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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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A PLATFORM FOR PROMOTING ENERGY EFFICIENCY IN SMEs

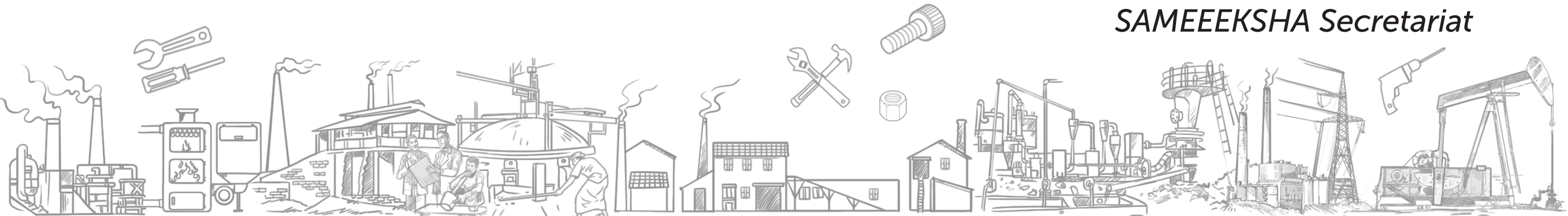
IN THIS ISSUE...

The theme of this issue is the imperative need to adopt a 'policy package' approach to achieve widespread energy efficiency improvements in the major energy intensive MSME sub-sectors in India. Each policy package should be based on thorough surveys, needs assessments and barrier analyses; it should link and help synergize the individual policy instruments so that they work together in addressing the various barriers and challenges faced by MSMEs, and facilitate rapid energy efficiency improvements on a large scale.

The theme article describes a study project undertaken by TERI at the behest of International Energy Agency (IEA) to develop a comprehensive, implementable policy package for scaling up energy efficiency in the textile industry—among the most energy intensive sectors in India. The study focused on the MSME segment in three major energy consuming sub-sectors within the textile industry— spinning, weaving, and processing— which have the largest energy savings potential.

The article outlines the technology levels and energy usage patterns among the textile units; the energy-efficient technological options that have been identified; and the major barriers to energy efficiency that confront units and other stakeholders in each sub-sector. The article also outlines key elements of the policy package designed and recommended by TERI for bringing about large-scale adoption of energy-efficient technologies across the textile industry. The policy package takes into consideration the fact that even as the textile industry grapples with the challenges due to the ongoing pandemic, this is a time when incentives can play a more significant role in implementing the various economic stimulus packages launched by the government; a time when policy-makers have the opportunity to place conditions on grants and funding such as implementation of EETs and achieving benchmarks for EE while supporting technology and process improvements.

SAMEEEKSHA Secretariat



EVOLVING POLICY PACKAGE FOR SCALING UP ENERGY EFFICIENCY IN TEXTILE INDUSTRY

Backdrop

Even as the world embarks on the path of socio-economic recovery from the devastating effects of the Covid-19 pandemic, the need for nations to reduce CO_2 emissions assumes a new urgency in the light of a recent report by the Intergovernmental Panel on Climate Change (IPCC), which warns that limiting global warming to close to 1.5 °C or even 2 °C over the next 20 years will be beyond reach unless immediate and large-scale reductions are made in greenhouse gas emissions[1]. Industry—the engine that drives economic growth—contributes almost one-third of total global CO_2 emissions, primarily from the burning of fossil fuels to meet thermal energy requirements. Hence, the immediate challenge before all countries is to bring about drastic reductions in industrial emissions without affecting industrial recovery and growth.

The imperative need to cut down emissions has particular relevance to India, which ranks as the third-largest global emitter of CO_2 despite low per capita CO_2 emissions. India is also the world's third-largest energy-consuming country, with 80% of energy demand still being met by coal, oil and solid biomass[2]. The industrial sector contributes over 45% of India's total energy-related CO_2 emissions, and Niti Aayog has estimated that the energy demand from Indian industry will triple over the next 25 years[3]. To sustain its economic growth yet become a 'net-zero' carbon economy by 2070, India must therefore find ways to 'decarbonize' its industrial sector through the rapid and large-scale dissemination of low-carbon technological solutions. This is particularly important in energy intensive MSME sub-sectors, where a large proportion of industrial units continue to depend on fossil fuels.

Need for policy package

Opportunities to introduce clean, energy efficient technologies (EETs) abound in the Indian MSME sector, and many significant initiatives to develop and promote EETs among MSMEs have been undertaken by different agencies, as reported in this newsletter over the past decade. However, standardized, commercially available EET solutions are seldom available for industrial units in the Indian MSME sector given its sheer diversity—with units showing great variation in technologies, operating practices and products not only within the same industrial sub-sector but often within the same MSME cluster. This diversity, and the consequent need for customization of EETs to meet the often-unique unit-level requirements and conditions, poses a huge barrier to increasing energy efficiency quickly and on a large scale across the MSME sector.

There are also other major and well-recognized barriers to scaling up energy efficiency among MSMEs, manifest as gaps and shortfalls in the broad and overlapping domains of policy, regulation, finance, capacity (including lack of awareness, knowledge, skills training, and technical support services at unit/cluster levels) and infrastructure (including unreliable grid electricity, unavailability and/or the high prices of cleaner fuels like natural gas, and lack of centralized steam generation and distribution facilities at the cluster level).

The need, therefore, is for an implementable 'policy package' to be developed to unlock the energy efficiency benefits for major energy intensive MSME sub-sectors. For the package to address the specific challenges of the sub-sector and facilitate energy efficiency improvements, it should be based on thorough surveys, needs assessments and barrier analyses. For sustaining the energy efficiency achievements of the sub-sector, instead of isolated individual policy instruments, it is better to have a comprehensive policy package linking individual policy instruments so that they work together. In essence, a comprehensive policy package will be based on three mechanisms: regulations, information and financial incentives. The aim will be to overcome the barriers to energy efficiency so that industrial units are encouraged to invest in EETs and thereby reduce their emissions.

The project

As a step in this direction, the International Energy Agency (IEA) entrusted TERI to develop a policy package designed to address the specific challenges of the MSME segment in the textile industry and facilitate energy efficiency improvements. Bureau of Energy Efficiency (BEE) is a partner of IEA in India.The study targeted the three major energy consuming sub-sectors within the textile industry—spinning, weaving, and processing—which have the largest energy savings potential.

1 IPCC Working Group I report, August 2021: Climate Change 2021: the Physical Science Basis.
2 IEA. India Energy Outlook 2021. Full report available at https://www.iea.org/reports/india-energy-outlook-2021/energy-in-india-today
3 SAMEEEKSHA 11(3), September 2020.

In order to provide a more detailed evaluation of the potential for energy savings and identify the barriers and solutions, interviews and surveys were carried out with key stakeholders in five textile clusters—Ahmedabad, Bhiwandi, Coimbatore, Surat and Tiruppur.

Drawing on the findings and insights from the study, this article presents a broad profile of the Indian textile industry including the main categories of textile units with their technology levels and energy usage patterns; lists some EET options that were identified for unlocking the largest energy efficiency potentials and addressing the specificities of the medium enterprises in the textile sector, with estimates of the overall energy savings potential; summarizes some of the major barriers to improving energy efficiency in the textile industry; and outlines the comprehensive policy package that has been formulated and recommended to scale up energy efficiency across the entire textile industry. The key elements of the policy package have been classified under three main policy mechanisms:

- Regulation—which lays out legal requirements, such as expansion of the Perform, Achieve and Trade (PAT) scheme
- Information—to help enterprises and government make choices (such as deep-dive energy efficiency programs)
- Incentives—to support regulation and transform the market (such as concessional loans for efficient technologies)

Textile industry profile

The Indian textile industry contributes to 7% of industrial production, 12% of exports and is highly energy and labour intensive. It is also among the most energy intensive industrial sub-sectors, with energy accounting for 15–20% of total production cost.

The textile industry is dominated by MSMEs in terms of numbers, with an estimated 600,000 small and micro sized power loom units in the weaving category alone. Brief profiles of spinning, weaving and processing units—the three categories of textile units covered under the study project—are presented in the sections below.

Spinning mills

Spinning mills process fibres into yarn. There are an estimated 3000 spinning mills in the organized sector. In addition, there are an estimated 10,000 smaller spinning mills operating in the unorganized sector. The total installed capacity of the Indian spinning industry is 52 million spindles. The annual production of yarn is about 5200 million kg, of which the share of cotton yarn is 69%, blends 20%, and non-cotton 11%. The majority of the spinning mills, especially among the MSMEs, produce cotton yarn. Figure 1 shows some of the common machinery used in a spinning mill.

Figure 1. Machinery used in spinning: (top) Simplex; (bottom) winding machine

Electricity is used to drive the induction motors used in different processes in a spinning mill. Electrical energy accounts for 12–15% of the manufacturing cost in spinning.

Weaving units

Weaving units convert yarn into fabric or cloth, using hand looms or power looms to interlace two sets of threads. India has the world's highest installed loom capacity, which includes 2.8 million power looms. The total annual cloth production in India is about 68 billion square metres, of which about 60% comes from power looms.

The technology level of power looms ranges from semi-automatic looms such as shuttle and rapier looms to high-productivity automatic looms such as air jet and water jet looms (figure 2).

About 95% of the looms operating in India are locally made semi-automatic shuttle looms. There are only about 0.15 million shuttle-less looms in operation. Although offering higher productivity, these modern machines consume more power and entail high capital investments. Most of the automatic looms have been purchased second-hand from Europe, China and Japan.

Figure 2. Machinery used in weaving: (L) shuttle loom; (R) rapier loom

Electric motors account for most of the energy consumption in weaving. Electrical energy accounts for 5–6% of the manufacturing cost in semi-automatic looms and 10–12% in automatic looms.

Processing units

Processing units, also called dyeing & finishing units, impart the yarn and/or fabric with the required colours, textures, resilience, and other characteristics through a range of processes that can be grouped under the following three broad heads:

Figure 3. Dyeing machine (soft flow)

- Preparation processes such as scouring (washing), shrinking and bleaching
- Dyeing or 'wet processing'
- Finishing processes such as squeezing, drying and pressing

There is great variation among processing units in regard to the fabrics being processed (cotton/synthetic), fuels consumed (firewood/coal), and machines and operating practices being used. For instance, a variety of dyeing machines are used in different clusters: units in Tiruppur commonly use soft flow dyeing machines, while jiggers and jet machines are commonly used in the Surat cluster. Figure 3 shows a soft flow dyeing machine. Likewise, many small-sized processing units in the Tiruppur cluster practise natural drying, while processing units elsewhere commonly use specialized ovens called Stenters for drying.

Dyeing is the most energy-intensive operation in processing units, accounting for 40% of the total energy use. The dyeing process requires hot water or steam, with 45–50 litres of water being consumed per kg of cloth dyed. Coal and firewood fired boilers are commonly used to generate the required hot water/steam. Coal-based thermic fluid heaters are commonly used to provide hot air for the Stenters (figure 4), which account for 18–20% of the total energy use in processing. Other energy intensive utilities in processing units include air compressors and pumps. The energy cost (i.e., combined cost of electricity,

Figure 4. (top) Stenter; (bottom) thermic fluid heater

coal, firewood etc.) typically makes up 16–20% of the manufacturing cost in processing units. Water and chemicals add significantly to the overall manufacturing costs.

Energy usage patterns

The total annual energy consumption of the textile industry was estimated to be about 10.35 million tonnes of oil equivalent (Mtoe), of which processing accounts for the largest share (65%), followed by spinning (23%) and weaving (12%) as shown in figure 5. Spinning and weaving units depend almost entirely on electricity.

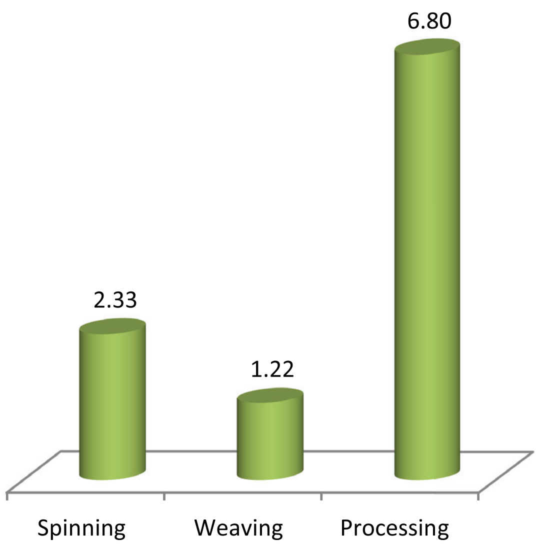


Figure 5. Energy consumption by textile sub-sector (Mtoe/y)

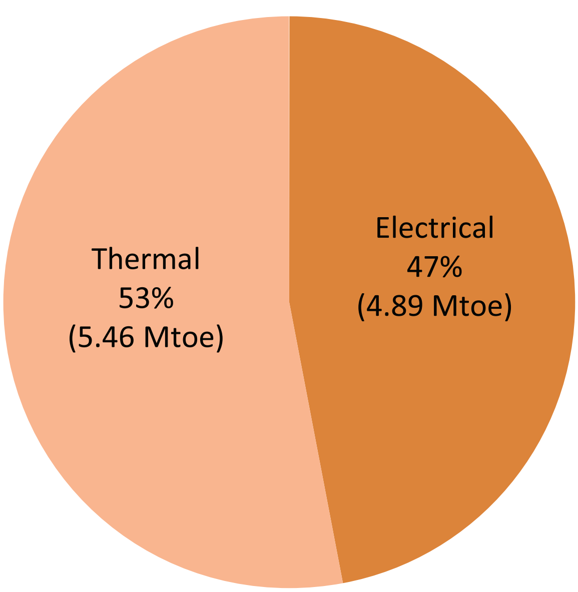


Figure 6. Overall energy consumption mix in textile sector

Thermal energy is used only by processing units and accounts for 53% of total energy consumption in the textile industry, while electricity accounts for the remaining 47% (figure 6).

Energy efficient technologies and practices

The study identified a large number of practical and economically viable EETs in each of the three sub-sectors. Table 1 lists a few of these EET options.

Table 1. Selected EETs in textile industries

Sub-sector	EETs and best practices
Spinning	• High speed ring frame • EE motor systems • Autoconer • Inverters for suction motors and other machines • Chute feeding system • EE fans in ring frame and other applications • Use compactor in ring frame • PLC control of humidification system • Load monitor • OLTC transformer
Weaving	• Replacement of shuttle looms with automatic shuttle-less looms • EE motors • EE lighting /daylighting
Processing	• CHP systems • PLC control in dyeing machines • WHR in fabric dyeing • EE automatic Stenters • High efficiency pumps • inverters for pumps and fans • Efficient water squeezing technologies • Optimization of exhaust temperature and moisture of cloth in Stenters • Natural gas firing in Stenters • Reuse of water in dyeing • PID-based flue gas monitoring system in boilers and thermic fluid heaters • Improved insulation of steam and thermic fluid pipelines • Temperature control using three-way valve in thermic fluid heaters • Improved condensate recovery • Energy monitoring system

It was found that the adoption of EETs often results in additional benefits such as reduced pollution, water savings, improved productivity, and better product quality. For example, it was found that the adoption of inverters in boiler feed-water pumps reduced maintenance, as the mechanical wear and tear of the pump parts was reduced. This in turn reduced down-time and increased the life of the pumps. Another example is that of using Autoconers for yarn winding by spinning machines, which results in improved productivity and better product quality.

Barriers to energy efficiency

Despite several policies and schemes to bring about modernization of the textile industry, MSMEs as well as other stakeholders confront barriers in different overlapping domains—technology, capacity, finance, regulatory and policy—that prevent the rapid uptake of EETs. A few overarching barriers are summarized below.

Barriers at unit and cluster levels

Limited access to EE technology; lack of capacity

There are no indigenous manufacturers of some energy efficient machines used by the textile industry. For example, automatic (air jet and water jet) looms in weaving have to be imported at high cost. Another major barrier is the lack of suitably trained machine operators for these modern machines.

Low awareness levels

Awareness levels are generally low regarding the benefits of EETs and improved operating practices. Even where such awareness exists, units lack information on reliable technology suppliers.

Inability to access clean fuels like natural gas at affordable cost

In processing (i.e. dyeing & finishing) units, there is significant potential to reduce ambient air pollution, mitigate CO_2 emissions and save money by switching away from coal to natural gas for generating steam. However, dyeing clusters like Tiruppur do not yet have access to natural gas; while in clusters like Ahmedabad and Surat where natural gas is available, the high price of gas has forced dyeing units to switch over to polluting fossil fuels like coal.

Barriers at institutional, regulatory and policy levels

Difficulties in financing EETs

There are several schemes to finance new/improved technologies for MSME textile units. Despite these numerous supportive initiatives, however, the less progressive textile MSMEs that are most in need of financial support still lack the knowledge and wherewithal to access the government subsidy schemes and to obtain collateral-free loans for EETs from financial institutions.

Lack of data on technologies, practices, and energy/environmental performance

There is a scarcity of rigorously compiled and periodically updated information on the textile industry in regard to different technologies, operating practices, energy sources and usage, the associated CO_2 emissions, and other related aspects. The lack of such data hinders the benchmarking of technologies and practices, which is necessary to guide textile units towards improving their energy and environmental performance.

Policy package

Based on analyses of the various identified barriers to energy efficiency, the project has created and recommended a policy package for bringing about large-scale adoption of EETs across the textile industry. This policy package takes into consideration the current situation, when the textile industry is still grappling with challenges due to the ongoing pandemic, and when the various economic stimulus packages launched by the government are focused on industrial recovery and restoring/ increasing jobs. This is a time when incentives can play a more significant role in implementing the economic stimulus packages; a time when policy-makers have the opportunity to place conditions on grants and funding, which could include implementation of EETs, achieving benchmarks for EE while supporting technology and process improvements, and so on.

The actionable elements of the policy package are integrated along three broad and parallel tracks (figure 7):

1. Regulation
2. Information/technical assistance
3. Financial incentives

Regulation

- **Expand PAT.** The success of the Perform, Achieve and Trade (PAT) scheme has shown that direct regulation can lead to energy savings: PAT sets targets for efficiency improvement, establishes a culture of regular energy audits, and stimulates EE investments and adoption of best practices. Therefore, the PAT scheme (which is already being implemented in large-scale textile units) could be expanded to cover medium-scale textile units with energy consumption above a threshold of (say) 2000 toe/year.
- **Promote EE motors.** Promote the widespread

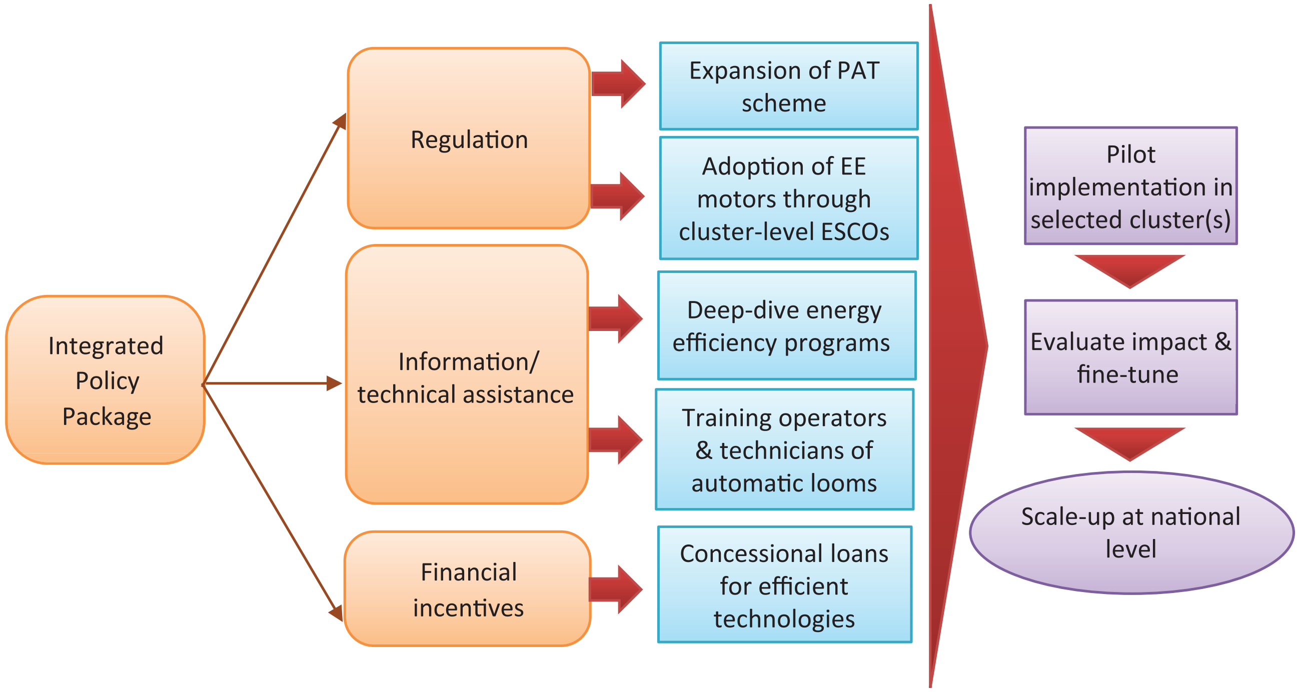


Figure 7. Integrated policy package for scaling up energy efficiency in textile industry

adoption of EE motors via an ESCO-based business model, as was successfully demonstrated by TERI among MSMEs in the Ankleshwar chemical cluster.[4]

Information/technical assistance

- **Conduct deep-dive EE programs.** The effectiveness of deep-dive programs in quickly achieving significant energy savings and CO_2 reductions has been demonstrated under different projects.[5] The focus is on conducting a large number of energy audits among MSMEs to identify techno-economically feasible EE measures and to provide technical assistance to implement the measures.
- **Train operators and technicians on automatic looms.** Automatic looms (air jet and water jet) account for only 5% of all power looms operating in India. A major barrier to their wide-scale adoption is the lack of skilled machine operators and LSPs. Dedicated training centres can be established, with appropriate curricula and faculty, to create a cadre of automatic loom operators and technicians who in turn could spur the large-scale adoption and replication of these EE looms in the weaving sub-sector.

Financial incentives

- **Concessional loans for EETs.** Concessional loans need to be provided for EETs in the textile sector. The following approach may be adopted by banks/ financial institutions for better technical and financial evaluation of each project before loan disbursement:
  - Prepare a list of eligible EETs for easy finance: Financing of EE projects by banks/FIs can be promoted by creating a list of EETs that offer attractive energy savings and returns on investment.
  - Pre-assess EE loan applications: To overcome the capacity barriers faced by bankers in appraising EE loan proposals, such proposals could be 'pre-assessed' and certified as credit-worthy by energy professionals—who could be personnel from the banks' own technical cells or external consultants.

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4 For more information on this ESCO-based initiative, please visit http://www.sameeeksha.org/brouchres/esco-brochure.pdf

5 For example, see SAMEEEKSHA 9(2), June 2018—a case study on deep dive in Rajkot engineering cluster

NATIONAL STAKEHOLDER CONSULTATION WORKSHOP ON ENERGY EFFICIENCY IMPROVEMENTS AMONG SME TEXTILE UNITS

The International Energy Agency (IEA), in partnership with BEE, organized a national stakeholder consultation workshop (webinar) on energy efficiency (EE) improvements among small and medium (SME) textile units in India on 10th June 2021. The objectives of the webinar were to share and discuss the findings of the textile sector study conducted by TERI with industry stakeholders, and thereby help crystallize possible policy options to scale up EE in the textile industry and outline possible pathways for their effective implementation.

Among those who participated in the discussions were Ms Melanie Slade, Senior Programme Manager, Energy Efficiency, IEA; Mr Abhay Bakre, Director General, BEE; Ms Roop Rashi, Textile Commissioner, Mumbai; and a number of entrepreneurs and representatives from industry associations. TERI, presented an overview of the three main textile sub-sectors covered under the study (spinning, weaving and processing); the possible EE options identified for each sub-sector; the key barriers to EE improvements; and possible policy instruments that could be designed to tackle these barriers.

Some of the key takeaways from the discussions are summarized below.

- Greater collaboration between industry, academia and government will help in developing and promoting innovative technologies and policies for the textile sector.
- Awareness generation about new technologies and energy audits are important to improve EE.
- There is a need to take a systems-approach rather than just an equipment-based approach when looking at EE improvements.
- Multiple benefits such as increased productivity and competitiveness need to be measured and highlighted to increase the uptake of EE measures.
- A policy-level push is needed to support the indigenous manufacture of EE textile machinery. As most textile machinery manufacturers in India have limited financial resources to conduct R&D, support should be provided to them for collaboration with international machinery manufacturers.
- Implementation of high-efficiency fans and waste recovery systems could yield significant energy saving among spinning units. Other options for energy savings are reducing compressed air leakages, proper loading of transformers, adoption of inverters, and closed loop humidification systems. Medium scale processing units could adopt cogeneration for significant energy and cost savings.
- The lack of skilled labour is a major challenge to the adoption of automatic looms. Other challenges faced by the weaving units include the high cost of raw material (yarn), differences in electricity rates between micro and small units, and infrastructural deficiencies in many textile clusters.

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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