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.

ENERGY IS LIFE BEE CONSERVE IT
Bureau of Energy Efficiency

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Confédération suisse
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Swiss Agency for Development and Cooperation SDC

teri
The Energy and Resources Institute

MSME
MICRO, SMALL & MEDIUM ENTERPRISES

A PLATFORM FOR PROMOTING ENERGY EFFICIENCY IN SMEs

IN THIS ISSUE...

The small-scale brick making industry is one of the largest MSME sub-sectors in India in terms of energy consumption and CO_2 emissions. With the demand for bricks increasing to meet the growing needs of the infrastructure, commercial and housing sectors, there is urgent need to reduce the pressure on the natural resources that go into brick making such as clay and coal, as well as to cut down on pollution by brick kilns. However, any efforts in this direction must take into account the fact that the traditional technologies used in brick making—from clay extraction and moulding to the loading and firing of bricks—are very labour-intensive and provide livelihoods to millions of people, particularly in rural areas.

During the last few years, several initiatives have been undertaken to improve the energy and environmental performance of the Indian brick sector. The stories carried in this issue underline the point that significant savings in resources and energy can be achieved in the existing brick kilns by adopting better brick firing technologies, and by switching to the manufacture of less resource-intensive products such hollow blocks and perforated bricks.

A profile is presented of the Varanasi brick cluster, one of the largest in the country. This issue also highlights an initiative to demonstrate energy efficient kiln firing technology in the Varanasi brick cluster, and an initiative to create an enabling environment for the production and use of clay-fired resource-efficient bricks like perforated bricks and hollow blocks.

SAMEEEKSHA Secretariat

PROMOTING THE MANUFACTURE OF RESOURCE-EFFICIENT BRICKS: GEF–UNDP–MOEFCC PROJECT

In India, small-scale brick kilns constitute one of the largest MSME sub-sectors. The Indian brick industry is highly resource-intensive, seasonal, and characterized by the use of inefficient manufacturing methods/ technologies that are labour-intensive. As per TERI's estimate, there are between 190,000–280,000 small-scale brick kilns of different kinds operating in the country, with an estimated annual production of 220–280 billion bricks using different brick firing technologies. About 29–35 million tonnes of coal and 12–16 million tonnes of biomass are consumed by the brick industry each year. The products mainly comprise solid bricks.

The Indian brick industry is currently in a transition phase. On the production side, the industry is being driven by increasing fuel prices, difficulty in sourcing labour, and stringent environmental norms to look for better and alternative technologies for green brick production and brick firing. On the market side, rapid urbanization and increased awareness on conservation of resources is driving consumers to look for alternatives to the conventional solid bricks that would also be cost-effective.

In this backdrop, a project is being supported by Global Environment Facility (GEF) with the aim of addressing key barriers related to modernization of the Indian brick sector and adoption of clay-fired resource efficient bricks (REBs) like perforated bricks and hollow blocks. The United Nations Development Programme (UNDP) is implementing the project, and the Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India, is the executing agency of the project. TERI is the responsible partner for project implementation. The key barriers at various levels that are inhibiting technological improvement of the Indian brick industry, and the project's achievements in addressing these barriers, are summarized below.

Policy

The Bureau of Indian Standards (BIS) has already notified specific codes related to clay-fired perforated bricks and hollow blocks. However, the construction agencies of state governments had not included these specifications in their 'schedule of rates'. In order to bridge this awareness gap, the project has conducted a large number of awareness programs and focused group discussions with government departments, both at central and state levels. The project has also organized exposure visits of government officials to brick kilns producing REBs, and to building sites where REBs are being used.

Due to the project's efforts, perforated bricks have been included in the specifications of the Public Works Department (PWD) of the state of Punjab.

The project is interacting closely with BIS to revise the existing code related to clay-fired perforated bricks, so that it becomes more conducive for the large-scale manufacturing of these products.

Finance

The project has prepared Detailed Project Reports (DPRs) to guide brick kiln entrepreneurs in adopting mechanization of the clay preparation and green brick moulding processes. These DPRs have been discussed with a number of banks and financial institutions. Based on the discussion and evaluation of DPRs, Karnataka State Financial Corporation (KSFC) and Corporation Bank have given their in-principle consent to provide loans to brick kiln entrepreneurs who are interested in adopting mechanization.

An investment guide on REBs is being prepared to further increase the awareness of financial institutions on REBs, and to help brick kiln entrepreneurs in availing financial assistance from banks/FIs. The guide will provide information related to capacities of machineries available, investment needs, financial analyses, list of technology suppliers, and advantages such as energy saving, resource savings and environmental improvements.

Technology

A large number of interactions were organized between brick kiln entrepreneurs and national and international machinery suppliers, in order to enhance technological knowhow on mechanization among the entrepreneurs. The project has so far facilitated REB production in 12 brick kilns units in different parts of the country.

Also, hands-on training programs were organized for masons in order to build their capacities in using REBs.

Resource audits were carried out of brick kiln units involved in manufacturing of solid bricks, perforated bricks and hollow blocks, so as to ascertain the benefits of producing REBs in place of conventional solid bricks. It was found that production of REBs results in savings of 5%–59% in clay and 8%–59% in coal consumption as compared to solid bricks.

Awareness

A number of awareness workshops and capacity building programs were organized in order to enhance awareness among stakeholders on the production and use of REBs. Specific knowledge products such as documents, video films and reports addressing various aspects of REB production and use were prepared and shared with stakeholders (Table 1).

Table 1. Knowledge products on REB production and use

Title	Prepared by
Model project report for REB production for Southern Region	TERI, New Delhi
Model project report for REB production for Northern Region	Punjab State Council for Science and Technology (PSCST), Chandigarh
Suitability of clay samples for extrusion and production of hollow blocks	National Institute for Interdisciplinary Science and Technology (NIIST), Thiruvananthapuram
Structural properties of perforated/hollow clay fired brick masonry	IIT–Roorkee
Capacity assessment report on construction practices of masons	TERI, New Delhi
Energy analysis of building using REBs as walling material	CEPT University, Ahmedabad
Technical assessment of operating extruders to identify constraints and develop corrective actions	TERI, New Delhi
Resource Efficient Bricks- A handbook on burnt clay constructions	Sathya Consultants, Bangalore
Investment guide for REB production	TERI, New Delhi
Modernization of Indian brick industry	IZF Germany
Market assessment report on REB production and its demand in India	Greentech Knowledge Solutions, New Delhi
Case study and booklet on benefits of producing REBs	TERI, New Delhi

A dedicated website for the project is also available, wherein different knowledge products related to the project have been uploaded (http://www.resourceefficientbricks.org).

PROMOTING ENERGY-EFFICIENT FIRING TECHNOLOGY IN VARANASI BRICK CLUSTER: BEE SME PROGRAM

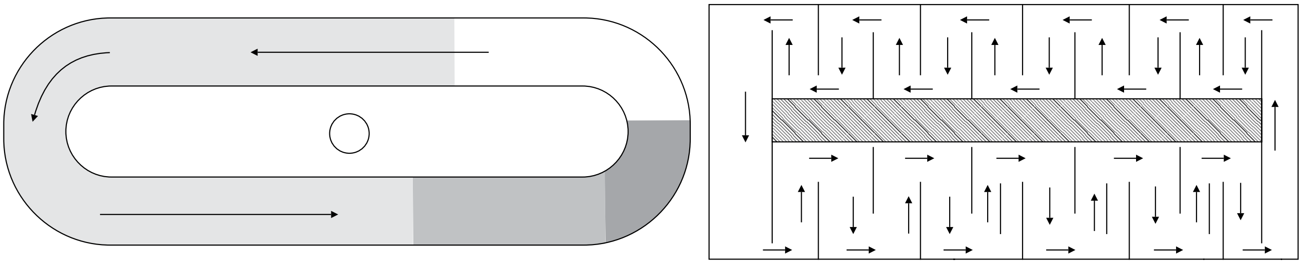
Under the 11th Five Year Plan (2007–12), BEE carried out diagnostic studies in 25 energy-intensive SME clusters across India under its SME Program. The studies provided information on technology status, best operating practices, gaps in skills and knowledge, energy conservation opportunities, and energy saving potential in these clusters. Detailed project reports (DPRs) were also prepared for the identified technological options in each cluster. In order to accelerate the adoption of energy efficient technologies and practices, BEE is supporting technology demonstration projects during the 12th Plan (2012–17) in five of the SME clusters studied, one of which is the Varanasi brick manufacturing cluster.

Under its current program, BEE intends to implement 10 demonstration projects of the natural draft zigzag firing technology, one of the identified energy conservation options, in the Varanasi brick cluster. TERI has been entrusted by BEE to access the energy savings achieved by implementing this energy-efficient firing technology.

The local industry association, Int Nirmata Parishad (INP), has identified 10 brick making units in Varanasi cluster to participate in the demonstration projects. All these units use coal as fuel to fire Bull's trench kilns (BTKs), to produce fired bricks. In order to study the existing energy usage patterns, TERI conducted baseline energy audits in each of the 10 units (Table 1).

What is zigzag firing technology?

The pattern of setting the green bricks in a kiln determines the travel path of the fire (and therefore, hot air) through the kiln. In a conventional BTK, the bricks are set in linear pattern and the path of fire/hot air too is linear. If the bricks are set in a zigzag pattern, the travel path of the fire/hot air is prolonged. This increases the exposure of the green bricks to heat, reducing fuel consumption and improving the overall thermal efficiency of the kiln. Zigzag kilns are typically shorter (in trench size and overall kiln length) and have longer combustion zones than the conventional, straight firing kilns.



(a) (b)

Path of fire/hot air through (a) conventional kiln (b) zig-zag kiln

Table 1. Profile of brick making units identified for demonstration projects

S. No.	Unit name	Village	Production capacity (per circuit)	SEC* (MJ/ kg fired brick)
1	Brick kiln unit 1	Kharupur	700,000	1.59
2	Brick kiln unit 2	Bandaha	750,000	1.43
3	Brick kiln unit 3	Shaina Kalan	500,000	1.39
4	Brick kiln unit 4	Cholapur	600,000	1.64
5	Brick kiln unit 5	Undi	900,000	1.36
6	Brick kiln unit 6	Jaipar	850,000	1.57
7	Brick kiln unit 7	Raichandpur	625,000	1.33
8	Brick kiln unit 8	Sultanpur	700,000	1.54
9	Brick kiln unit 9	Todarpur , Mohansarai	950,000	1.53
10	Brick kiln unit 10	Gosaipur, Mohav	900,000	1.67

**SEC—specific energy consumption*

The specific energy consumption (SEC) values were found to be high in all the units, ranging between 1.3–1.6 MJ/kg-fired brick against an optimal value of about 1.1–1.2 MJ/kg-fired brick. The studies also highlighted a number of sub-optimal operating practices that reduce the energy efficiencies of the kilns. These include:

- Lack of proper insulation on kiln surfaces, resulting in high levels of heat losses.
- Poor fuel feeding practices; the frequency of fuel feeding ranges between 45–75 minutes, against an optimal frequency of about 30 minutes.
- Cooling zones are too long, resulting in high percentage of unburned carbon in the ash.
- Poor mixing of air and fuel.

Of the 10 kiln units studied by TERI, two kilns have already adopted zigzag firing technology. A detailed energy audit was carried out in March 2016 on one of these units while it was in operation. The SEC of the kiln was evaluated to be 1.12 MJ/kg-fired brick as against 1.36 MJ/kg-fired brick during the baseline study. The result indicates that adoption of zigzag firing technology has indeed helped in improving the energy efficiency of this kiln.

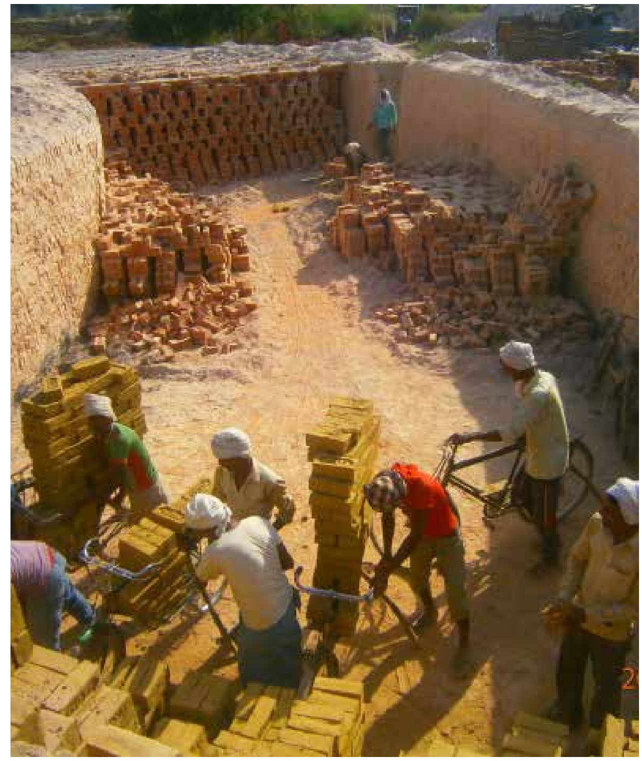
The result of the study was discussed with the kiln owners, as well as with INP office bearers. It is expected that INP's dissemination efforts will help persuade other brick making units in the cluster to adopt the zigzag firing technology during the following brick making season.

VARANASI BRICK MAKING CLUSTER

Background

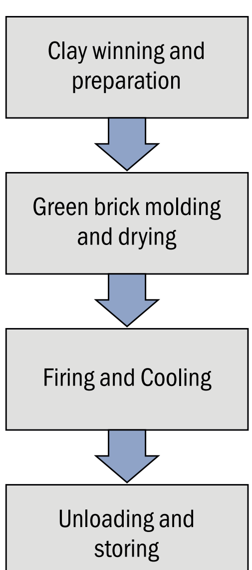
One of the largest brick making clusters in India is located in the clay-rich riverine plains of greater Varanasi district, in eastern Uttar Pradesh. The Varanasi cluster has about 300 brick kilns. Almost all the units in the cluster produce handmade solid bricks. One unit has adopted mechanization for clay preparation and green brick moulding, and in addition to solid bricks, produces resource-efficient bricks (REBs) like perforated bricks and hollow blocks. The total annual cluster-level production is estimated to be 975 million bricks. The capacities of the kilns vary from 0.5 million–0.8 million bricks per round (with each round, or circuit, lasting about 30 days). Avoiding the rainy season, the kilns operate for six to eight months during the dry season, from November/December to May/June.

The primary industry association of brick manufacturers in the Varanasi cluster is the *Int Nirmata Parishad* (INP). INP has taken several initiatives to promote energy conservation and reduce emissions during the brick manufacturing process in the cluster. It has organized a number of exposure visits and focused workshops/seminars to increase the awareness of its members on energy and environmental aspects.



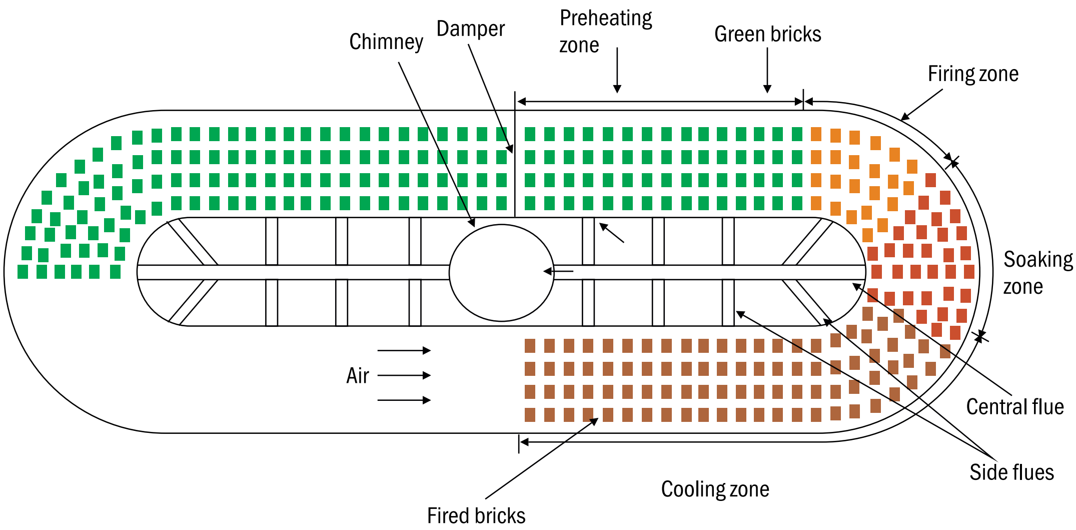
Technology status and energy use

Brick making in the Varanasi cluster still follows traditional, labour-intensive processes and practices, with minimal use of mechanization. The basic raw materials used for making bricks are clay, sand and water. Due to its location in the vicinity of the Ganga, the entire Varanasi cluster has an abundance of good quality clay, with near-ideal chemical and physical properties for brick making. The clay is taken from the topsoil of fallow fields and moulded into green bricks, which are then sun-dried and 'fired' in a *bhatta*, or kiln. Firing means heating the bricks to 800°–1100° C over a period of time, holding them at this temperature for a while, and then cooling them. Most of the kilns in the Varanasi cluster are traditional, coal-fired Bull's trench kilns (BTKs) of fixed chimney, natural-draft type. A few kilns use induced draft (ID) fans for better airflow in the firing/cooling zones of the kilns. The products are the familiar 'fireclay' or burnt bricks. The flowchart shows the major process steps in brick making.



What is a Bull's trench kiln?

The Bull's trench kiln (BTK) is essentially a circular or oval-shaped trench with a chimney that is usually located in its middle. The trench is connected to the chimney by evenly spaced chambers along its length. Bricks are stacked in the chambers and fired every day, using coal and biomass as fuel. The fire moves through the trench, chamber by chamber, and the fired bricks are unloaded and green bricks loaded on a continuous basis.



Energy consumption

Almost the entire energy consumed by brick kilns in the Varanasi cluster is derived from burning coal. A few units also use coal mixed with biomass such as wood and sawdust. The total energy consumption of the Varanasi brick cluster is estimated at 84,800 tonnes of oil equivalent (toe). The specific energy consumption (SEC) varies from 1.3–1.6 MJ/kg-fired brick, against an optimal value of between 1.1–1.2 MJ/kg-fired brick. This indicates considerable potential for improving the energy efficiency of the brick kilns in the cluster.

Options for energy saving

Table 1 summarizes the major energy conservation measures (ECMs) that could be adopted by brick making units in the Varanasi cluster.

Table 1. Energy conservation measures for brick making units in Varanasi cluster

ECM	Summary of benefits
Improved operating practices	
■ Improved coal feeding/charging practices: ■ Using mechanized coal crusher to crush coal to particles of ≈ 10 mm. ■ Using smaller capacity spoons (750 – 1000 g) for feeding coal ■ Increasing the length of firing zone by feeding coal in more than three lines (instead of two lines as is current practice) ■ Continuous (instead of intermittent) feeding of coal ■ Adopting single man feeding practice ■ Keeping optimal lengths of cooling and pre-heating zones ■ Sealing wickets (openings, in the kiln outer wall, used to carry green and fired bricks inside/outside of the kiln) with at least two- brick-thick walls with mud plaster on both sides	Efficient combustion of coal, resulting in improved energy efficiency
Revamp	
Adopting zig-zag firing process instead of conventional firing process	■ Improved combustion (and hence, reduced coal consumption) due to improved circulation of air and better mixing of air and fuel ■ Reduced surface heat losses ■ Reduced CO and particulate emissions

11TH MEETING OF SAMEEEKSHA

The 11th Coordination Committee Meeting of SAMEEEKSHA was held at TERI, New Delhi on 28th July 2016. The meeting was chaired by Dr Ajay Mathur, Director General, TERI. The other participants included representatives from BEE, SDC, SIDBI, PCRA, EESL, UNIDO, GIZ, SBI, IBA, other financial institutions, implementing agencies, and technical consultancy organizations. The following presentations were made:

- SAMEEEKSHA Platform and TERI-SDC EESE project: an update—Mr Upinder S Dhingra, Secretary, SAMEEEKSHA and Mr N Vasudevan, TERI
- Update on BEE-SME Program—Mr Milind Deore, BEE
- Design and Demonstrate an ESCO business model to promote EE motors in chemical industries in Gujarat—Mr Hemanth Kumar, International Copper Association India (ICAI) and Mr Upinder S Dhingra, TERI

The salient points from the presentations and discussions are summarized below.

- Energy related data has been gathered, and cluster profiles prepared, on 43 more MSME clusters (33 under the SDC-TERI EESE project, and 10 under the TERI-SSEF project). With this, the SAMEEEKSHA website hosts comprehensive energy data on 83 MSME clusters, which together consume about 10 million tonnes of oil equivalent (Mtoe) annually. Data on about 50 of these clusters has been placed on the 'Energy Map'.
- Under the EESE project, TERI has undertaken detailed unit-level studies in about 80 foundry units in the Rajkot and Howrah foundry clusters, and identified around 900 energy conservation measures (ECMs) that together offer potential annual energy savings of 1633 toe. About 25% of these ECMs have already been adopted by the foundries, with technical support from TERI.
- Under the BEE SME Program, baseline energy audits have been conducted, EETs identified, and technical and capacity building support provided for implementation of EETs in five SME clusters: (1) Ludhiana forging; (2) Indore food processing; (3) Kochi seafood; (4) Pali textiles; and (5) Varanasi brick making.

Other BEE initiatives include:

- Launch of a knowledge management portal www.indiasavesenergy.in under the GEF-World Bank Project 'Financing energy efficiency at SMEs'
- Setting up a toll-free helpline for energy-related information, 1800-2009-250
- Setting up a Knowledge Management Centre for motors efficiency in Faridabad
- Under a collaborative applied research project, TERI and ICAI, with support from Shakti Sustainable Energy Foundation (SSEF), have evolved an innovative vendor-based ESCO model to promote the use of high-efficiency motors (HEMs) among small-scale chemical units in Ankleshwar, in partnership with Gujarat Energy Development Agency (GEDA), the local industry associations, and banks/financial institutions. Efforts are on to finalize the institutional arrangements for implementing the model.

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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