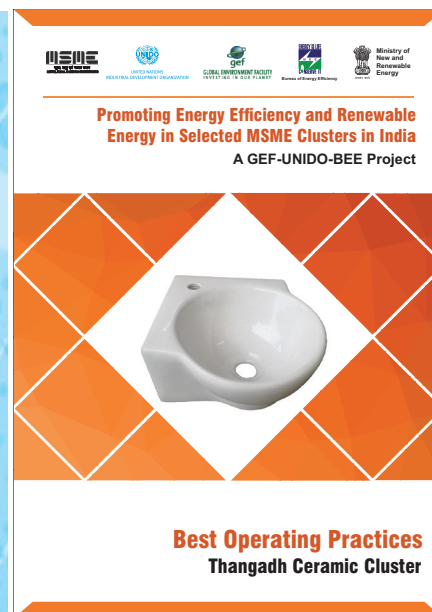
Intervention

The project initiated its activities in the Thangadh cluster in 2014. Following an inception workshop, a Cluster Leader was identified and appointed. Thereafter, walk-through energy audits and detailed energy audits (DEAs) were carried out on selected units in the cluster, based on which a number of energy efficiency (EE) measures including Best Operating Practices (BOP) were identified for adoption by the MSMEs in the cluster. Hands-on training on BOP was provided to plant-floor personnel; BOP documents and Common Monitorable Parameters (CMP) posters were developed; and three workshops were conducted for knowledge sharing among other units in the cluster. The project also established



<div><div><div>UNITED NATIONS DEVELOPMENT PROGRAM</div></div><div><div>GLOBAL ENVIRONMENTAL FUND</div></div><div><div>NATIONAL RENEWABLE ENERGY CENTRE Ministry of Energy & Power</div></div><div><div>Ministry of New and Renewable Energy</div></div></div> <div><h3>COMMON MONITORABLE PARAMETERS – THANGADH CERAMIC CLUSTER</h3><h4>GEF-UNIDO-BEE PROJECT "PROMOTING ENERGY EFFICIENCY & RENEWABLE ENERGY IN SELECTED MSME CLUSTERS IN INDIA"</h4></div>									
S. No.	EQUIPMENT	PARAMETER	INSTRUMENT	FREQUENCY OF MEASUREMENT	UNIT	Des. Range	WARR.	REMARKS BY SUPERVISOR	
1	<div>Tunnel Kiln </div>	Specific Energy Consumption (Energy consumption per ton of material loaded to calculate the specific energy consumption)	Fuel Flow Meter	Each operation cycle	kg of fuel / ton			For Tunnel Kiln: Pre-heating Zone: 200-400°C Heating Zone: 800-1200°C Cooling Zone: 700-200°C For Shuttle Kiln: Up to 1100°C Furnace Oil: 4-5% Natural Gas: < 2%	
		Kiln Temperature (It is very important to know the temperature at various sections of the kiln to ensure that temperature inside the kiln is within the permissible limits)	Thermocouple	Hourly	°C	Furnace Oil: < 180-220°C Natural Gas: < 10°C higher than ambient temp.			
		Oxygen Level in Flue Gas (An increase in oxygen percentage in flue gas indicates reduced combustion efficiency and increased fuel consumption)	Oxygen Analyser	Hourly	%				
		Flue Gas Temperature (It signifies the amount of sensible heat carried away outside the furnace. Monitor the flue gas temperature on chimney, before any waste heat recovery device)	Thermocouple	Daily	°C	Furnace Oil: < 180-220°C Natural Gas: < 10°C higher than ambient temp.			
		Side Wall Temperature (It gives insight about refractory lining of the furnace and also heat loss from furnace wall)	Thermocouple	Daily	°C	For Tunnel Kiln: 10-20 hours For Shuttle Kiln: Up to 12 hours for heating and from cooling			
2	<div>Shuttle Kiln </div>	Firing Cycle (Firing cycle time decides the actual energy consumption. Optimised firing cycle will improve the specific energy consumption)	Electronic Timer	Each operation cycle	min.				
		Loading Density of Ware (A proper density of the kiln car will reduce the additional energy consumption at thermal storage)	Electronic Weighing Scale	Loading per car	kg/m ³	Standard ± 10%			
		Winding (When the current is high or the resistance low winding will damage the motor and hence shorten the life of the motor)	Power Analyser	Weekly	V	< 5% of rated voltage			
		Current (Over-current can eventually lead to permanent damage to the motor or electrical device)	Power Analyser	Weekly	A	< 5% of rated current			
		Power Factor (Low PF can contribute to low efficiency, higher losses, and unnecessary electric utility charges)	Power Analyser	Weekly	PF	Close to unity			
3	<div>Pump Set </div>	Pressure (Regularly check suction and discharge heads to ensure proper maintenance of pump)	Pressure Gauge	Weekly	kg/cm ²	As per manufacturer's recommendation (Refer to name plate details)			
		Water Flow Rate (A good performing pump should deliver minimal amount of flow)	Flow Meter	Weekly	m ³ /hr				
		Power Consumption (It gives insight about the motor loading and power efficiency)	Power Analyser	Weekly	kW				
4	<div>Compressed Air System </div>	Pressure (Pressure variations leads to decrease in system efficiency and higher energy consumption)	Pressure Gauge	Daily	kg/cm ²	Motor load: < 0.3 bar Distribution Line: < 0.5 bar			
		Temperature (Increased temperature of compressed air means the loss in efficiency)	Thermocouple	Daily	°C	As per manufacturer's recommendation			
		Specific Power Consumption (It gives the energy consumption to produce 1 cfm of compressed air. Comparison of this value with OEM's catalogue gives deviation in SEI)	Power Analyser	Daily	kWh/cfm				
		Loading and Unloading Time (Loading hours and loading hours signify the actual utilization of the set over the day)	Electronic Timer	Daily	min.				

CMP Poster



BOP Booklet

an energy management cell (EMC) equipped with a set of energy auditing instruments, and provided comprehensive training to unit personnel on usage of the instruments for conducting energy audits and analysing the results.

Impacts

A large number of MSME units have adopted the recommended EE measures, with support from the Cluster Leader and project team. These EE measures are yielding significant benefits in terms of monetary saving and reduced CO₂ emissions, as illustrated by a few case studies that follow.

Replacing conventional ceiling fans by energy efficient BLDC fans

Among sanitary ware units, a key stage in the manufacturing process is the shaping of sanitary

ware by pouring the clay slurry into plaster-of-Paris moulds. This work is done in casting rooms. During the shaping process, the moulds absorb water from the clay slurry and become wet. The moulds have to be completely dried in 24 hours so that the shaped ware can be cast the following day. With humid air slowing down the natural drying of moulds, units have installed conventional ceiling fans in their casting rooms to expedite the drying process. Typically, one ceiling fan is required for every four moulds, and each unit has about 600–800 fans which run for almost 20 hours a day (depending on ambient weather conditions). Energy audits showed that the conventional fans were low in energy efficiency, with most of them consuming 70–75W at full speed. Also, the performance of fans was poor due to age: typically, a unit incurred monthly expenditure of ₹5000–8000 on maintenance and repair of fans.

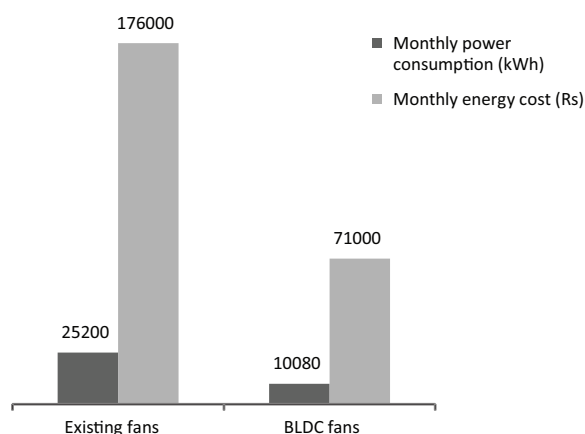
Based on the project recommendations, sanitary ware units are replacing their conventional fans with energy efficient BLDC (brushless direct current) fans which consume only 28W at full speed. Other advantages offered by the BLDC fans are:

- Elimination of friction and associated power loss
- Better flexibility over controlling motor speed
- No spark and minimal electrical noise, as no slip rings or mechanical brushes are used
- The BLDC fans come with three years on-site replacement warranty



Energy Management Cell in Thangadh cluster





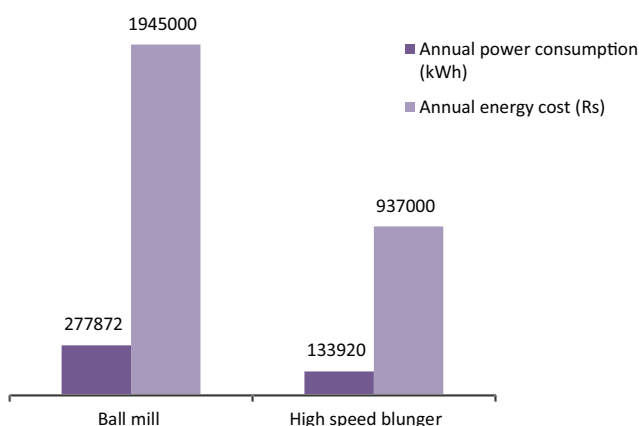
Benefits of replacing conventional 70 W fans by 28 W BLDC fans

The project has achieved cost reduction of the BLDC fans through demand aggregation, and thereby spurred their large-scale adoption. The figure shows the monthly energy and cost savings for a typical unit with 600 fans, that replaces all its 70W conventional fans with 28W BLDC fans (it is assumed that all the fans operate for 20 hours daily, 30 days a month).

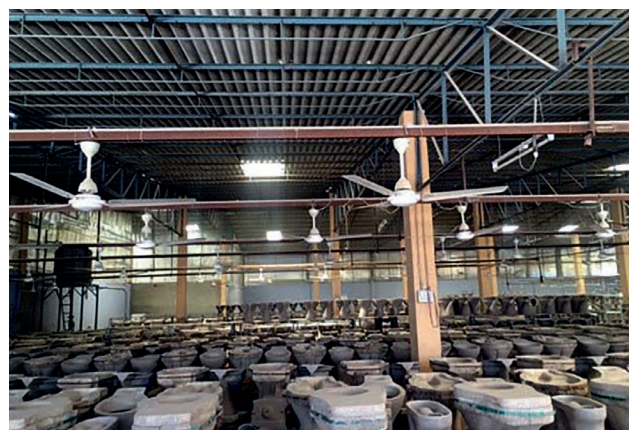
So far, about 80 ceramic units in Thangadh have replaced over 14,500 conventional fans by BLDC fans at a total investment of about ₹2.25 crore, against which they are saving an estimated ₹3.34 crore annually in energy costs! This measure is saving over 3.6 million kWh of electricity and avoiding 2671 tonnes of CO₂ emissions each year.

Using high speed blunger technology in place of normal ball mill

Most of the ceramic units use ball mills to mix the raw materials with water to produce ceramic slurry (also called slip). Generally, the conventional ball



Benefits of replacing ball mill with high speed blunger system



Energy efficient BLDC fans in casting room

mills require a lot of time and labour for loading and unloading. Also, they use grinding media that themselves take up a lot of space and reduce the effective capacity of the ball mills.

Based on the project recommendations, two units have installed high speed blunger systems in place of their existing ball mills. The figure summarizes the energy and cost savings brought by adoption of the new technology (the assumption is that raw materials are charged twice daily).

The high speed blunger system offers the following additional advantages compared to the ball mill:

- Easy and efficient conveyor loading system, even during blunger operation
- Higher charge capacity (22 tonnes) compared to ball mill (20 tonnes)
- No grinding media needed in the blunger

Installation of rooftop solar power systems

Electricity cost constitutes 20–30% of total energy cost among ceramic units. As the Thangadh cluster



Participants undergoing hands on Energy Audit Training at AIP-NPC Chennai

receives plenty of solar radiation—usually, for over 200 days in a year—and as the ceramic units are spread across a large land area with broad sheds having significant roof areas, there is significant potential for the units to generate solar power for in-house applications through rooftop solar photovoltaic (PV) systems.

Table 1 shows the economic benefits of installing a 50 kilowatt-peak (kWp) rooftop solar PV system. Four units have already installed solar PV systems, together generating about 300 MWh of electricity and avoiding 243 tonnes of CO₂ emissions annually.

Table 1. Benefits of installing rooftop solar PV system

Parameter	Value
Total rooftop area	888 m ²
Maximum solar potential	88 kWp
Permissible solar potential	50 kWp
Annual energy generated	75000 kWh
Annual monetary savings*	Rs 525,000
Cost of solar PV system	Rs 22,00,000
Simple payback period	4.2 years

* Assuming cost of electricity at Rs 7/kWh



Rooftop solar PV system

Other EE initiatives

Table 2 summarizes some of the other significant EE measures that being implemented by units in the cluster.

Table 2. Other EE measures being implemented in Thangadh ceramic cluster

EE measure	Energy saving	Implementations	
		No.	Units
Low thermal mass car in tunnel kiln	Up to 5% reduction in PNG consumption	10	10
High alumina media /lining in glaze ball mill in place of natural lining	Up to 40% reduction in electricity consumption	7	6
VFD screw air compressor system in place of fixed motor compressor	More than 10% reduction in electricity consumption	14	11
Modification in existing tunnel kiln design—double deck system and shortening of firing zone	About 10% reduction in PNG consumption	2	2
Replacing old compressed air pipeline with joint-less seam pipe line to avoid air leakages	5–8%	3	3

With the various interventions of the GEF-UNIDO-BEE project, the MSME units in the cluster achieved an annual energy savings of about 1100 tonne of oil equivalent (toe) and annual monetary benefits of ₹5.8 crore against an investment of ₹9 crore. These energy conservation initiatives helped in mitigation of 6200 tonnes of carbon emissions.

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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