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Factors Influencing the Uptake of Energy Efficiency Initiatives by Indian MSMEs

Report | August 2018

TIRTHA BISWAS, SACHIN SHARMA, AND KARTHIK GANESAN

Image: Sachin Sharma/CEEW

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CEEW Report
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ceew.in

Report on 'Factors Influencing the Uptake of Energy Efficiency Initiatives by Indian MSMEs'.

Citation: Tirtha Biswas, Sachin Sharma, and Karthik Ganesan (2018) 'Factors Influencing the Uptake of Energy Efficiency Initiatives by Indian MSMEs' August.

Reviewers: Padu S. Padmanaban, Consultant, King Abdullah Petroleum Studies and Research Center (KAPSARC); Dr Mahesh Patankar, CEO, MP Ensystems Advisory Pvt. Ltd; Dr Bhaskar Natarajan, Director of Energy Efficiency & Clean Energy, Institute for Sustainable Communities; and Dr Vaibhav Chaturvedi, Research Fellow, CEEW; Sanchit Waray, Programme Associate, Kapardhi Bharadwaj, Programme Associate, (CEEW).

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Publication team: Alina Sen (CEEW), Mihir Shah (CEEW), Chitralekha Manohar, Twig Designs, and Friends Digital.

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Tirtha is a policy analyst, working on the development of sustainable and competitive pathways for Indian industry to support its low-carbon growth aspirations. At The Council, his research revolves around mineral resource security, greenhouse gas emissions, and energy efficiency of the domestic industrial sector in India. Tirtha is currently developing a framework for the periodic assessment of non-fuel critical minerals for the manufacturing sector. He is also leading a project to understand the determinants of energy efficiency investments for the MSME sector in India, to complement the existing policies, programmes, and schemes targeted at the industry.

Tirtha is working closely with the GHG Platform India, developing an inventory of greenhouse gas emissions from the industrial sector and analysing the key underlying drivers for facilitating a policy dialogue on India's GHG emissions profile, sources, and related policies. He has completed a dual degree from the Indian Institute of Technology (Indian School of Mines), Dhanbad, and holds an undergraduate degree in Mineral Engineering and a Master's in Mineral Resource Management.

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Sachin is an energy engineer whose research is focused primarily on the power sector, energy efficiency, energy conservation, demand-side management, and climate change mitigation. Prior to his stint at The Council, he worked on demand-side management programmes in Maharashtra, analysing load patterns of DISCOMs and devising policies for effective management of electrical demand across the state. He has also worked on a project funded by the World Bank and the Global Environment Facility (GEF), which focused on increasing investments in energy efficiency measures by industries, especially MSMEs.

Sachin holds an undergraduate degree in Mechanical Engineering from Mumbai University and a M.Tech. in Energy Systems from the University of Petroleum and Energy Studies, Dehradun.

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An engineer by training, Karthik leads The Council's work on the Power Sector. His research focus includes the operational reform of DISCOMs in India and the competitiveness of various power generation sources.

In recent years, Karthik has led an independent effort to assess GHG emissions from the industrial sector and improve transparency in reporting and has had an integral role in the establishment of the GHG Platform India. He has also led a first-of-its-kind evaluation of the impact of industrial policies on the renewable energy sector in India. He supports ongoing work on the drivers of energy efficiency uptake in industry and the evaluation of energy access indicators for rural Indian households. Karthik holds a Master's degree in Public Policy from the Lee Kuan Yew School of Public Policy at the National University of Singapore. He also holds an undergraduate degree in Civil Engineering and an M.Tech. in Infrastructure Engineering from the Indian Institute of Technology, Madras.

Acknowledgements

The authors acknowledge the financial support provided by Shakti Sustainable Energy Foundation (SSEF) to this piece of research. From SSEF's team, we are grateful to Subhashish Dey for his assistance in finalising the report.

We are extremely grateful to the external peer reviewers Padu S. Padmanaban, Dr Mahesh Patankar, and Dr Bhaskar Natarajan for their critical comments and suggestions towards improving the analysis and shaping the report.

We thank industry experts Shankar Haldar (Small Industries Development Bank of India-SIDBI), Girish Sethi (The Energy and Resources Institute-TERI), Vishal Dev (Foundation for MSME Clusters-FMC), and Niranjan Deevela (United Nations Industrial Development Organization-UNIDO) for relevant insights and perspectives on the current state of energy efficiency in the sector.

We would like to acknowledge the critical inputs received from the participants representing SIDBI, Bureau of Energy Efficiency (BEE), Alliance for an Energy Efficient Economy (AEEE), UNIDO, Institute for Sustainable Communities (ISCVT), Ckinetics, TERI, FMC, ICF International, Inc, IamSMEofIndia, and PHD Chamber of Commerce and Industry during the roundtable discussion on key findings of the study. We would also like to acknowledge inputs from the various heads of industrial associations and all the interviewees who gave their time and valuable expertise to the survey.

We thank the officials from the MSME-DI institutes in Kolkata, Agra, and Mumbai and from the DIC offices in Firozabad, Jalandhar, Ludhiana, and Thane, and from the CGDI Centre in Firozabad for their detailed insights contributing towards the analysis.

We thank our colleagues, Dr Vaibhav Chaturvedi, Sanchit Waray, and Kapardhi Bharadwaj, for their review and critical feedback on the analysis. We are also indebted to our Outreach team for their continued support in putting together a quality output.

Image: iStock

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Abbreviations

ARI	Agro & Rural Industry Wing of Ministry of Micro, Small, and Medium Enterprise
BEE	Bureau of Energy Efficiency
CGTMSE	Credit Guarantee Fund Trust for Micro and Small Enterprises
CLCSS	Credit Linked Capital Subsidy Scheme for Technology Upgradation
CSO-IS	Central Statistics Office
DC-MSME	Development Commissioner (MSME)
DCs	designated consumers
DIC	District Industries Centre
EET	energy-efficient technology
EU ETS	The EU Emissions Trading System
GDP	gross domestic product
KVIC	Khadi and Village Industries Commission
MEPS	Minimum Energy Performance Standards
MoMSME	Ministry of Micro, Small, and Medium Enterprise
MoSPI	Ministry of Statistics and Programme Implementation
MSME	micro, small, and medium enterprise
MSME-DI	MSME Development Institutes
NBFC	non-banking financial company
NSSO	National Sample Survey Office
PAT	Perform Achieve Trade Scheme
PMEGP	Prime Minister's Employment Generation Programme
PRGFEE	Partial Risk Guarantee Fund for Energy Efficiency
SDA	State-Designated Agency
SEC	specific energy consumption
SME	Small & Medium Enterprises Wing of Ministry of Micro, Small, and Medium Enterprises
TEQUP	Technology and Quality Upgradation Support to MSMEs
UAM	Udyog Aadhar Memorandum

Executive Summary

Image: Sachin Sharma/CEEW

The micro, small, and medium enterprises (MSMEs) sector in India is heterogeneous in terms of products manufactured, firm size, processes and technological advancement, and volume and types of output. MSMEs that are engaged in manufacturing account for 45 per cent of India's total industrial output and eight per cent of the national GDP (MoMSME, 2017).

When compared with large enterprises, MSMEs have smaller scale operations and a smaller capital base; therefore, they typically do not have access to affordable financing and readily available technology solutions. Instead, they opt for low-cost and inefficient solutions. Within the MSME sector, firms engaged in energy-intensive operations incur disproportionately higher costs as these firms pay more per unit of energy compared to larger industries making them more vulnerable to increases in energy prices. In addition to the cost savings it offers, energy efficiency (EE) is recognised across the world as a cost-effective way to mitigate climate change and increase economic productivity and competitiveness. However, the absence of comprehensive data on the energy consumption of the estimated 6,000 MSME manufacturing clusters in India - of which about 400 clusters have been identified by various studies as 'energy-intensive' - hampers the government's and other stakeholders' efforts to offer robust recommendations to improve energy efficiency in MSMEs. Therefore, there is a perceived need to establish an energy consumption baseline across energy-intensive clusters.

In addition to the cost savings it offers, energy efficiency (EE) is recognised across the world as a cost-effective way to mitigate climate change and increase economic productivity and competitiveness

The Ministry of Micro, Small, and Medium Enterprises (MoMSME), which is the apex body for drafting policies under the Development Commissioner (DC-MSME) wing, has implemented or launched 26 schemes which target MSMEs. Three of these schemes specifically target technological upgradation (TU) and energy efficiency in MSMEs: Credit Linked Capital Subsidy Scheme (CLCSS), Credit Guarantee Trust Fund for Micro and Small Enterprises (CGTMSE), and Scheme for Technology and Quality Upgradation Support to Micro, Small and Medium Enterprises (TEQUP). A budgetary analysis of the TEQUP scheme, which primarily aims to increase manufacturers' awareness of the benefits of energy efficiency and to facilitate financing of energy-efficient technologies (EETs) through capital subsidies, shows a high percentage of unutilised funds (71 per cent), and the scheme itself constitutes less than one per cent of the overall budget of the ministry. Being on the concurrent list of the Constitution, MSMEs are affected by both, state-specific policies as well as central government initiatives. A budgetary analysis of eight states (Andhra Pradesh, Gujarat, Karnataka, Maharashtra, Punjab, Tamil Nadu, Telangana, and West Bengal) indicated that the budgetary expenditure in all states except Telangana has declined over the last three financial years.

A comprehensive review of the existing literature shed light on the challenges facing the adoption of energy efficiency technologies in the MSME sector. Various bilateral and multilateral organisations have implemented programmes to promote energy efficiency in this sector. The impact of these programmes was evaluated in this study, which helped identify obstacles and problems in the sectors and clusters where they were implemented.

This study was aimed at evaluating the MSME sector in terms of its physical and financial performance; assess its current state of awareness and its perceptions and responsiveness towards energy efficiency; identify the gaps and limitations in the implementation of various financial

and technical support programmes and to gauge the responsiveness of MSMEs to these programmes; and develop a set of implementable recommendations which will complement the Government of India's plan to improve energy efficiency in MSMEs.

For this purpose, semi-structured interviews and a survey of enterprises was conducted. A questionnaire highlighting the various issues facing the MSME sector was developed following a detailed literature review. Semi-structured interviews were held with the following individuals and agencies: officials of government departments (such as the DC-MSME, MSME Development Institute [MSME-DI], district industries centres [DIC], and departments of Industries of various states); financial institutions such as the Small Industries Development Bank of India (SIDBI) and Yes Bank; cluster associations; and various multilateral and bilateral institutions working towards improving the energy efficiency of MSMEs, including United Nations Industrial Development Organization (UNIDO), Foundation for MSME Clusters (FMC), Stenum Asia, Center for the Development of Glass Industry (CGDI), Development Envionergy Services Ltd. (DESL), and IamSMEofIndia. These interviews helped in designing the questionnaire that was administered during the survey. This questionnaire was tested in a pilot survey carried out at six enterprises in the Gurgaon automotive and ready-made textile garments manufacturing clusters in the presence of CEEW researchers.

The energy-intensive clusters were selected according to several criteria, including: total aggregate energy consumption by the enterprises in the cluster; average annual energy intensity; a higher potential for technological upgradation as identified by a study conducted by UNIDO (UNIDO, 2003); and the number of operational enterprises engaged in a specific manufacturing process in a particular geographic area. Clusters were selected from across the country: from the Ludhiana and Haryana brick clusters in the north; the Varanasi brick cluster and Bargarh rice cluster in the east; the Jamnagar foundry cluster, Morbi ceramic cluster, Surat textile cluster, and Malegaon power loom cluster in the west; and the Belgaum foundry cluster and Tirupur textile dyeing cluster in the south.

Survey findings

A total of 429 enterprises were surveyed across 11 clusters located in eight states. Of these enterprises, 32 per cent were micro-scale, 62 per cent were small-scale and six per cent were medium-scale enterprises. Formal enterprises comprised 61 per cent of the total. Demand outlook was stagnant for 77 per cent of the enterprises surveyed. For 96 per cent of enterprises, capacity utilisation remained lower than 70 per cent. Electricity was the most common source of fuel, accounting for the highest share of expenditure on fuel, in more than half of the enterprises, followed by coal, natural gas, and petroleum products. Of the enterprises surveyed, 56 per cent are monitoring and recording their energy consumption, but only 35 per cent had conducted an energy audit within the last three years. Though energy efficiency workshops have been conducted in various clusters, less than one-fifth of the enterprises had participated in one, indicating that the enterprises were unaware of them.

Self-financing was listed as the major source of financing for both capital and operational expenses for 56 per cent of the enterprises surveyed. Other formal means of financing exist, but their adoption is low. Awareness of schemes such as TEQUP, CLCSS, and CGTMSE remained low, and their adoption even lower.

A total of 429 enterprises were surveyed across 11 clusters located in eight states

We conducted a regression analysis to understand the various attributes of an enterprise that act in combination, to drive the adoption of energy-efficient measures. The factors shown to have a significant impact on the decision to deploy energy-efficient

technologies (EETs) were: competition with large industries; access to information on various programmes and schemes through peers; participation in energy efficiency workshops; the relative level of energy inefficiency of an enterprise within a cluster; and the age of the enterprise.

Most enterprises are unaware of effective methods of energy monitoring and did not participate in energy efficiency workshops

A key insight from the survey was that a higher level of capacity utilisation facilitates larger investments in technology upgradation and EETs. In the clusters we surveyed, the presence of an overcapacity inhibited investment in EETs. We further observed that those enterprises that compete with larger firms are more likely to invest in EETs.

The results indicate that most enterprises are unaware of effective methods of energy monitoring and did not participate in energy efficiency workshops. This poor awareness and low participation is a deterrent to better energy management practices, responsiveness, and the ownership enterprise owners feel towards energy conservation. Hence, financial incentives (by way of subsidies) alone are not sufficient to encourage enterprises to implement energy conservation measures.

Furthermore, about half of workshop participants are not satisfied with the extent of practical training or the showcasing of successful case studies in energy efficiency workshops. Improving the quality of the workshops and carrying out technology demonstrations is of utmost importance. Information, references, and recommendations passed on by peers within a cluster is reported to have a significant impact on the decision to implement energy efficiency measures.

Finally, existing financing instruments do not support the implementation of energy efficiency measures. Enterprises that availed formal financing specifically for technology upgradation, capacity expansion, and replacement of defunct/old equipment may have channelled some of these funds towards energy efficiency interventions. Even units that do not have access to formal financing have invested in energy efficiency. Merely being in the formal financing system is not sufficient for the adoption of EETs; instead, financial instruments should satisfy the needs of MSMEs and make funds more easily available.

Key takeaways and recommendations

Institutional reforms: A review of India's energy efficiency policies highlights the lack of coordination between implementing agencies. Also, the various state departments of industry participate minimally in implementing centrally funded support programmes. Given the wider reach of state government agencies, their increased participation and active contribution would significantly improve the outcome of existing schemes. Along with this, a broad-based programme implementation network is needed to facilitate better implementation and to collect timely feedback on the performance of energy efficiency programmes.

Energy benchmarking for MSMEs: The absence of energy consumption and benchmarking data for the MSME sector leads policy planners and researchers to resort to estimates that are at best approximations. Enterprise-level energy consumption data are currently being recorded by the enterprise. This information can be collected by the MoMSME through the MSME databank initiative. This can be complemented by incentivising voluntary reporting as part of other programmes. A comprehensive database can thus be created, thereby also contributing to the establishing of sector- and process-specific benchmarks.

Pilot and technology demonstration platform: One of the key findings was enterprises were more likely to invest in EETs on the basis of recommendations from peers. More demonstrations and pilot projects should be conducted in a few enterprises across a large number of clusters (not limited to the clusters which usually see a lot of activity). This would require the establishing of an institution to carry out such pilots in coordination with financing agencies, which will also help address the perceived risks of investing such EETs.

Targeted energy audit programme: Various state programmes promote energy audits in MSMEs. These voluntary programmes must be made mandatory or must be incentivised by linking successful completion to incentives or financial assistance (such as lower cost loans from public banks) from public institutions. This will enable enterprises to better understand and analyse their energy consumption and will lead to more enterprises reporting their energy consumption data to the MSME databank. Initially, the programme could target energy intensive enterprises[1] having annual turnover above INR 25 crore and can be later extended to cover all enterprises having annual turnover of more than INR 25 crore.

Energy savings targets programme: Learnings from the Perform Achieve Trade (PAT) scheme should be extended to the MSME sector. A cohesive policy framework should be established to incentivise enterprises to adopt energy efficiency measures. The setting of minimum energy performance standards (MEPS) for appliances or equipment such as motors would be the first step to increase energy efficiency and optimise overall processes. These mandatory programmes should not be perceived by MSMEs as an administrative burden; therefore, the incentives should be provided through existing schemes or instruments.

Creating awareness and training on energy efficiency and energy monitoring (short-term): Increasing firms' awareness of energy efficiency, either through workshops or through learning through peers, has a positive impact on investment in EETs. The frequency of workshops on energy efficiency and energy monitoring technologies must be increased, with a focus on hands-on training that is tailored to specific sectors and includes a generous dose of positive case studies from other successful implementations.

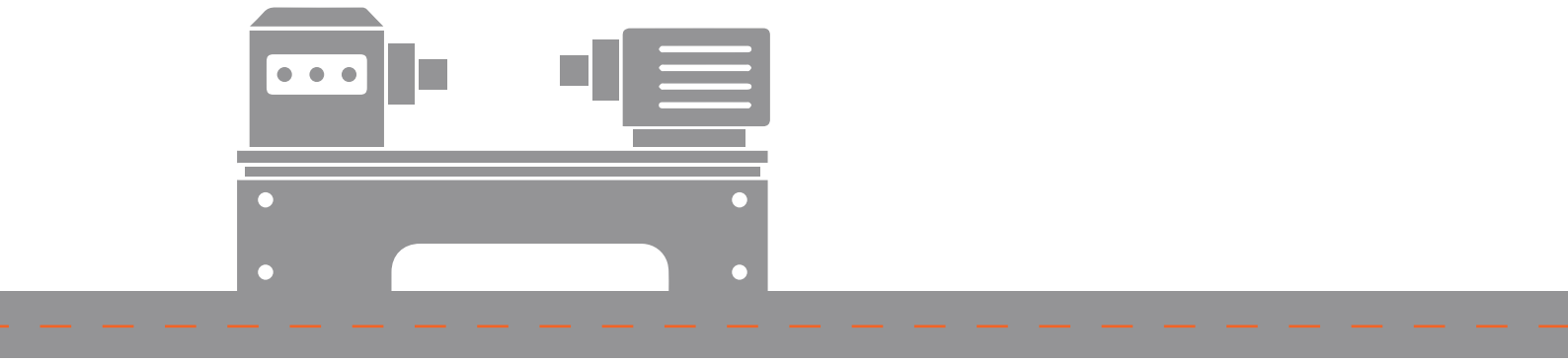
Addressing the risks associated with financing energy efficiency in MSMEs: Adoption of formal financing instruments has been poor, as shown by the findings of the survey. This may be attributed to the general perception that MSMEs rank poorly in terms of credit worthiness. This is likely to change with the implementation of the Goods and Services Tax (GST), as more information on firms' output and turnover will now be available to evaluate their financial status. Also, energy efficiency financing is inherently risky because of the uncertainties associated with the performance of technological interventions and the difficulty in demonstrating savings. This could be addressed by establishing clear energy saving benchmarks and by creating a reliable baseline for energy consumption in firms.

This information gap can also be addressed by demonstrating the performance of such technologies at a sizeable number of units. Also, innovative financing mechanisms need to be developed to provide firms smaller loans for investing in EETs. Options like pooling and aggregating of small loans across units are often suggested: these could help increase the attractiveness of the investment and also reduce overall risk. Inclusion of fintech companies in the mainstream financing sources for the MSMEs can improve the access to formal financing in the sector. Favourable regulatory framework is needed to be put in place enable successful partnerships with the traditional financing institutions.

[1] Having energy cost higher than 20 per cent of overall manufacturing cost

The policy roadmap

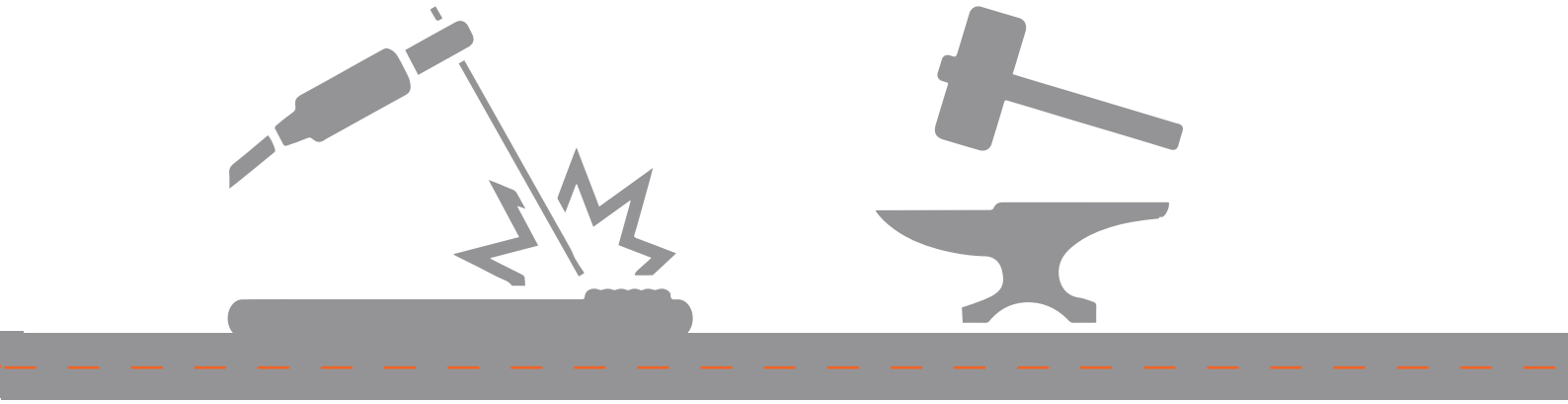
Based on the proposed recommendations/suggested measures the following implementation roadmap has been developed for the central government ministry. The suggested actions should be prioritised towards the medium and small-scale enterprises and have been further classified into short-term (less than 2 years), medium-term (2-5 years), and long-term (5 years and above).



MoMSME: Ministry of Micro, Small and Medium Enterprises
MoF: Ministry of Finance
MoSPI: Ministry of Statistics and Programme Implementation
BEE: Bureau of Energy Efficiency
DST: Department of Science and Technology
SIDBI: Small Industries Development Bank of India
#: A detailed list of key research institutes has been provided in Supplementary information – VII

Source: CEEW analysis

FLIP TO DISCOVER

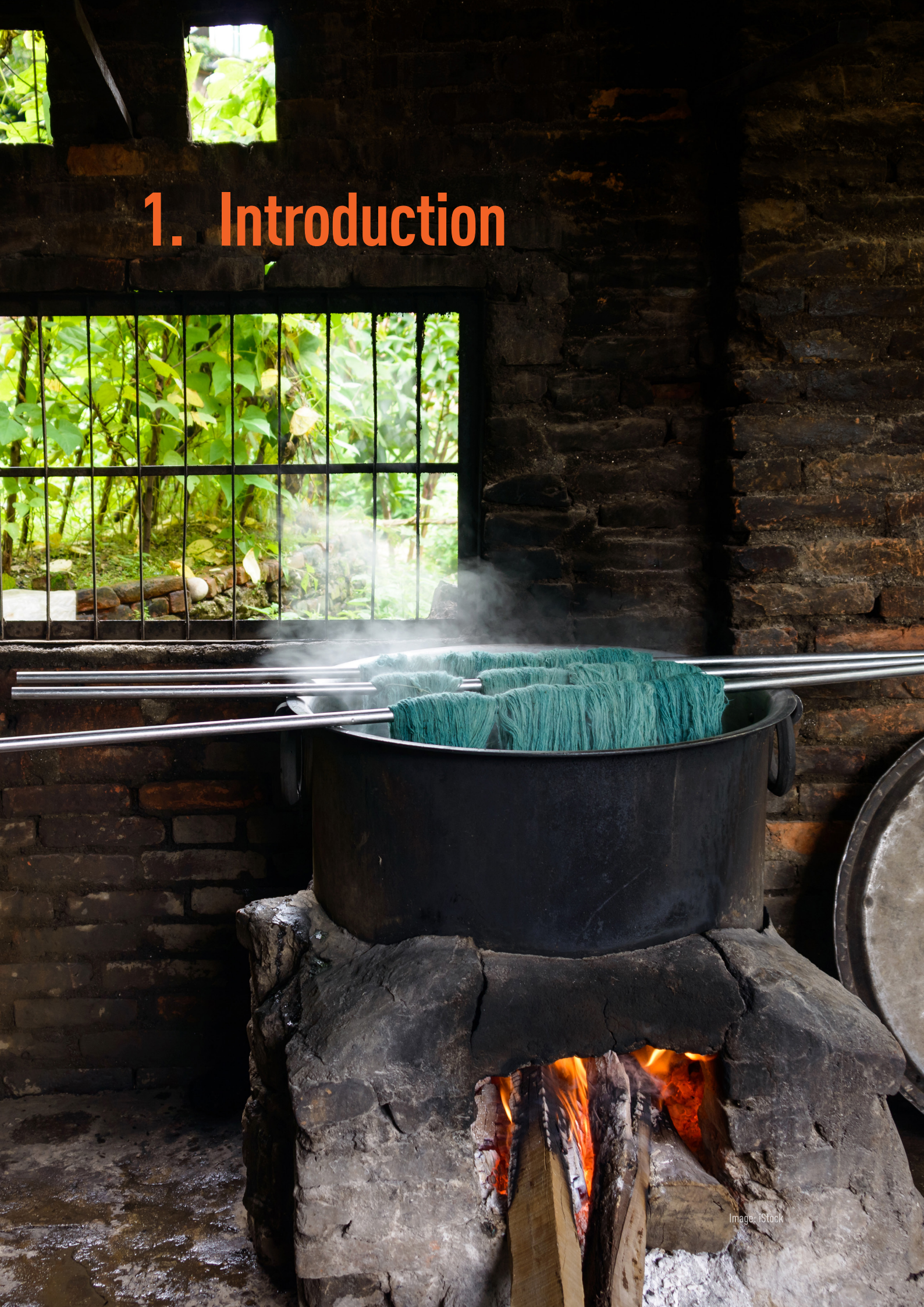


Recommended measures	Timeline	Short-term	Medium-term
Pilot and technology demonstration		■ Identifying and creating implementing agencies with budgetary support for pilot and technology demonstration ■ Creating linkages between agencies, TDI/TDC and other R&D labs to act on the feedback from MSMEs and provide relevant technical inputs on EE ■ Tie up with financial institutions and technology providers for commercially scalable projects	■ Review of the programme considering the number of projects demonstrated, uptake of such processes and technologies by MSMEs ■ Creation of an online resource pool of information on performance benchmarks for various technologies across different processes; successful case studies of enterprises implementing EE technologies ■ Creation of more such bodies or affiliates (not limited to government), at the state level enabling higher outreach to cluster associations and MSMEs
Energy benchmarking for MSMEs		■ Promote voluntary energy data reporting through MSME Databank by offering soft-incentives ■ Strengthening of survey, studies and policy-research division of MoMSME in conducting studies to evaluate the performance of the sector with respect to energy use and processes ■ Enabling co-ordination and resource sharing with MOSPI in establishing best practices in data gathering and validation	■ Review of voluntary energy data reporting measure and its cost benefit analysis ■ Mandating energy data reporting to MSME databank ■ Creation of additional reporting channels through states for wider reach and more effective implementation
Targeted energy audit programme		■ Linking energy audits to the availability of support from public funded programmes (interest rate subventions, capital subsidies) to provide a soft-push for energy audits targeting energy intensive manufacturing enterprises having annual turnover above INR 25 crore ■ Creation of sector specific, standardised energy audit reporting formats	■ Extending the programme to all enterprises having annual turnover above INR 25 crore ■ Voluntary energy audits for enterprises having turnover below INR 25 crores ■ Financial assistance towards implementation of energy audit recommendations with a sunset clause
Energy savings targets programme		■ Adoption of MEPS at equipment level and phasing out of manufacturing of less efficient equipment through regulations ■ Clubbing energy efficient equipment loans with existing CAPEX loans taken by the MSMEs. Thus, reducing the additional transaction costs associated with smaller energy efficiency loans	■ Roll out of energy savings targets programme in energy intensive processes and clusters as identified through energy benchmarking programme ■ Mandating disclosure of energy consumption across the vendor chain for large companies towards "Greening the Supply Chain" initiative ■ Creation of a savings trading platform linking EScerts from PAT and ESCerts from MSMEs ■ Allowing clubbing of smaller savings credits between different MSMEs to enable registry of such saving certificates easily and effectively thereby reducing registry costs
Addressing risks associated with financing of EE in MSMEs		■ Capacity building of financial institutions in evaluating EE investment proposals ■ Supporting public sector banks to adopt innovative mechanisms (by leveraging utility payment mechanisms, GST filings etc.) to evaluate the credit worthiness of an enterprise ■ Regulatory framework to enable partnership between fintech companies and traditional financing institutions	■ Innovative financial instruments allowing aggregation of small ticket size loans
Institutional reforms		■ Creation of linkages between State Designated Agencies, MSME-DI and DIC ■ Increasing levels of funding to be commensurate to the goals described in Centre and State government schemes ■ Capacity building of DIC officials for Energy Efficiency in MSME with a focus on technical up-skilling	
Creating awareness and training on energy efficiency and energy monitoring		■ Increase in budgetary allocation for EE workshops for MSMEs towards wider outreach in the sector ■ Setting of targets/KRAs/KPIs for bodies consulting such trainings and workshops ■ Use of ICTs for effective implementation of such workshops ■ Review of EE workshop and training programmes	

Long-term

	Key stakeholders
■ Seamless access to R&D labs/technology support centres for major industrial clusters	MoMSME; DST; SIDBI; Research institutions#
■ Review of the energy consumption data reporting programme ■ Revising benchmarks so as to reflect the actual state of technology and setting of energy saving targets	MoMSME; MoSPI; BEE
■ Assess quality of energy audits, and adopt a mechanism for independent verification of quality of audits and recommendations provided and follow up from audits	MoMSME; BEE; State Ministry of Industries; and State Ministry of Energy/ Power
■ Review of effectiveness of the programme for effective implementation and setting of targets for immediately next target period	MoMSME; BEE; SIDBI
■ Assess impact of lending to MSME on asset quality of FIs. Identifying vulnerable sectors with risky exposure and create safeguards for lenders	MoF; BEE
■ Review and overhaul (as necessitated) of the effectiveness of these linkages in programme implementation	MoMSME; State Ministry of Industries; and State Ministry of Energy/Power
	MoMSME; BEE; State Ministry of Industries; and State Ministry of Energy/ Power

1. Introduction



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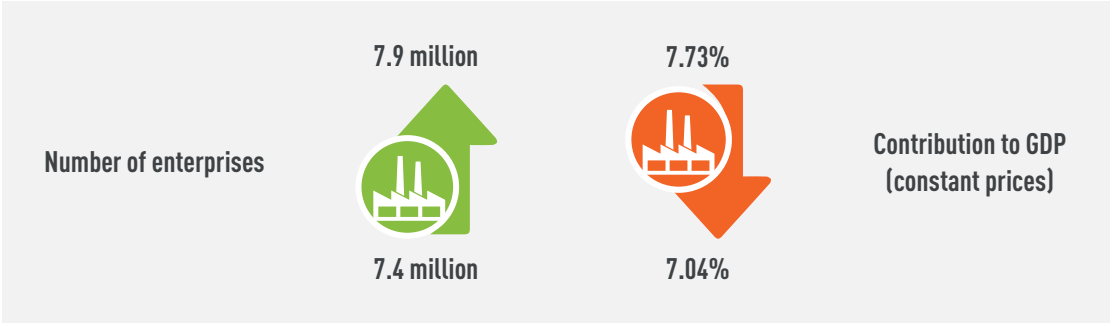
Micro, small, and medium enterprises (MSMEs) are the key drivers of Indian industry. They account for about 90 per cent of all industrial units in India, contribute to 45 per cent of industrial value addition, and produce 40 per cent of all exports. This sector, in effect, contributes to eight per cent of India's GDP. The MSME sector employs the largest share of the Indian workforce (40 per cent) after agriculture (MoMSME, 2017). MSMEs are heterogeneous in terms of unit size, type of output, and use of technology. They are dispersed across the country, producing a diverse range of products mainly to meet the needs of local markets. They mostly operate in 'clusters', where a group of enterprises in a particular area produce similar products. MSMEs have played a vital role in the economic and social development of India by creating jobs, scaling up manufacturing capabilities arresting migration from rural areas to urban centres, and exporting goods overseas. The MSME sector is well positioned to generate new employment as it is relatively easy to start an MSME enterprise with limited capital, compared to larger firms. These enterprises are engaged in agricultural activities as well as non-agricultural activities such as retail, manufacturing, real estate, repair and maintenance, and other related services. As of 2014-15, there were approximately 51 million working MSMEs distributed across about 6,000 clusters in the country. More than 70 per cent of these enterprises were concentrated in only 10 states: West Bengal (11.62 per cent); Uttar Pradesh (11.55 per cent); Maharashtra (10.02 per cent); Tamil Nadu (7.24 per cent); Andhra Pradesh (6.13 per cent); Kerala (5.21 per cent); Rajasthan (5.01 per cent); Gujarat (4.89 per cent); Karnataka (4.83 per cent); and Madhya Pradesh (4.32 per cent) (MoMSME, 2015-2016).

However, the performance of small-scale manufacturing enterprises has been decreasing over time due to the rising cost of energy and raw materials and lack of access to better technologies. The sluggish growth of the sector is made evident by the slow growth in the number of new enterprises and the reducing contribution of this sector to the economy (Figure 1).

Figure 1: Growth of the sector between 2006-07 to 2013-14



Source: Fourth All India Census of MSME (2006-07); Sixth Economic Census (2013);(MoMSME, 2015-2016)

1.1. Energy consumption and savings potential in the MSME sector

MSMEs across the country employ highly heterogeneous manufacturing processes to produce similar products. Most enterprises in India are small-scale operations with a small capital base and poor access to timely and adequate finance; therefore, they lack the resources to implement the technology solutions available in the market (Dun & Bradstreet, 2017). Instead, they opt for low-cost sub-standard solutions, leading to further inefficiencies in production processes.

Enterprises operating in energy-intensive industries like bricks manufacturing, foundries, glass, ceramics, and textile dyeing incur disproportionately high energy costs. For example, a small-scale ceramics manufacturing firm can easily spend 35-40 per cent of its total production expenditure on energy. Studies have identified about 400 energy-intensive clusters which employ obsolete or sub-standard technologies (TERI, 2015). Table 1 below highlights the approximate share of energy costs in overall production expenditure for some energy-intensive sectors.

Table 1: Energy cost across key energy-intensive sectors

Sector	Energy cost as a share of total manufacturing cost
Forging	50 %
Foundry	50 %
Die casting	35 %
Ceramics	35-40 %
Moulding	12-50 %
Sheet metal	12-28 %
Textile dyeing	10 %

Source: (SIDBI, 2016)

In the absence of comprehensive data on the energy consumption across the 6000 estimated clusters, and considering the lack of energy benchmarking in the sector, offering robust recommendations on possible interventions for achieving EE in MSMEs remains a challenge. Benchmarking and tracking the specific energy consumption (SEC) of units will help in tailoring policies and programmes relevant to their needs. The MoMSME carried out periodic censuses until 2006-07. Although the fourth (and last) MSME census covered both, registered and un-registered enterprises, it did not capture usable information regarding energy consumption. According to the MSME census, out of 26.1 million enterprises, 18.6 million enterprises (approximately 71 per cent) did not use any form of energy to carry out their operations. Of the remaining, 51 per cent used electricity, eight per cent used coal, nine per cent used petroleum fuels, five per cent used LPG/CNG, and the remainder used other forms of energy (mostly biomass) (DC-MSME, 2009). The Report of the Working Group on Power for Twelfth Plan (2012-2017) has provided an estimate of the energy consumption of the entire MSME sector. According to this report, the MSME manufacturing sector consumed about one-quarter of the total energy consumed by the industrial sector (Report of the Working Group on Power for Twelfth Plan 2012-2017). However, a more detailed breakdown of energy consumption data by sector is not provided.

Two donor-funded studies have examined the energy consumption of 96 of the 400 energy-intensive clusters. The Bureau of Energy Efficiency-SME (BEE-SME) programme has carried out surveys to estimate the energy consumption of 19 subsectors spread across 35 clusters. The total energy consumption of these clusters was estimated to be about 5 Mtoe in 2010-11 (BEE, 2010b). The Energy and Resources Institute - Swiss Agency for Development and Cooperation (TERI-SDC) partnership programme on Scaling up Energy-Efficient Technologies in MSMEs estimated the total energy consumption of 59 clusters (including six clusters covered in the BEE-SME programme) to be 22.6 Mtoe in the year 2015-16 (SAMEEKSHA, 2018)

Table 2: Comparison of specific energy consumption across clusters

Cluster	TERI-SDC initiative (2015-16)			BEE-SME programme (2010-11)		
	Annual production (tonnes)	Energy consumption (TOE)	SEC	Annual production (tonnes)	Energy consumption (TOE)	SEC
Ganjam rice mills	N/A	1,248		916	339	0.37
Coimbatore foundry cluster	6,00,000	58,640	0.10	6,45,545	39,701	0.06
Belgaum foundry cluster	3,60,000	34,436	0.10	4,03,606	25,629	0.06
Varanasi clay fired brick-making cluster^	5,80,000	56,00,000	9.66	7,075.28	69,456	10
Muzaffarnagar paper cluster	N/A	1,03,100		1,09,996	49,498	0.45
Ludhiana forging cluster	3,72,000	59,080	0.16	3,73,163	54,855	0.15

Source: (BEE, 2010(a)); (BEE, 2010b); (SAMEEKSHA, 2018); CEEW compilation
SEC: Average energy consumption per unit production; ^: Production units in lakhs of bricks

Table 2 compares the average energy consumption per unit of production within the six clusters mapped under both, the BEE-SME programme and the TERI-SDC initiative. It is observed that, with the exception of the Varanasi brick cluster, the SEC per unit production for the remaining clusters has increased between 2010-11 and 2015-16. Our discussion with the president of the Int Nirmata Parishad of the Varanasi brick cluster revealed that this is because many brick kilns have invested in energy efficiency measures with the support of various supported programmes and are also producing resource-efficient hollow bricks. Thus, it is important to establish an energy consumption baseline across energy-intensive clusters, conduct periodic evaluations of energy consumption, and then design targeted programmes that can be tweaked depending on the feedback/follow-ups.

Energy efficiency is increasingly being recognised as a cost-effective way to not only increase economic productivity and competitiveness, but also to mitigate climate change. Energy efficiency improvements can generate cost savings which can contribute to the profitability of enterprises and free up working capital that can be channelled towards business expansion, research and development, and new products.

MSMEs in India are also vulnerable to price fluctuations as they pay more per unit of energy compared to larger enterprises (TERI, 2015), and they typically use outdated or inefficient technologies. Such inefficiencies lead to higher energy costs and lower profit margins, especially for energy-intensive operations. Energy-efficient technologies (EETs) potentially offer lower energy costs, lower raw material costs, and higher productivity, thus improving the production quality.

MSMEs alone could potentially take up sixteen per cent of India's total energy-efficiency market (Pacharne, Koratkar, & Dange, 2014). The energy savings that could result from adopting EETs across various MSME sectors is shown in Table 3.

Table 3: Energy savings potential across key industrial sectors in the MSME sector

Sector	Energy savings potential
Forging	20 %
Foundry	10-30 %
Die casting	10-20 %
Ceramics	15-30 %
Moulding	15 %
Sheet metal	5-10 %
Textile dyeing	15-30 %

Source:(SIDBI, 2016)

The Government of India has introduced a number of policy interventions to promote the growth of small-scale industries. These include shoring-up demand for MSME output by setting mandatory government procurement targets for products and intermediates from MSMEs; creating credit and marketing facilities; and offering concessions and tax exemptions. For the Twelfth Five-Year Plan, the Bureau of Energy Efficiency set a target of reducing the total energy consumed by the MSME sector by 5.75 per cent by 2017. This is equivalent to a savings of 1.75 Mtoe (1.59 Mtoe from thermal and the remainder from electrical energy), requiring budgetary support of INR 55 crores (Report of the Working Group on Power for Twelfth Plan 2012-2017). There has been no assessment of the methods employed and the outcomes of this proposal.

1.2. Governance and programmes to promote energy efficiency in the MSME sector

1.2.1 Governance of the sector

The Ministry of Micro, Small, and Medium Industries (MoMSME) is the apex agency for drafting policies and regulations related to the MSME sector in India. The MoMSME has three main divisions, or 'wings': Small & Medium Enterprises (SME); Agro & Rural Industry (ARI); and the office of the Development Commissioner (DC-MSME).

The ministry has implemented about 26 programmes to promote the development of MSMEs in India via the DC-MSME and its various state offices: the MSME Development Institutes (MSME-DIs), Tool Rooms/Tool Design Institutes (TRs/TDIs), and Technology Development Centres (TDCs) (Supplementary Information-II) (MoMSME, 2016-2017).

Other government departments, such as the Office of the Textile Commissioner in the Ministry of Textiles, run programmes specific to their sector.

As industries are on the concurrent list, not only the centre but state governments too have the power to implement policies to promote the growth of the MSME sector. One could argue that the states hold the primary responsibility for promoting and developing MSMEs, as small businesses tend to benefit more from local endowments compared to larger firms. The MoMSME and its affiliated divisions and organisations assist state agencies in their efforts to encourage entrepreneurship, employment, and livelihood opportunities in their respective states by developing the competitiveness of MSMEs.

State governments have implemented various policy interventions including fiscal incentives and the provision of institutional support for developing MSMEs (Supplementary Information-III). Energy conservation is currently being promoted by states through their respective state-designated agencies or district industries centres (DICs). They offer rebates on the cost of energy audits and subsidise the implementation of audit recommendations. An analysis of the eight industrialised states reveal that five states (Andhra Pradesh, Maharashtra, Gujarat, Tamil Nadu, and West Bengal) give rebates on energy audit expenses whereas five (Maharashtra, Gujarat, Tamil Nadu, Telangana, and Karnataka) provide incentives for the implementation of energy audit recommendations.

A review of the various central-and state-level programmes to promote energy efficiency (listed in Supplementary Information-II & Supplementary Information-III) reveals a lack of coordination and resource sharing between implementation agencies. The office of the DC-MSME implements the TEQUP scheme and provides training on energy efficiency through their 58 MSME Development Institutes. The nodal agencies (tool rooms, TRs/TDIs, and TDCs) act as the front end for implementing central government programmes and schemes along with the Development Institutes.

The Bureau of Energy Efficiency (BEE), established under the Energy Conservation Act, 2001, funds state-designated agencies (SDAs) to conduct awareness campaigns, provide training, and finance the implementation of energy efficiency measures within states. However, very few SDAs provide dedicated support for the MSME sector such as subsidised energy audits or training and workshops on energy efficiency.

Within a state, the Directorate of Industries is the principal agency that oversees the development of the sector. It operates via the 422 DICs present across the country. However, very few states have dedicated programmes on energy efficiency implemented through DICs.

Interviews with MSME-DI officials showed that the officials have adequate technical expertise, but they lack the manpower to adequately cover all the clusters. In contrast, DIC offices are constantly in touch with enterprises, but they lack the technical expertise to persuade them of the benefits of energy conservation.

1.2.2 An analysis of budgetary allocations

A preliminary budgetary analysis of the three MoMSME divisions based on data from the Twelfth Five-Year Plan reveals an underutilisation of funds. Among the three departments, the office of the DC-MSME accounted for the largest share of unspent funds. As is evident from Table 4, the unspent funds totalled approximately INR 3,000 crore, an amount that exceeds the planned annual average expenditure on the 26 schemes operational under the DC-MSME.

The total unspent funds of the office of DC-MSME during 12th plan was higher than its annual operating budget during the period

Table 4: Budget allocation and expenditure among the key divisions of MoMSME

Division	12th plan outlay	BE during 12th plan	Actual expenditure during 12th plan	Per cent unspent funds
SME	1,535	1,190	886	42 %
ARI	11,705	9,060	7,240	38 %
Office of the DC-MSME	10,884	4,494	3,282	70 %

Source: (Parliamentary Standing Committee, 2017-18)
Note: All figures are in INR crore

Further, among the schemes implemented by the MoMSME, three in particular target the uptake of EETs and technological upgradation (TU). A budgetary analysis of these schemes is presented in Table 5.

Table 5: Budget analysis of central schemes promoting energy efficiency and technology upgradation in MSMEs

Type of support	Scheme name	Budget expenditure-total 12th plan	Actual expenditure-total 12th plan	Unspent funds-total 12th plan	Budget allocated to the ministry-total 12th plan
Capital investment subsidy for technology upgradation of MSMEs	CLCSS	1,733	1,619	7 %	36.03 %
Credit guarantee support for micro and small enterprises	CGTMSE	260	274	-5 %	6.09 %
Financial assistance towards product certification	TEQUP	87	25	71 %	0.55 %
Generating awareness on energy-efficient technologies					
Capital investment subsidy for energy-efficient technologies for MSMEs					

Source: CEEW compilation

CLCSS: Credit Linked Capital Subsidy Scheme for Technology Upgradation
CGTMSE: Credit Guarantee Fund Scheme for Micro and Small Enterprises
TEQUP: Technology and Quality Upgradation Support to MSMEs
Note: All figures are in INR crore

The TEQUP scheme is part of the National Manufacturing Competitiveness programme and has two objectives. The first is to make MSMEs aware of the benefits of adopting EETs and manufacturing processes, including lower production costs and reduce greenhouse gas emissions (MoMSME, 2017). The second objective is to improve the product quality of MSMEs and to encourage them to become globally competitive.

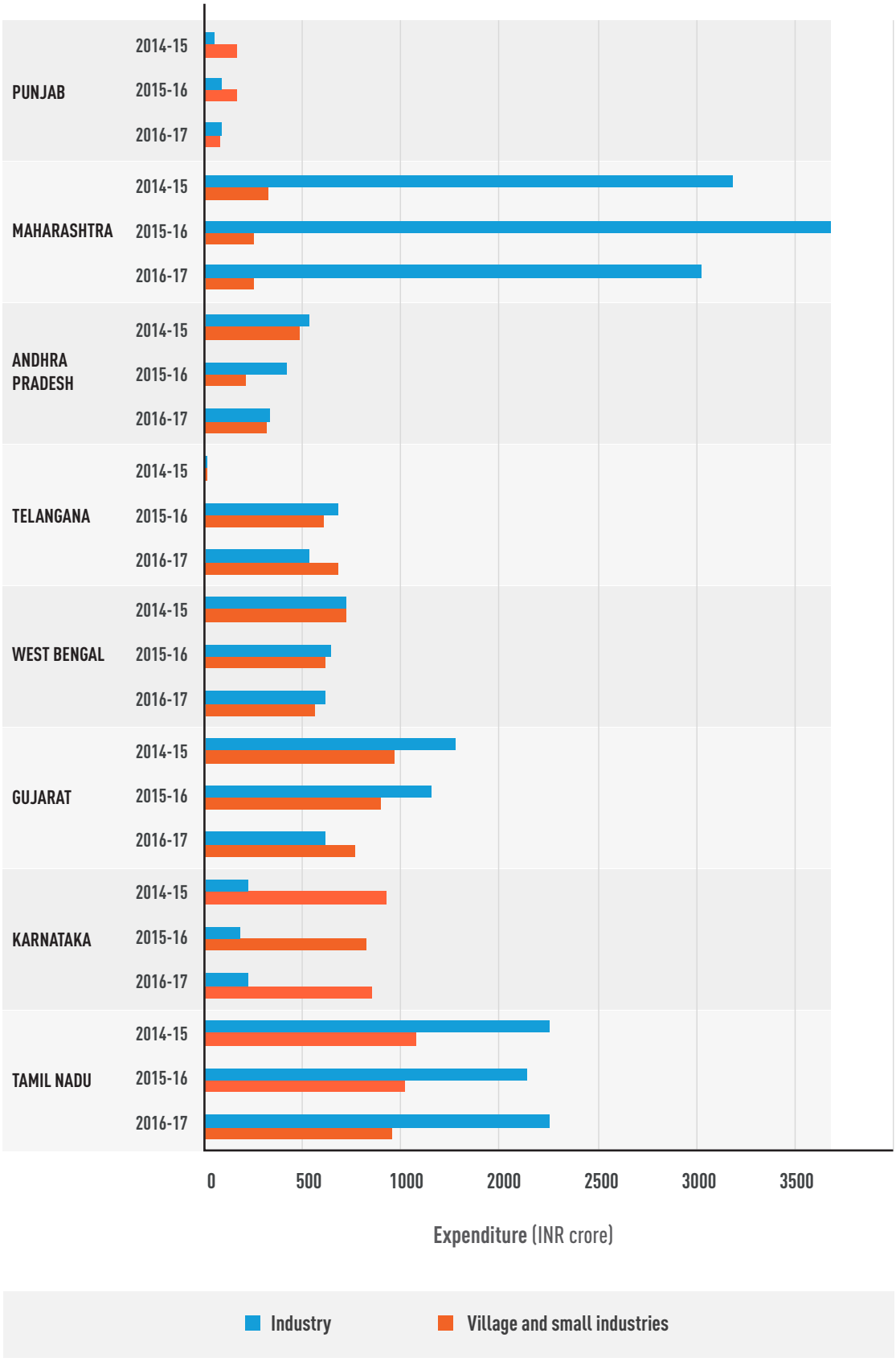
More than 70 per cent of the budgetary allocation for TEQUP scheme has remained unspent during the Twelfth Plan

When compared to other schemes run by the ministry, the funds allocated to this scheme were meagre, amounting to less than one per cent of the ministry's total budget for the period. However, more than 70 per cent of this allocation remained unspent during the Twelfth Plan. Since its inception in 2010, only 229 enterprises have been assisted in the implementation of energy efficiency measures under this programme, and only 92 energy efficiency awareness programmes have been conducted. Since all the schemes currently run by the office of the DC-MSME are demand driven, this underutilisation of funds reflects a failure to make enterprises aware of them, and a failure to address the needs of MSMEs. These are clear signs that energy efficiency is not being accorded the right level of priority by the ministry, and this also reflected in the poor performance of the scheme.

To address these concerns on poor uptake and under-performance of schemes, the SME division needs to carry out surveys, studies, and policy research. However, during the entire period of the Twelfth Five-Year Plan, only INR 13 crores was allocated for these activities, an amount that is grossly inadequate considering that there is currently no primary data necessary to design and optimise schemes. For comparison, let us consider the Central Statistics Office-Industrial Statistics (CSO-IS) wing of the MoSPI (which represents industries currently registered with the Factories Act, 1984), whose primary responsibility is to carry out annual surveys and study the growth and performance of formal sector enterprises. The budget for surveying the approximately two lakh enterprises annually is nearly INR 80 crores.

An analysis of the revenue expenditure of eight states over the last three financial years (2014-15 to 2016-17) indicates that the budgeted expenditure on large industries is higher than on village and small industries (Figure 2). It can be inferred that states such as Gujarat, Maharashtra, and Tamil Nadu - which are considered to be industrially advanced-spend more on promoting the formal industrial sector. States like Andhra Pradesh, Telangana, and West Bengal spend almost equally on larger-and smaller scale industries. Only Karnataka spends more on village and small industries-almost 75 per cent higher than that of the total expenditure allocated for the development of industries. Except for Telangana, the budgeted expenditure on village and small industries dwindled across all the remaining states over the period.

Figure 2: State-wise budget allocation comparison for industry and small-scale village enterprises



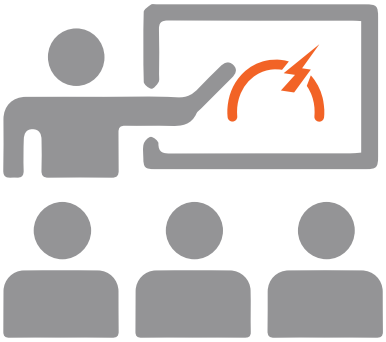
Source: CEEW analysis

1.3. Status of the various other programmes for improving energy efficiency in MSMEs

Several agencies at the national, state, regional, and district levels have been set up to improve the efficiency and market competitiveness of SMSEs by providing financial and technical assistance. Table 6 provides a list (not comprehensive) of the major programmes implemented in this sector.

Table 6: Major donor-funded programmes promoting the implementation of energy efficiency measures in the MSME sector

Programme	Objective
BEE-SME Programme (2007-12)	▪ To improve the energy intensity of the Indian economy by improving the EE of the SME sector ▪ To accelerate the adoption of EE technologies and practices in 25 SME clusters through knowledge sharing, capacity building, and innovative financing mechanisms
GEF-UNIDO-BEE Scheme 'Promoting Energy Efficiency and Renewable Energy in Selected MSME Clusters in India' (2011-2016)	▪ To foster an environment conducive to introducing energy efficiencies and enhancing the use of renewable energy technologies in 12 energy-intensive MSME clusters in India ▪ To improve the productivity and competitiveness of the units as well as to reduce their overall carbon emissions and improve the local environment
World Bank-GEF Project 'Financing Energy Efficiency at MSMEs' (2010-2016)	▪ To increase the demand for energy efficiency investments in target MSME clusters and to enhance their access commercial finance
TERI-SDC Project 'Scaling up Energy Efficiency in Small Enterprises' (2014–17)	▪ To create a policy environment conducive to facilitating/stimulating the adoption of EETs in the MSME sector ▪ To promote the use of EE technologies/ practices in the foundry sector to expand EE beyond the directly project-supported MSMEs ▪ To promote energy-efficient technologies/ practices used by other MSME sectors (aluminium, etc.)



Key activities performed

- Conducting energy use and technology analysis
- Capacity building
- Implementing EE measures
- Developing innovative financing mechanisms

- Conducting techno-economic studies at the unit and cluster level
- Assisting in information sharing
- Conducting training and awareness workshops to share knowledge and experiences in EE and renewable energy
- Establishing 'energy management cells' at the cluster level
- Capacity building of local service providers to provide EE and renewable energy services and products to MSMEs
- Providing financial assistance to 'first movers' for a demonstration project
- Assisting in identifying financial resources for energy efficiency and renewable energy measures

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- Building capacity and awareness
- Increasing investments in EE
- Facilitating knowledge management and sharing

- Collating energy data on energy-intensive MSME clusters in India
- Supporting the implementation of EETs and best operating practices in foundry clusters
- Conducting studies on aluminium melting furnaces and agricultural pump sets

Programme	Objective
ADB - Industrial Energy Efficiency Project (1995-2000)	▪ To increase the economic and technical efficiency of energy use within subsectors where market forces create the appropriate incentives
GEF-UNDP Energy Conservation in small sector Tea Processing Units in South India (2008-12)	▪ To address the major barriers to greater adoption of energy conservation technologies and practices in the firewood intensive tea sector in South India
GEF-UNDP Energy Efficiency in Steel Re-Rolling Mills (SRRM) in India (2004-13)	▪ To increase the energy efficiency of steel re-rolling mills, reduce associated emissions, and increasing adoption of environmentally-sustainable energy-efficient technologies in the sector
UNDP-AusAID 'Upscaling Energy-Efficient Production in Small-Scale Steel Sector Industry in India (2013-15)	▪ To improve energy efficiency to save energy and reduce energy costs ▪ To mitigate greenhouse gas emissions ▪ To improve productivity by providing technological support to small entrepreneurs
GEF-UNDP EE improvements in Indian Brick Industry (2009-16)	To promote production of resource-efficient bricks by: ▪ Demonstrating REB technologies and developing technology models ▪ Building awareness and developing sustainable markets for REBs among various stakeholders such as architects, builders, individual end-users ▪ Influencing government organisations, financial institutions, and policy and decision makers

Source: CEEW compilation

Key activities performed

- Modifying production processes through the installation of equipment required for energy efficiency and the optimisation of plant operations
- Technological restructuring of production facilities
- Licensing or acquiring EE related or other technologies

- Creating awareness about EET/renewable energy technologies' relevance to tea units and implications of their adoption
- Creating an institutionalised mechanism for knowledge creation and management
- Carrying out energy audits in tea processing units
- Institutionalisation of commercial lending for investment in EE/renewable energy equipment
- Developing and operationalising a risk insurance scheme
- Capacity building of agencies to replicate EE projects in other areas and sectors

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- Establishing benchmarks for eco-tech options and packages
- Creating an effective information dissemination programme
- Enhancing capacity of stakeholders for EE in SRRM sector
- Increasing ESCO and third-party financing options for SRRM units

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- Providing technical assistance to carry out energy audits and implement energy efficiency measures in units
- Providing knowledge inputs regarding cost-benefit interventions and post-implementation measurements compared to baseline measurements
- Providing financial incentives to units that have achieved set goals

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- Providing market linkages
- Capacity building
- Providing technical assistance and REB equipment to manufacturers to develop DPR's to establish REB production

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Till now, a total of USD 241 million has been provided through budgetary support, lines of credit, and grants, to help approximately 8,000 enterprises implement energy efficiency measures

One such key agency, the Small-Scale Industries Development Bank of India (SIDBI) - alongside other governmental, international, and multilateral organisations like BEE, Technology Information, Forecasting and Assessment Council (TIFAC), World Bank, DFID, Japan International Cooperation Agency (JICA), KfW, GiZ, and AFD - has carried out studies aimed at identifying the key barriers to enterprises adopting energy efficiency measures. In addition, SIDBI has carried out pilots to test energy efficiency solutions, conducted workshops to promote awareness of the benefits of energy efficiency, and has provided financial and technological assistance for investing in EE improvements. Till now, a total of USD 241 million has been provided through budgetary support, lines of credit, and grants, to help approximately 8,000 enterprises[2] implement energy efficiency measures (Supplementary Information-IV). While this may appear a large investment in absolute terms, it was paid out over decades and is still only a small fraction of what is required for a true transformation. While many of these donor programmes were reported to be successful, their scope remained limited to a small number of clusters (compared to the thousands across the country), with no expansion of the programme across geographies. An independent evaluation of why these interventions have not spun off success stories in other clusters is not available in the public domain.

1.4. Overall aim and objectives of the study

The aim of the study will be to complement the existing efforts of the central and state governments to improve the energy efficiency of MSMEs. The primary objective of the study is to understand the effectiveness of these initiatives, examine their impact on energy efficiency in the MSME sector, and propose some actionable items to improve the overall state of energy efficiency of this sector.

A detailed view of the objectives of the study are as follows:

a) Evaluating the current status of the MSME sector in terms of

- state of technology, energy consumption patterns, and technological improvements that could potentially lead to energy savings
- awareness of energy efficiency and enterprises' perception and responsiveness towards a sustainable business outlook.

b) Identifying the gaps and limitations in the implementation of these initiatives, and tracking the responsiveness of MSMEs towards these policies, programmes, and schemes, as perceived by their various implementing agencies. These agencies will encompass: state and district level DIC offices; MSME-DI centres; establishments providing financial support under the aegis of line ministries; and multilateral and civil society organisations working closely with the MSME sector.

c) Identifying the gaps and limitations in the delivery of various financial support programmes and examining the responsiveness of the MSMEs to these programmes and schemes, as perceived by scheduled banks, non-banking financial companies (NBFCs), and other financial institutions extending credit to the sector.

d) Developing a set of actionable recommendations that will complement (or inform) the Government of India's evolving plan of improving energy efficiency in MSMEs.

[2] This number excludes the MSMEs that benefited from attending training programmes and awareness campaigns on energy efficiency.

Image: Sachin Sharma/CEEW

Image: iStock

2. Data and Methodolgy

Locations of

- Surveys conducted
- Interviews with clusters
- Interviews with MSME-DI and DICs centres

Source: CEEW compilation

A mixed methodology approach comprising literature review, semi-structured interviews, and a survey of enterprises has been adopted in this study.

1. An extensive review of relevant literature was first carried out, in order to understand the challenges and knowledge gaps that impede the adoption of energy efficiency measures in the MSME sector. The sources reviewed included: reports from relevant ministries; project implementation and supporting institutions such as SIDBI and BEE; other research institutions including The Energy and Resource Institute (TERI); and other agencies active in the area of energy efficiency.

2. In order to incorporate a range of perspectives on the limitations and challenges of adopting EETs, semi-structured interviews were conducted with members of industrial associations; experts from institutions and agencies providing technical and financial assistance to the MSME sector; and energy service companies.

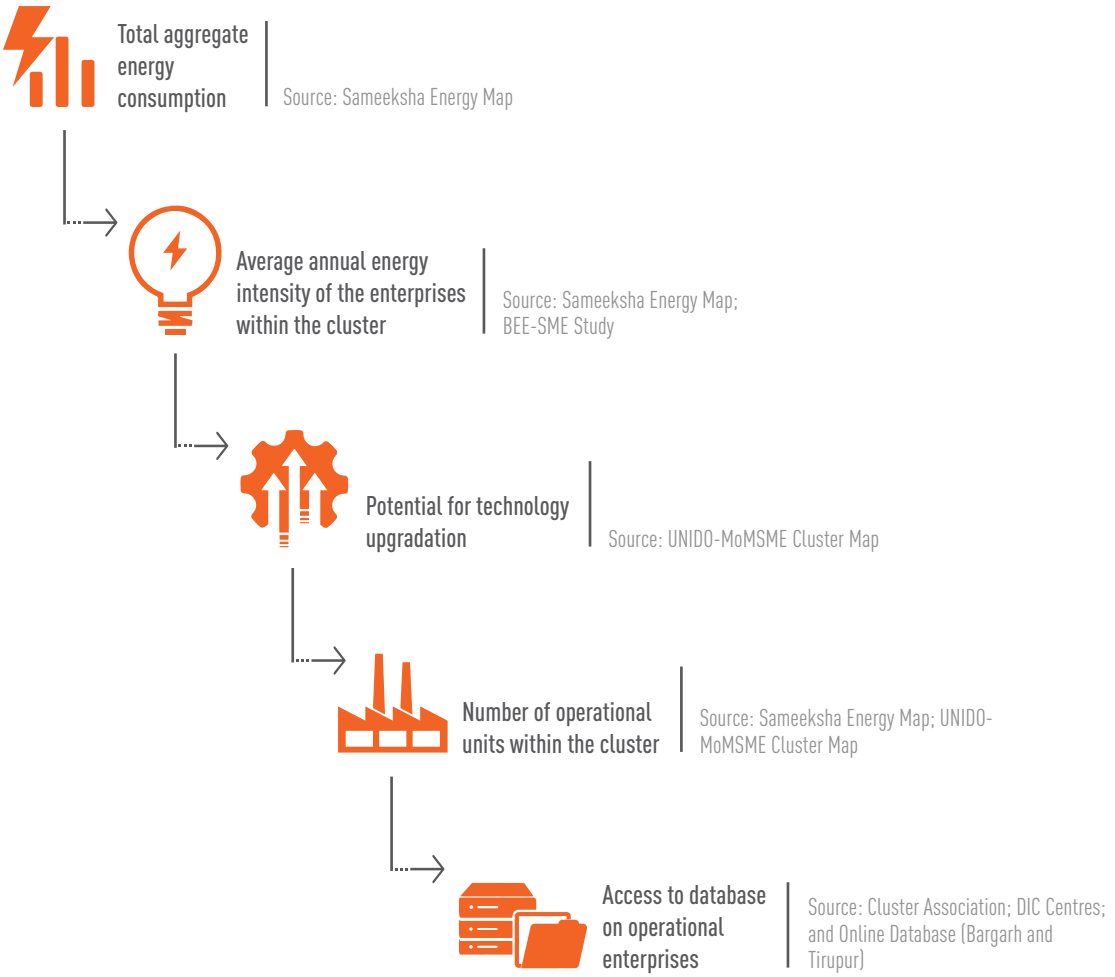
3. Semi-structured interviews were conducted with government departments and agencies to understand their constraints in implementing existing schemes, and to record their opinions on the efficacy of the interventions implemented thus far.

4. A survey questionnaire was designed to gather additional data on the questions raised in our study, as well to reflect the views expressed by stakeholders during our pre-survey discussions.

2.1. Selection of clusters for the survey

Though there is an urgent need to roll out energy efficiency measures in all industries, it is likely to find greater acceptance in energy-intensive sectors, and in cases where experts can guarantee a reasonable return on investment. Hence, the survey was limited to clusters which were expected to have energy-intensive processes: forging, foundry, ceramics, metal fabrication, textile manufacturing, and bricks manufacturing. In the absence of detailed mapping of such clusters,no information regarding their cumulative energy consumption, and with no categorisation of clusters and enterprises according to specific manufacturing processes, we used energy consumption data from the only available study that has conducted energy benchmarking across 36 energy-intensive clusters (TERI, 2015). The final selection of clusters for the survey was based on specific criteria: (i) the total aggregate energy consumption by the enterprises in particular clusters; (ii) the average annual energy intensity of the enterprises within the cluster; (iii) the potential for technology upgradation; (iv) the number of operational units within the cluster; and (v) access to a database on operational enterprises (Figure 3).

Figure 3: Cluster selection process for the survey



Source: CEEW compilation

We obtained information about the potential for technology upgradation and the number of operational enterprises from a detailed cluster map developed for about 388 clusters by UNIDO as part of the UNIDO-Cluster Development Programme (UNIDO-CDP) (UNIDO, 2003). However, this data is considerably dated and further consultation with experts from the Foundation for MSME Clusters (FMC) and UNIDO was carried out to get more current information on these parameters. Since a purposive sampling technique has been used, the final shortlisting of the clusters was based on the availability of a database that provided the contact details and addresses of MSME units. A total of 11 clusters across eight states were selected for the survey, and representatives from a total of 429 enterprises from these clusters were interviewed (information on the share of survey responses from each cluster is provided in Table 7). Six surveys were carried out in an automobile parts manufacturing cluster and a readymade garments manufacturing cluster in Gurgaon as a pilot study under the supervision of researchers from CEEW, to obtain feedback on the survey instrument.

Table 7: Details of clusters surveyed

State	District	Cluster name	Industry sector	Enterprise surveyed
Gujarat	Morbi	Morbi ceramics	Glass and ceramics	51
Gujarat	Jamnagar	Jamnagar brass	Foundry and forging	49
Gujarat	Surat	Surat textile	Textile	30
Haryana	Jhajjar, Bahadurgarh	Haryana clay fired brick-making	Brick	39
Karnataka	Belagavi	Belgaum foundry	Foundry and forging	52
Odisha	Bargarh	Bargarh rice mills	Food processing	35
Punjab	Ludhiana	Ludhiana forging	Foundry and forging	50
Tamil Nadu	Tirupur	Tirupur dyeing	Textiles	24
Maharashtra	Nasik	Malegaon textile	Textiles	49
Uttar Pradesh	Varanasi	Varanasi brick	Brick	50

Source: CEEW compilation

2.2. Semi-structured interviews with cluster associations and industry experts

We carried out a series of stakeholder discussions with the heads of a number of cluster associations: a bricks manufacturing cluster in Varanasi; a mixed cluster in Faridabad; a textile cluster in Panipat; a foundry cluster in Howrah; and a glass cluster in Firozabad. We also carried out interviews with proprietors and managers of individual units in Faridabad as well as of a textile cluster in Panipat,a chemical cluster in Ankleshwar, a mixed cluster in Tarapur, and the forging cluster in Jalandhar.

Our survey instrument was further refined based on inputs from experts at TERI, FMC, UNIDO, Centre for Glass Development Institute in Firozabad (CGDI), and Northern India Textile Research Association in Panipat (NITRA-Panipat).

We also had discussions with representatives from SIDBI, Yes Bank, and a few energy service companies.

2.3. Semi-structured interviews with key government organisations

Both central and state governments play an important role in the development of the MSME sector, through MSME-DI and DIC offices respectively. We also interacted with officials associated with the MSME-DIs in Kolkata, Agra, and Mumbai, and DICs in Firozabad, Jalandhar, Ludhiana, and Thane (a detailed list of all semi-structured interviews and meetings is available in Supplementary Information-V.)

2.4. Survey exercise

2.4.1. Sampling and questionnaire design

A homogeneous, purposive sampling method has been employed in this study. Such a sample is not meant to capture the attributes of the entire population of MSMEs, but it is intended to deliver quick insights into the challenges faced by a set of energy-intensive clusters. The enterprises were randomly selected from a database containing information about the operational enterprises within each cluster. The databases were obtained from the respective cluster associations.

As mentioned earlier, the questionnaire was based on issues that were highlighted in earlier interviews. The instrument went through several rounds of revision based on observations from the pilot studies to test for ease of administration of the questionnaire and the ability of respondents to understand the questions and respond meaningfully. The full questionnaire will be available along with the download link for the full report.

2.4.2. Data collection and cleaning

We used computer-assisted personal interviewing(CAPI) to complete the survey. The enumerators used handheld devices to carry out the survey, thus enabling the use of a wide range of tools for monitoring and quality control. A total of 11 teams comprising 23 enumerators and 11 supervisors were deployed to carry out surveys in all the eight clusters. They were deployed in a staggered manner so as to identify issues in administering the survey and fixing them, without resorting to changing the questionnaire itself and thereby keeping it consistent across all respondents. We carried out extensive training sessions for the field enumerators to make them comfortable with the process of conducting the survey. Researchers from CEEW also periodically evaluated the data for outliers and obvious errors.

2.4.3. Data analysis

Exploratory data analysis has been performed using MS-Excel and further statistical analysis has been carried out in STATA. A test for significance of proportions was carried out to establish the significance of the difference in population proportions estimated from two samples. For example, for the two population samples- enterprises aware of energy audit subsidy programmes and enterprises not aware, we want to test whether the share of enterprises carrying out energy audits is significantly higher in the first sample when compared to the second. We use Fisher's-p values to establish the significance at 95% confidence levels. Secondly, the nature of both the dependent and independent variables being categorical, a logistic regression model was used to quantify the impact and test the significance of the various interest variables on the adoption of energy efficiency measures.

Image: Sachin Sharma/CEEW

Image: iStock

3. Results

The survey covered 11 MSME manufacturing clusters across eight states. It provided insights on a number of important questions: the attitude of enterprise owners towards technology upgradation and energy efficiency; their current financing patterns; their awareness of various institutional and government programmes for technology upgradation and implementing energy efficiency measures; and the status of energy financing mechanisms in these clusters.

3.1. Sample profile

A total of 429 enterprises were surveyed. As per the definitions provided under Micro, Small and Medium Enterprises Development Act, 2006 (DC-MSME, 2009), the firms were categorised as micro, small, and medium enterprises based on the quantum of their investment in plant and machinery. Sample distribution was as follows: micro (32 per cent), small (62 per cent), and medium (six per cent). Geographically, 32 per cent of the surveyed firms were located in the northern region (Punjab, Haryana, and Uttar Pradesh); 18 per cent in the southern region (Karnataka and Tamil Nadu); 42 per cent in the western region (Maharashtra and Gujarat); and eight per cent in the eastern region (Odisha). Table 8 shows the distribution of the key characteristics of the sample across states.

Table 8: Distribution (number of enterprises) of key sample characteristics across states

Characteristics	Parameter	GUJ (per cent)	HAR (per cent)	KAR (per cent)	MAH (per cent)	ODI (per cent)	PUN (per cent)	TN (per cent)	UP (per cent)
Type	Micro	23	3	60	57	0	40	58	28
	Small	64	97	40	43	89	58	33	72
	Medium	13	0	0	0	11	2	8	0
Operation	Formal	55	5	94	98	97	64	96	2
	Informal	45	95	6	2	3	36	4	98
Respondent	Owner	76	74	92	90	11	96	83	88
	Senior management	23	26	8	10	89	2	13	0
	Others	1	0	0	0	0	2	4	12
	GUJ (Gujarat)	**HAR** (Haryana)	**KAR** (Karnataka)	**MAH** (Maharashtra)					
	ODI (Odisha)	**PUN** (Punjab)	**TN** (Tamil Nadu)	**UP** (Uttar Pradesh)					

Source: CEEW compilation

While 99 per cent of the enterprises surveyed were registered under a number of different statutes, approximately 61 per cent of the enterprises belonged to the formal, or organised, sector.[3] The larger share of informal enterprises in Haryana and Uttar Pradesh can be attributed to the brick manufacturing enterprises surveyed in Bahadurgarh/Jhajjar and Varanasi respectively (see Table 8).

[3] As per the classification used by National Accounts Statistics of India, the organised/formal sector comprises all enterprises registered under sections 2m(i) and 2m(ii) of the Factories Act 1948, and the Bidi and Cigar Workers Act 1966.

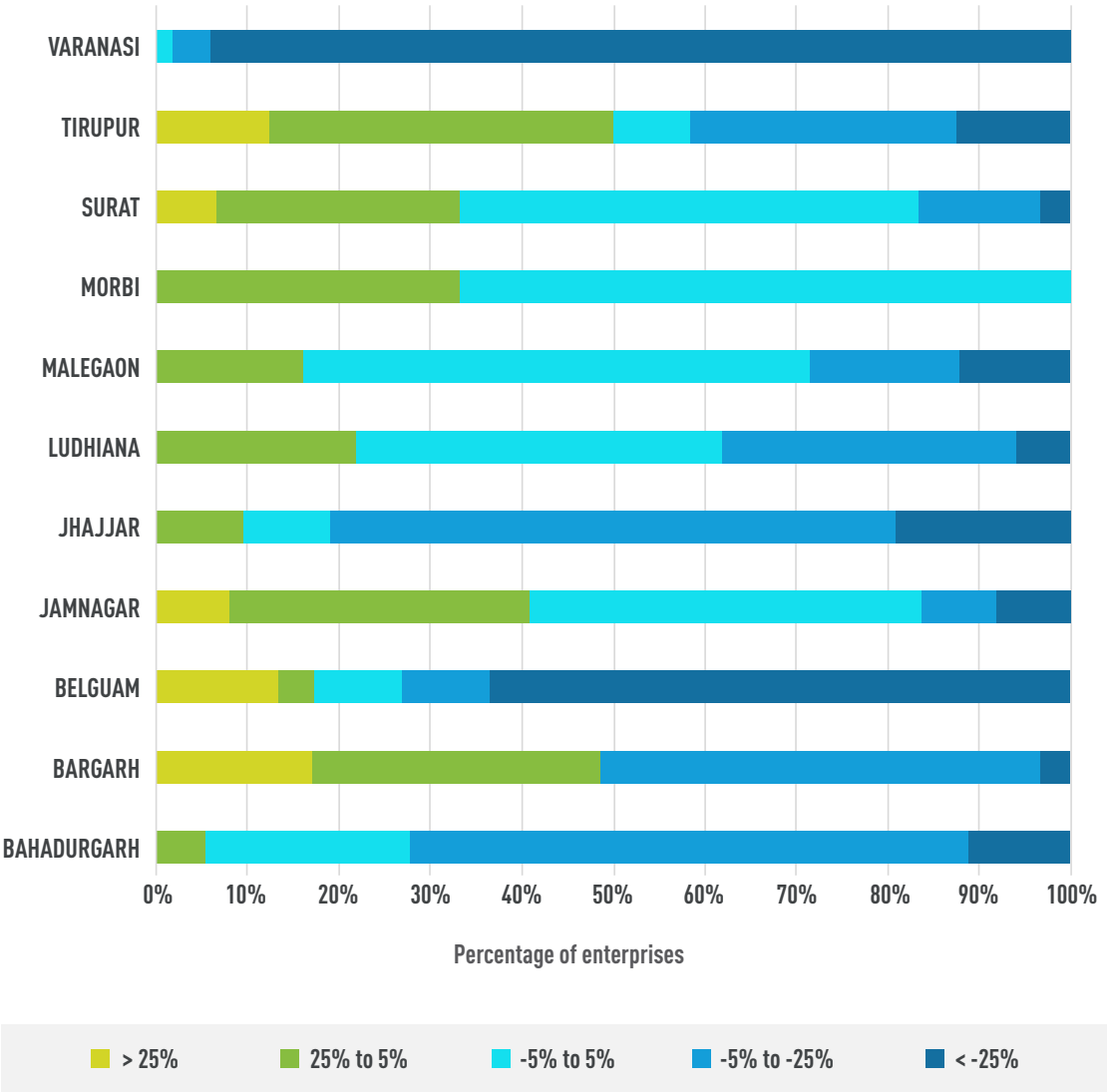
3.2. Enterprise owners' outlook on demand, capacity utilisation and investment

3.2.1. Demand outlook

Sustained demand facilitates the growth of an enterprise and attracts investments that can be channelised towards modernisation and expansion. When asked if demand for their products had increased over the past five years, about 77 per cent of the enterprises reported a stagnation or decrease in demand.

At the cluster level, brick-making enterprises in Bahadurgarh, Jhajjar, and Varanasi also reported a decrease in demand over a five-year period. In contrast, most enterprises operating in Gujarat (Morbi, Jamnagar, and Surat clusters) reported an increase in demand (Figure 4).

Figure 4: Demand growth over the past five years



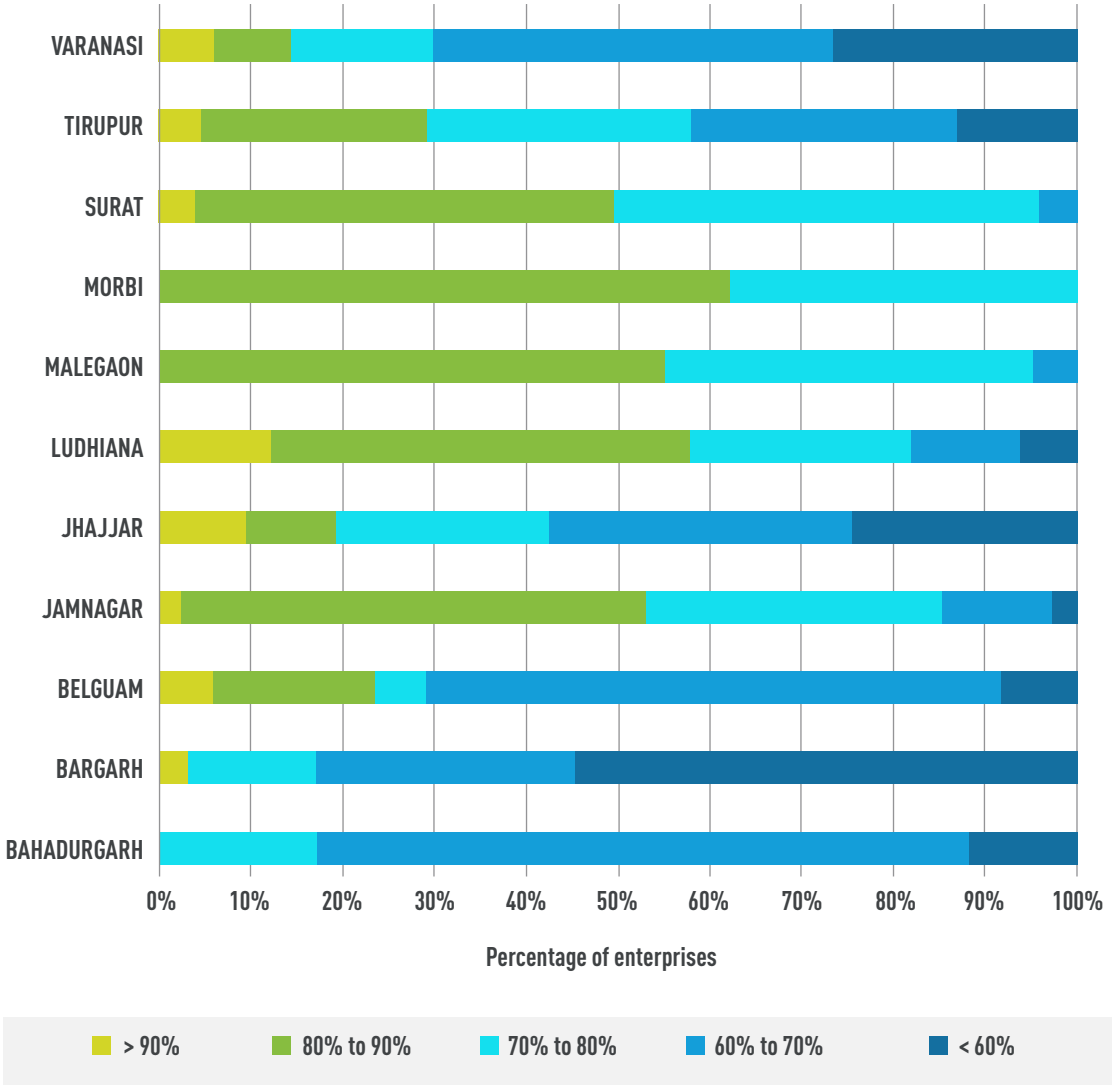
Source: CEEW compilation

3.2.2. Capacity utilisation

At the aggregate level, the capacity utilisation of most of the enterprises surveyed remained below 70 per cent. Only four per cent of the enterprises were able to use more than 90 per cent of their installed capacity.

Figure 5 highlights the average annual capacity utilisation of the surveyed enterprises by cluster. The product demand and capacity utilisation trends appear similar, except for in the case of the rice mills of Bargarh, where firms reported a lower capacity utilisation not commensurate with the growth in demand for their products. This anomaly can be attributed to a 'false' declaration of milling capacity (in excess of their actual capacity) in order to avail of a higher allotment of rice for processing, as highlighted in a recent investigation by the Odisha Government (Odisha Watch, 2016).

Figure 5: Annual average capacity utilisation

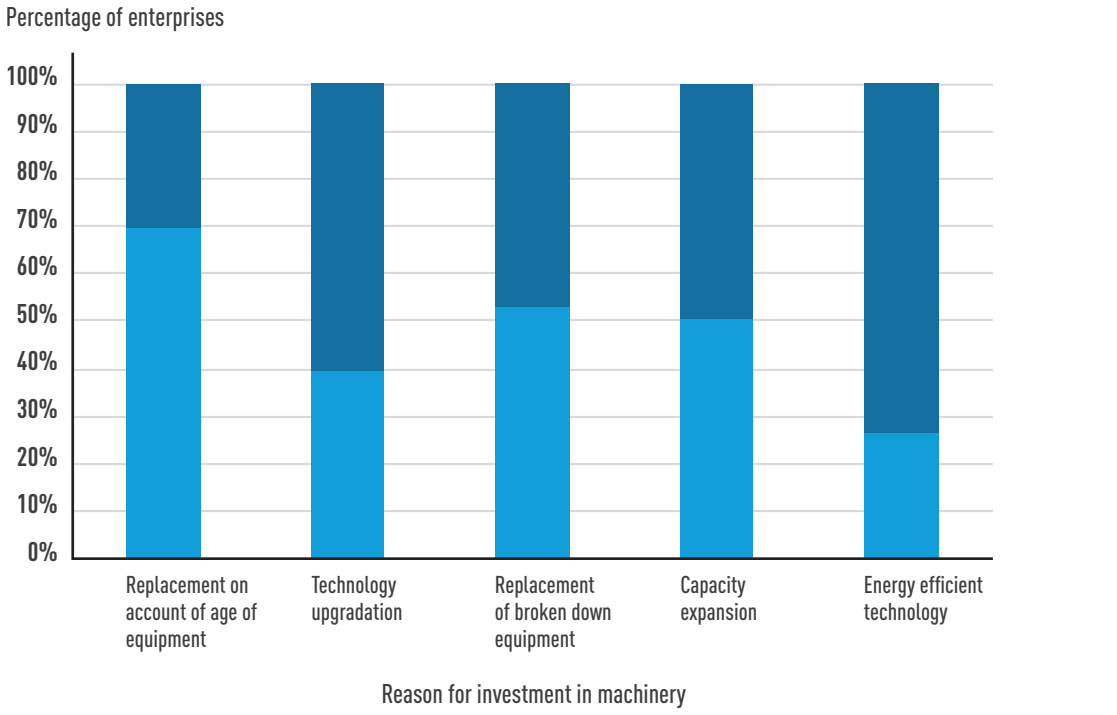


Source: CEEW compilation

3.2.3. Investments on machinery

An analysis of the reasons reported by enterprises for their most recent investment in machinery yielded three main answers: 'replacing broken-down equipment' (about 36 per cent); 'upgrading to more recent technology' (about 34 per cent); and 'replacing on account of age of equipment' (about 16 per cent).

Figure 6: Comparison of types of machinery investments across capacity utilisation levels



Source: CEEW analysis

Capacity utilisation is found to be a crucial factor in influencing the decision of an enterprise owner with regard to investment in machinery. Growing capacity utilisation in recent years (which in turn could be caused by robust growth in demand) is more likely to incentivise an enterprise owner to invest in newer and more EETs, as opposed to investing in replacing old and defunct machinery.

Enterprises that have an annual capacity utilisation of more than 80 per cent are significantly more likely to invest in technology upgradation and EETs than enterprises that have a capacity utilisation of less than 80 per cent (Figure 6).

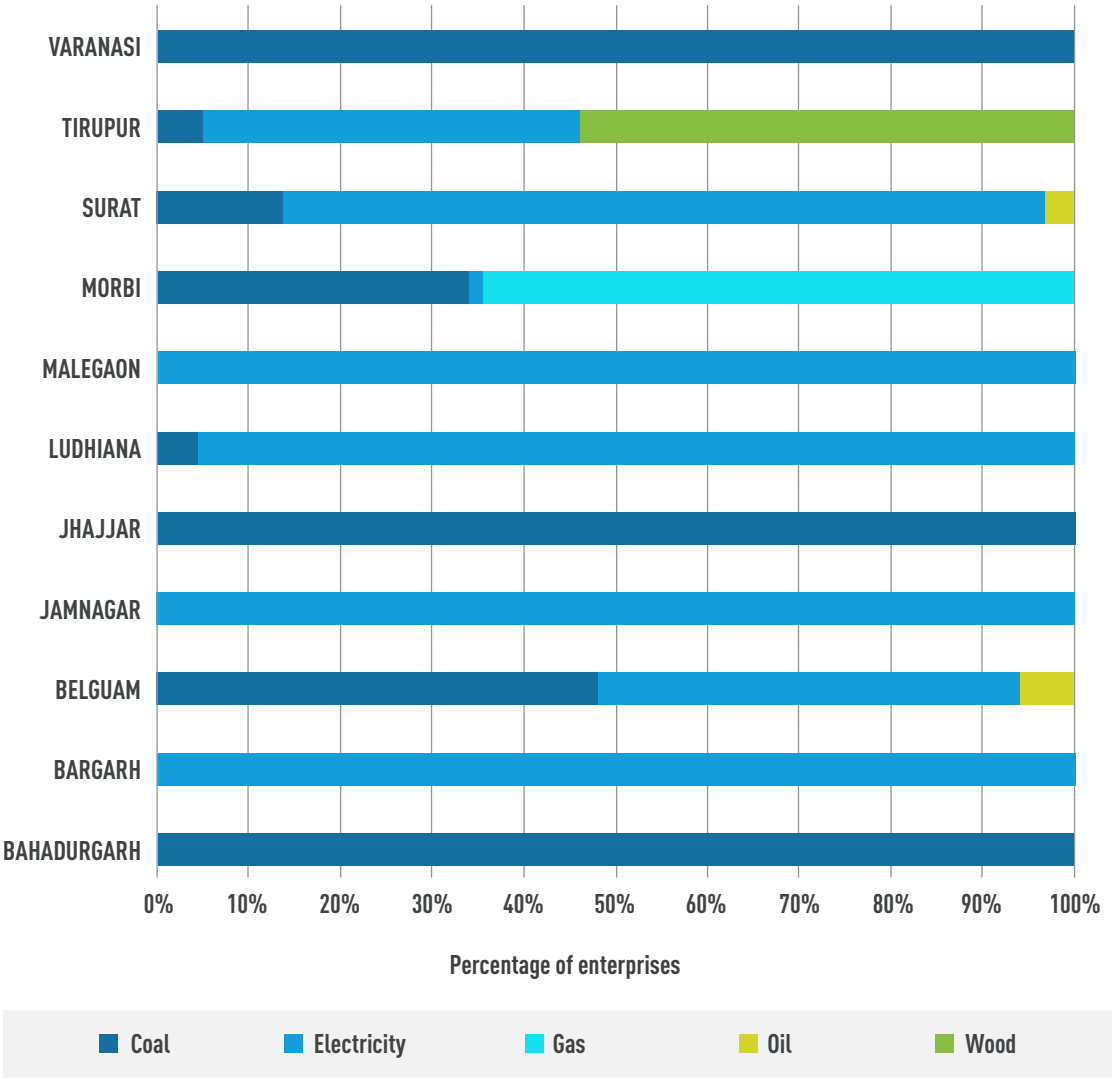
Growing capacity utilisation in recent years (which in turn could be caused by robust growth in demand) is more likely to incentivise an enterprise owner to invest in newer and more EETs, as opposed to investing in replacing old and defunct machinery

3.3. Current state of energy consumption, energy monitoring, and energy audits

3.3.1. Energy consumption

Electricity was found to be the preferred energy source for most the units surveyed. It was the largest expenditure for 60 per cent of respondents. Coal was the main energy source for 29 per cent of units, natural gas for seven per cent, petroleum products for one per cent, and other fuels for three per cent. Figure 7 provides a cluster-wise comparison of energy consumption.

Figure 7 : Distribution of primary energy consumption across clusters



Source: CEEW analysis

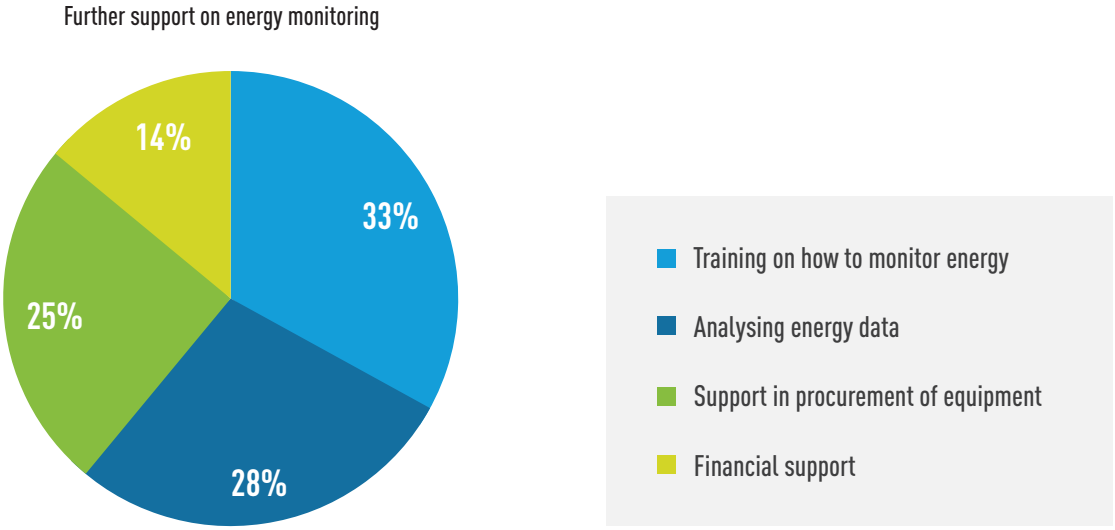
The higher percentage of enterprises consuming electricity in the brass cluster of Jamnagar and the forging cluster of Ludhiana is a result higher number of machining units surveyed in these clusters.

3.3.2. Energy monitoring

About 93 per cent of the units surveyed declared that they are monitoring their energy consumption in some manner. Of these, 56 per cent are only tracking energy bills, and 20 per cent are tracking energy bills and carrying out equipment-level energy monitoring. Findings from the study indicate that 60 per cent of enterprises only use energy bills to monitor energy consumption.

Tracking energy bills only allows for an understanding of energy costs and gives a broad overview of the overall energy performance of the unit; however, it does not provide information about the performance of particular equipment or other underlying factors like the impact of energy consumption on productivity. When enterprises were asked whether they needed additional support for energy monitoring, 42 per cent said that they would require support. The top three requirements as highlighted by enterprises were: i) training on methods of monitoring energy; ii) help in analysing energy data; and iii) support in procuring monitoring equipment (Figure 8). This clearly highlights a significant knowledge gap on the part of enterprise owners with regard to effective methods of energy monitoring.

Figure 8: Various support on energy monitoring as highlighted by the enterprises



Source: CEEW analysis

Most (88 per cent) enterprises maintain consistent records with regards their energy consumption. Of these, 48 per cent maintain a separate book and 30 per cent have computerised records. This finding highlights the potential to aggregate this data in a nation-wide database on energy consumption by the MSME sector. The creation of such a database will aid policy planners by making available a baseline and periodic evaluations of energy consumption within the MSME sector.

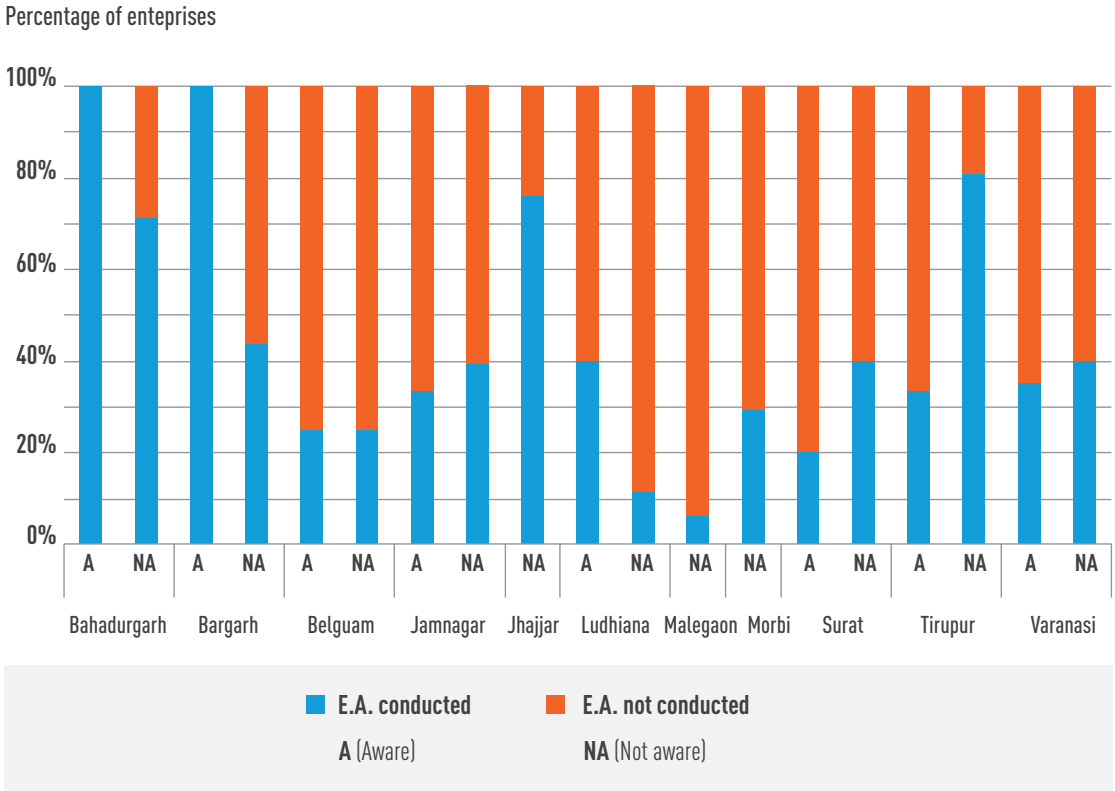
3.3.3. Energy audits

An energy audit is the first step towards energy conservation and improving the energy efficiency of an enterprise. Data shows that only 35 per cent of enterprises have carried out an energy audit. Our survey showed that energy audits were carried out by six per cent of enterprises in the Malegaon textile cluster, 14 per cent in the Ludhiana forging cluster, and 25 per cent in the Belgaum foundry cluster. In contrast, 77 per cent of enterprises in the Haryana brick clusters had carried out energy audits, and 75 per cent in the Tirupur textile cluster.

All the states considered in the survey subsidise energy audits by provide financial subsidies to the MSME enterprises for carrying out energy audits. However, a test for significance of proportions shows that the awareness on energy audit subsidies do not have any significant relationship with enterprises conducting energy audits (Table 10). A test for significance of proportions establishes the significance of the difference in population proportions estimated from two samples. In the current analysis, we consider the two population samples - enterprises aware of energy audit subsidy programmes and enterprises that are not aware. The test determines whether the share of enterprises carrying out energy audits is different in the two.

As seen in Figure 9, only in the Bahadurgarh and Bargarh clusters did all enterprises that were aware of energy audit subsidies carry out energy audits. In the remaining clusters, of enterprises that were aware of energy audit subsidies, only 40 per cent actually carried out energy audits in recent years (less than 3 years).

Figure 9: Impact of awareness of energy audit subsidies on enterprises carrying out energy audits

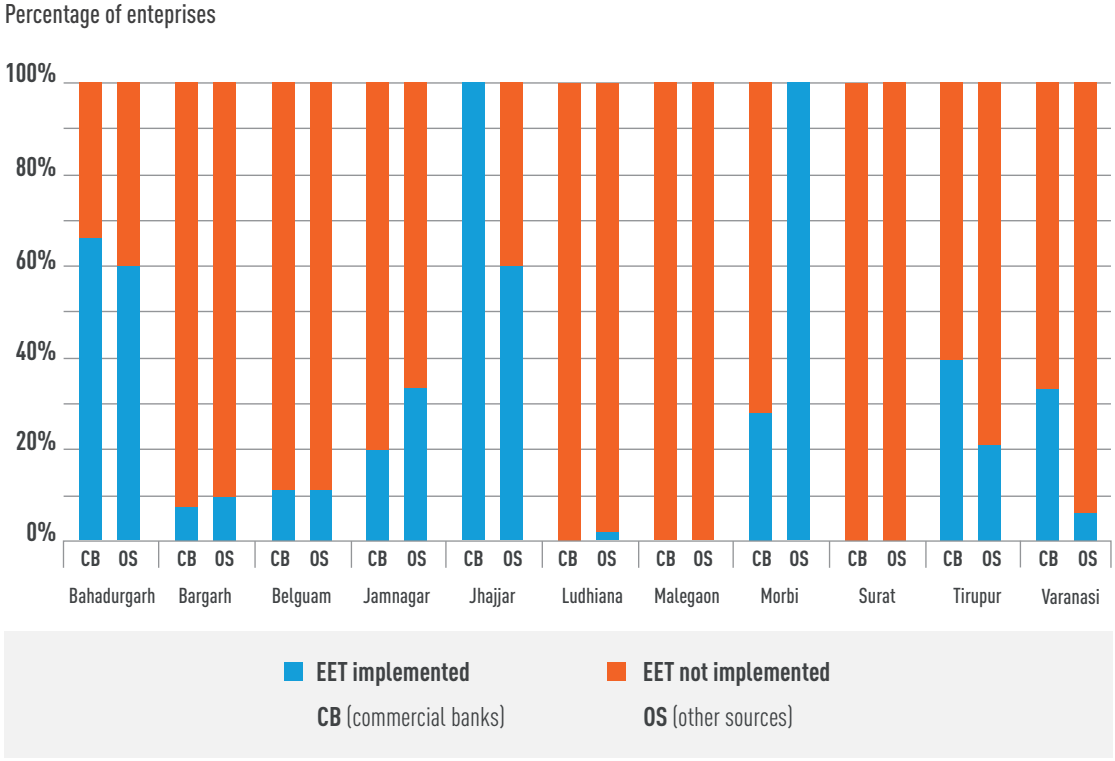


Source: CEEW analysis

3.4. Availability of formal finance and energy efficiency investments

When asked about their primary source of financing for working capital requirements, 63 per cent of enterprises reported that they rely on self-financing and 28 per cent said that they had taken loans from commercial banks. A similar trend has also been observed for capital investments: 56 per cent relied on self-financing, and 35 per cent took loans from commercial banks. The poor access to formal finance is mainly due to the perceived lack of credit worthiness of the sector (International Finance Corporation, 2013). Our analysis shows that 38 per cent of formal enterprises have access to bank loans, and 30 per cent have access to informal lenders. According to the Fifth Annual Employment-Unemployment Survey (2015-16) conducted by the Ministry of Labour and Employment, formal sector enterprises fall under the tax net, including GST (Labour Bureau, 2015-16), and are thus they are more likely to follow financial accounting standards. Statistical analysis shows a strong relationship between being a formal enterprise and access to formal credit (see Table 11 in Supplementary Information-1).

Figure 10: Impact of access to formal credit on enterprises investing in energy-efficient technology



Source: CEEW analysis

Lack of access to formal financing is often cited as a key barrier to technological upgradation and the adoption of EETs in MSMEs. However, survey data suggests that the source of capital expenditure (CapEx) financing does not influence the decision to invest in EETs. A test of significance of proportions also indicates that the availability of formal finances not significantly influencing the investments in EETs (see Table 12 in Supplementary Information-1).This is also evident from lack of a visible correlation in Figure 10.

One plausible reason for this could be that existing financial instruments do not address the needs of enterprises towards these investments or are cumbersome to access. Survey responses show that while seven per cent of enterprises have invested in EETs using financing from the formal sector, only one per cent availed of a loan specifically for investing in energy efficiency. Furthermore, an analysis of the different purposes for which loans towards capital investments are taken shows that a most (55 per cent) enterprises availed of a technology upgradation loan from the formal sector, and 38 per cent have taken loans to replace non-functional equipment (details on the number of enterprises investing in EETs across clusters is provided in Supplementary Information-VI). Hence, it can be inferred that enterprises are investing in EETs by availing of other forms of loans from commercial banks.

3.5. Current status of the TEQUP scheme and energy efficiency workshops

3.5.1. TEQUP scheme

The TEQUP scheme has had a very poor uptake within the clusters that were part of the study. Only 14 per cent of enterprises were aware of the scheme and even fewer (eight enterprises) had availed of the benefits. A further investigation reveals that only one enterprise had invested in EETs, while the remaining seven have undertaken product certification.

3.5.2. Energy efficiency workshops

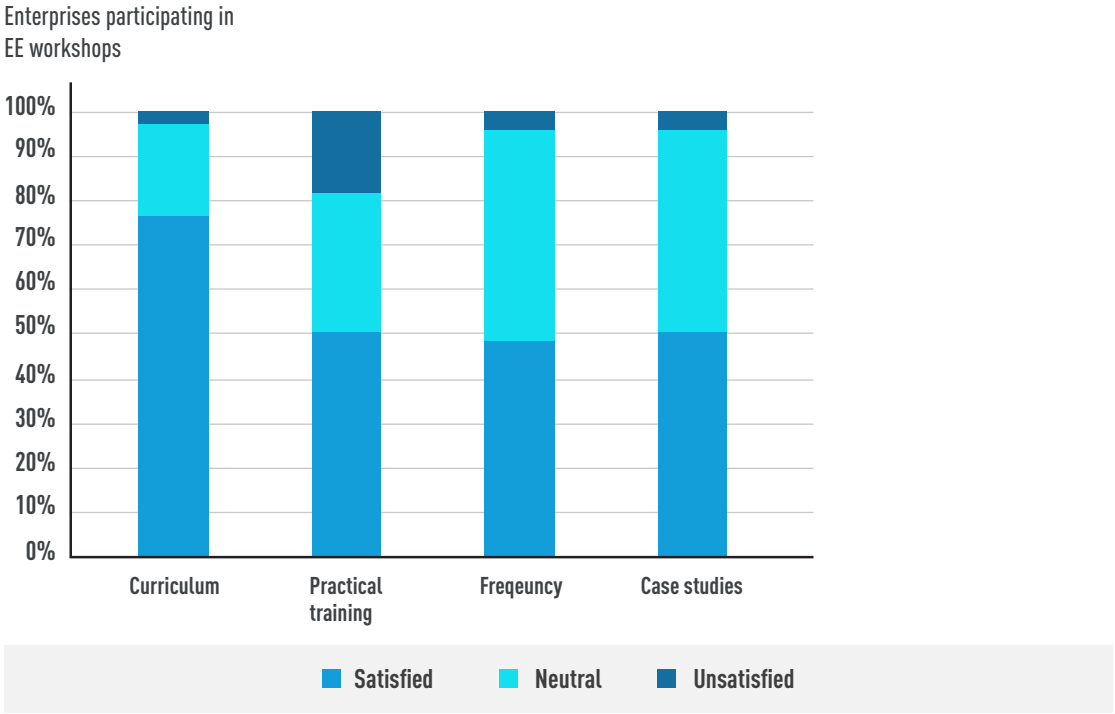
Survey data shows that only 19 per cent of the enterprises surveyed have participated in energy efficiency workshops. Of the 81 per cent that have never participated in an EE workshop, most (67 per cent) cited lack of information about these workshops as the primary reason for not participating.

Of those who attended such workshops, more than 70 per cent were satisfied with the curriculum. However, only 50 per cent of workshop participants were satisfied with the level of practical/ hands-on training, the frequency of training sessions, and the use of case studies (see Figure 11).

Surprisingly, only 56 per cent of the enterprises which had participated in these workshops were aware of the EETs relevant to their sector. Although we cannot derive a direct causation between their awareness (or lack thereof) and the workshops, this does raise questions about the efficacy of these workshops in their current form and suggests lower levels of awareness, enterprises' dissatisfaction towards the amount of practical training in the curriculum and the frequency at which workshops are held.

Only 19 per cent of the enterprises surveyed have participated in energy efficiency workshops. Of the 81 per cent that have never participated in an EE workshop, most (67 per cent) cited lack of information about these workshops as the primary reason for not participating

Figure 11: Satisfaction levels with current energy efficiency workshops



Source: CEEW analysis

3.6. Factors affecting energy efficiency adoption

A regression analysis was conducted to understand the key factors that influence an enterprise owner's decision to adopt of energy efficiency measures: the physical and financial performance of an enterprise; its current technology status; the level of energy monitoring practised; the enterprise owner's awareness and perception of energy efficiency and relevant technologies; and the enterprise owner's awareness of existing schemes and programmes. A logistic model was used to quantify the impact and test the significance of different variables on the decision to adopt energy efficiency measures. The adoption of energy efficiency measures, for reasons of simplicity, has been reduced to three distinct activities, as follows: a) carrying out energy audits; b) investing in EETs; and c) carrying out process modifications (including changes of fuel mix). Three different regression models were used to identify the factors influencing them. The equations for the logistic regressions are presented in Table 13, in Supplementary Information-1.

These models were arrived at after multiple iterations, eliminating collinearities between the independent variables, and after testing their significance levels with the dependent variables by carrying out a test for significance of proportions. For example, 'growth of demand for products' and 'presence of work contract' were dropped as they were highly correlated with 'capacity utilisation' and 'access to formal finance', respectively. An increase in demand would certainly lead to higher capacity utilisation, and the presence of a work contract would certainly decrease the risk for the formal financial institutions providing loans to enterprises. All the dependent and independent variables used in the models are categorical in nature, and their description is provided in Table 14 in Supplementary Information-1.

The results from the three regressions are presented as odds ratios in Table 9. Odds ratios are used to measure the association between an exposure and an outcome, the exposure here being the independent variables and the outcome being the dependent variable. In a logistic regression, the regression coefficient (represented as an odds ratio), is the estimated increase in the outcome per unit increase in the value of the exposure.

Table 9: Factors affecting the uptake of energy efficiency initiatives

Variable name	Odds ratio		
	Enterprises conducting energy audit	Enterprises investing in EETs	Enterprises carrying out process modifications
age of the enterprise	0.4 ***	0.5	0.4 ***
turnover	1.3	1.2	0.7
competition-large industries	2.9 ***	3.5***	1.5
capacity utilisation	0.9	1.5	1.2
access-formal-finance	1.0	1.6 (CapEx)	0.6
driver-compliance	0.8	0.6	1.4
driver-fuel efficiency	0.5	0.9	0.7
energy-inefficiency	1.3	0.4 ***	1
eeworkshop	2.2 ***	0.7	0.9
awareness-subsidised-EA	1.0		
awareness-TEQUP		0.7	
awareness-EETs		1.9 ***	1.9
source of information: Other enterprise	3.4 ***	7.3 ***	0.7
equipment-level monitoring			5.6 ***

Model 1: $2\chi = 59.92$; p (2χ) = 0.000, n = 429
Model 2: $2\chi = 75.59$; p (2χ) = 0.000, n = 429
Model 3: $2\chi = 54.18$; p (2χ) = 0.000, n = 429

Source: CEEW analysis

****: Significant at 95 per cent confidence; detailed information is provided in Table 15, Table 16, and Table 17*

MSMEs competing with larger enterprises are more likely to carry out energy audits and invest in energy-efficient technologies. MSMEs competing with larger firms cannot leverage economies of scale; however, a reduction in energy cost per unit of production allows them to be more competitive. Hence, competition with large enterprises increases the odds of carrying out an energy audit and investing in EETs by 290 per cent and 350 per cent, respectively.

Enterprises are more likely to carry out energy audits and invest in energy-efficient technologies if they learn about government programmes, other schemes, and technology solutions from their peers. This establishes the fact that information passed on by peers plays a key role in firms' decisions regarding energy conservation.

Participation in energy efficiency workshops is found to have a significant positive impact on enterprises towards conducting energy audits. Enterprises participating in energy efficiency workshops are 200 per cent more likely to conduct energy audits.

Energy-inefficient enterprises (those for whom energy is a large part of their overall input costs compared to the median for their cluster) are more likely to invest in EETs.

The age of the enterprise has a significant impact on the enterprise owner's decision to carry out energy audits and undertake process modifications. Enterprises with an operating age of less than five years are less likely to conduct energy audits or carry out process modifications.

Summarising the key observation from the survey higher levels of capacity utilisation facilitate larger investment in technology upgradation and EETs. However, overcapacity inhibits investments in EETs across clusters. Only those enterprises competing with large enterprises are more likely to invest in EETs.

The results indicate a lack of awareness of effective methods of energy monitoring and limited participation in energy efficiency workshops. These both act as a deterrent to improve energy management practices, as well as dampen the responsiveness of enterprise owners towards energy conservation. Hence, the mere introduction of a financial incentive (by way of subsidies), is not sufficient to encourage enterprises to implement energy conservation measures.

Furthermore, half of the enterprises participating in energy efficiency workshops mentioned that they are not satisfied with the extent of practical training or the use of case studies in EE workshops. Improving the quality of the workshops and carrying out technology demonstrations is of utmost importance. Information, references, and recommendations passed on by peers within a cluster are seen to have a significant impact on the decision to implement energy efficiency measures.

Finally, existing financing instruments are not catering to the needs of enterprises in driving energy efficiency. Enterprises that availed of formal financing specifically for technology upgradation, capacity expansion, and replacement of defunct/old equipment may have channelled some of this towards investment in energy efficiency, but even units that did not have formal financing have invested in energy efficiency. The conclusion that can be drawn here is that having access to the formal financing system is not sufficient to encourage investment in EETs, and that it is equally important to have financial instruments that are more easily available and that satisfy the needs of MSMEs.

Image: Sachin Sharma/CEEW

4. Takeaways and Recommendations

4.1. Institutional reforms

A review of various support programmes designed to promote energy efficiency, run by both the central and state governments, highlights a lack of coordination and resource sharing between their respective implementation agencies.

Enterprises can be encouraged to avail of schemes by providing them access to relevant and timely information and guidance with application processes. Our survey indicates that 65 per cent of enterprises regularly communicate with their nearest DIC office, while only 20 per cent communicate regularly with MSME-DIs. As a result, enterprises remain unaware of opportunities provided by MSME-DIs and SDAs, and the funds allocated to these departments remains unused. On the one hand, during the Twelfth Five-Year Plan (2012-17), the actual expenditure under the TEQUP scheme was 29 per cent of the allocated budget, while on the other, more than 80 per cent of the enterprises surveyed claimed lack of information as the major reason for not participating in an energy efficiency workshop.

However, the flagship Prime Minister Employment Generation Programme (PMEGP) scheme has leveraged the extensive network of the DICs and KVIC centres for more robust programme implementation. In the year 2015-16, INR 31 crore was allocated to create linkages for PMEGP. This has helped in the efficient delivery of the programme budget of INR 1,050 crore.

A programme implementation network that is in direct contact with the ultimate beneficiaries-the MSME units-will improve programme delivery and communication and facilitate robust feedback-taking, thus improving the implementation of EE programmes. Given the underutilisation of funds in the current institutional structure, there is room to optimise resource allocation through these diverse actors and ensure that awareness and implementation of EE measures is widespread in many more clusters.

4.2. Energy benchmarking for MSMEs

Energy that cannot be measured cannot be managed or saved. The absence of energy consumption and benchmarking data for the MSME sector has been repeatedly highlighted in the past; the lack of a comprehensive database leaves policy planners and researchers no option but to resort to estimations of energy consumption. This highly approximate information does not truly represent trends in actual energy consumption in the MSME sector.

Data on energy consumption is readily available with enterprises. As highlighted in the survey, 88 per cent of respondents record their energy consumption data in some form. The Ministry of MSME (MoMSME) started the MSME databank with the aim of collecting information on the physical and financial performance of the units registered with it. This platform could be extended to include voluntary reporting on energy consumption by MSMEs. This would provide a more accurate estimate of the actual energy consumption of MSME units in various energy-intensive and non-energy-intensive sectors. Voluntary reporting could be incentivised at first, in order to get MSMEs to share their energy consumption data, while providing details (quantity and price) on various sources fuels consumed.

4.2.1 Strengthening the survey, studies, and policy research division of MoMSME

To design and optimise schemes effectively, it is imperative to collect primary data on the energy consumption and productivity of MSMEs. The last comprehensive census of the MSME sector was conducted in 2005-06; it elicited limited information about the energy consumption patterns within the sector. The department within MoMSME responsible for carrying out surveys, studies, and policy research does not have sufficient budgetary support; its annual resource allocation is INR 2.6 crore. Some suggested modifications to this current structure are as follows:

a) Increase the budgetary allocation to the department. This will enhance its capacity to conduct surveys and to study the performance of the sector with a focus on energy use. The new budgetary allocation could be brought on par with that of the CSO-IS division of NSSO, which has an annual allocation of INR 80 crore.

b) The Ministry of Statistics and Programme Implementation (MoSPI) already conducts detailed annual and decennial enterprise surveys for both organised and unorganised enterprises. This report proposes a close coordination with the MoSPI to facilitate the sharing of resources and technical capacity for carrying out research studies on the MSME sector.

4.3. Pilot and technology demonstration platform

MSMEs by their very nature are spread out across the country and dispersed and not located in any one particular geography and they leverage local skills, materials, and markets to create a consumer base for their products or intermediates. While EE pilots and technology demonstrations have been conducted since 1994, they have received active support from only a handful of institutions, making their reach limited.

Our findings indicate that enterprises that access information-relating to a programme or a technology solution from their peers are more likely to invest in EE measures. Peers play an important role in the decision-making of an enterprise owner with regards investing in energy efficiency.

A key barrier to the implementation of such pilots and demonstration projects is the absence of institutional mechanisms and associated funding across the country. An institutional arrangement consisting of various technology developers, implementing agencies (technology), and financial institutions must be set up to carry out pilots and technology demonstrations. Their projects must have a commercial component and must demonstrate the ability to generate revenue after completion.

These pilot studies will help reassure financial institutions of the performance of EETs and other EE interventions by MSMEs. This will in turn lead to technical capacity building within financial institutions, enabling them to better appraise such interventions. These institutions can also aggregate data to develop performance benchmarks for various EE technologies used across industrial sectors.

4.4. Targeted energy audit programme

An energy audit is the first step towards better energy management in an enterprise. It provides a baseline of energy consumption, thereby paving the way for the implementation of best practices and EETs. Our survey has shown that only 35 per cent of respondents have carried out energy audits in their units.

Through their industries departments and state-designated agencies (SDAs), state governments have been providing subsidies to MSMEs for conducting energy audits. As is evident from the survey, an awareness of these subsidies has not led to a higher implementation of energy audits. As a first step, energy audits must be made mandatory in the next 3-5 years for all energy intensive[4] enterprises having an annual turnover of more than INR 25 crore; this can later be extended to all enterprises having annual turnover of more than INR 25 crore. These mandatory audits will highlight opportunities for energy conservation particular to each enterprise. Once a critical number of units have carried out audits, the subsidies for the same may be phased out. The economic value of the audits will be evident after these units come on board-and non-participants will also see that the benefits outweigh the costs. These audits could further strengthen the reporting of energy consumption data to the MSME databank.

A mandatory audit programme will help policymakers and regulators identify major energy efficiency bottlenecks and opportunities to intervene at scale. However, enterprises may perceive mandatory energy audits as an added administrative burden. Merely rolling out energy audits will not lead to energy savings. Once the data from the audits has been aggregated and analysed, energy performance standards must be set in a time-bound manner.

4.5. Energy savings targets programme

The Bureau of Energy Efficiency currently runs the Perform Achieve Trade (PAT) scheme to reduce specific energy consumption (SEC) in select high energy-consuming industries across India. The learnings of the PAT scheme could be extended to the whole of the MSME sector. To begin, this could be rolled out in a few energy-intensive sectors like forging, foundry, steel re-rolling, textiles, etc.

Bringing a bulk of the MSMEs into the fold of the "formal" sector-registered under relevant statutes, linked with financial institutions, and with a documented trail of physical and financial performance-is an important task for the government. Initiatives such as Udyog Aadhaar Memorandum (UAM) aim to simplify this process by creating a one-stop shop for all processes related to formalisation. Combining a mandatory energy audit with the UAM would yield a robust dataset that can be used to arrive at a set of reliable, targeted interventions with documented baselines that can be used to drive down the SEC in MSMEs.

Given the challenges that the PAT regime faced, in offering reliable incentives that push units well beyond their mandated targets, it remains to be seen how a steady tightening of SEC benchmarks for MSMEs (or large industries) will be implemented. It would require a policy framework that guarantees demand at prices that compel the market to pursue EE more aggressively. Perhaps a market stability reserve, as in the case of EU ETS, can be created to stabilise demand in scenarios where supply far exceeds demand.

The finding that 23 per cent of the enterprises surveyed are vendors to larger companies highlights an opportunity to 'green the supply chain'. MSMEs supplying intermediate products can be compelled to integrate energy conservation measures into their production lines to meet the product specifications of their clients. Samsung's eco-labelled products are currently recognised globally as eco-conscious products; they have a strong market presence in many developed countries. At their global manufacturing sites, Samsung has been able to make substantial headway in improving their energy efficiency (Samsung, 2018).

In India, a similar EE drive can be initiated among large companies by mandating energy consumption disclosures across the vendor chain for DCs covered under the PAT scheme. Furthermore, an extension of the SEC targets across the entire supply chain will help reduce energy consumption of their vendors, in this case MSMEs.

[4] Having energy cost higher than 20 per cent of overall manufacturing cost

The case of electric motors deserves a special mention within the overall framework of mandatory energy savings targets. More than 70 per cent of the electrical load in MSMEs comes from electric motors (IEA, 2007; Fleiter, 2012). These are the prime movers for most applications in industries, such as compressors, fans, blowers, and water pumps. They also find application in material-handling equipment. India has adopted IE2 as its Minimum Energy Performance Standard (MEPS) for motors. It must be brought up to the international standard of IE4; the sale of motors must be regulated to only allow MEPS motors.

This would require modifying existing standards and co-opting motor manufacturers to ramp up the production of efficient motors to cater to the increased demand in a mandatory scenario. To cover the additional cost of an appliance, these motors can be provided at subsidised rates for a specified duration. Subsequent to the removal of subsidies, norms could be made more stringent to ensure compliance.

Following up on the recommendations of the audits is mandatory to realise their potential. Therefore, the challenge is in converting audits to tangible changes that reduce energy consumption, either by investing in new equipment, upgrading existing equipment, or through process changes. Existing schemes like TEQUP are already geared towards providing the necessary support for these EE interventions. What is needed is a way of linking these energy audit recommendations to the process of applying for a government support mechanism, such as TEQUP. While TEQUP is a capital subsidy scheme, other options, such as tax benefits or interest rate subventions on debt for EE investments, must be explored.

Another finding from the study was that relatively small-sized loans are required for investing in EE. This is seen as an administrative burden on financial institutions. However, aggregating these loans or clubbing them with existing, reasonably-sized capital expenditure loans to improve administrative appeal is a potential way to overcome this challenge.

4.6 Creating awareness and training on energy efficiency and energy monitoring

Findings from the study indicate that approximately 60 per cent of enterprises use energy bills as a means of monitoring energy consumption or input. This is not sufficient to drive energy efficiency, as it precludes the ability to identify the specific processes or equipment that induces inefficiency into the manufacturing.

A majority of the enterprises also highlighted the need for training programmes on energy data collection and analyses. There is also a need for programmes on other direct and indirect techniques to measure energy consumption to be conducted in partnership with energy experts.

Awareness of the various EETs available in a particular sector increases the odds of investing in energy efficiency by 90 per cent. Our survey indicates that 90 per cent of enterprises did not participate in EE workshops, citing lack of information regarding these workshops as their reason. Additionally, only 56 per cent of the enterprises that did participate were aware of EE technologies relevant to their sector. Hence, there is a need to improve the participation of MSMEs in these periodic workshops by providing inputs tailored to the needs of the cluster; improving the information dissemination process; and setting an annual performance target for the implementing agencies.

4.7 Addressing the risks associated with financing EE in MSMEs

Our survey indicates that existing financial instruments for EE investments are seldom accessed by enterprises. While these investments may be financially attractive, bank loan approvals are based on many different criteria, of which the strength of the company's balance sheet or credit risks, technical risks associated with the performance of EETs, and associated transaction costs are the most important (Chatham House, 2011).

The creditworthiness of an MSME can be evaluated by triangulating a variety of data points. NBFCs and other fintech companies are increasingly evaluating the creditworthiness of enterprises using alternate data, like bank transactions, utility payments, invoices, and GST filings, etc. instead of legacy credit score metrics (Techcrunch, 2018). However, scheduled public sector banks, the biggest lenders to the MSME sector, are yet to adopt these innovative mechanisms. Inclusion of fintech and NBFCs in the mainstream financing sources for the MSMEs require institutional development measures through policy prescriptions. However, such partnerships would need support from the government in the form of establishing a favourable regulatory framework.

Various studies have highlighted that partial risk guarantees are an appropriate tool to address the credit risk associated with an investment (BEE, 2015). In India, the Partial Risk Guarantee Fund for Energy Efficiency (PRGFEE) has been setup under BEE. It is a risk-sharing mechanism aimed at lowering the risk for the banker by guaranteeing partial repayment of the loan upon a default event. In order for a project to be eligible for a guarantee, it must have demonstrable energy savings, viable technology, and monitoring and verification of energy savings. However, owing to their unproven nature at an industrial scale, the absence of data on performance standards and benchmarking parameters for various EETs result in low confidence, increasing the perceived risks of technologies or interventions. Energy efficiency investments can be made attractive to financiers by demonstrating and validating, at an industrial scale, the performance, installation time and costs, operation and maintenance costs, and reliability and operating lifetimes of various EETs.

A recurrent theme in our findings is that high transaction costs can be reduced by financing a portfolio of projects as opposed to financing individual ones. The credit requirements of MSMEs are usually defined by smaller ticket sizes. A loan portfolio could be created by pooling all such ticket sizes through an aggregator, in this case a cluster association or designated institution appointed by the state or central ministry.

4.8 The implementation roadmap

Based on the proposed recommendations/suggested measures an implementation roadmap has been developed for MoMSME. The suggested actions should be prioritised towards the medium and small scale enterprises and has been further classified into short term (less than 2 years), medium term (2-5 years), and long term (5 years and above). The detailed roadmap is presented in Table 10.

MoMSME: Ministry of Micro, Small and Medium Enterprises
MoF: Ministry of Finance
MoSPI: Ministry of Statistics and Programme Implementation
BEE: Bureau of Energy Efficiency
DST: Department of Science and Technology
SIDBI: Small Industries Development Bank of India
#: A detailed list of key research institutes has been provided in Supplementary information – VII

Source: CEEW analysis

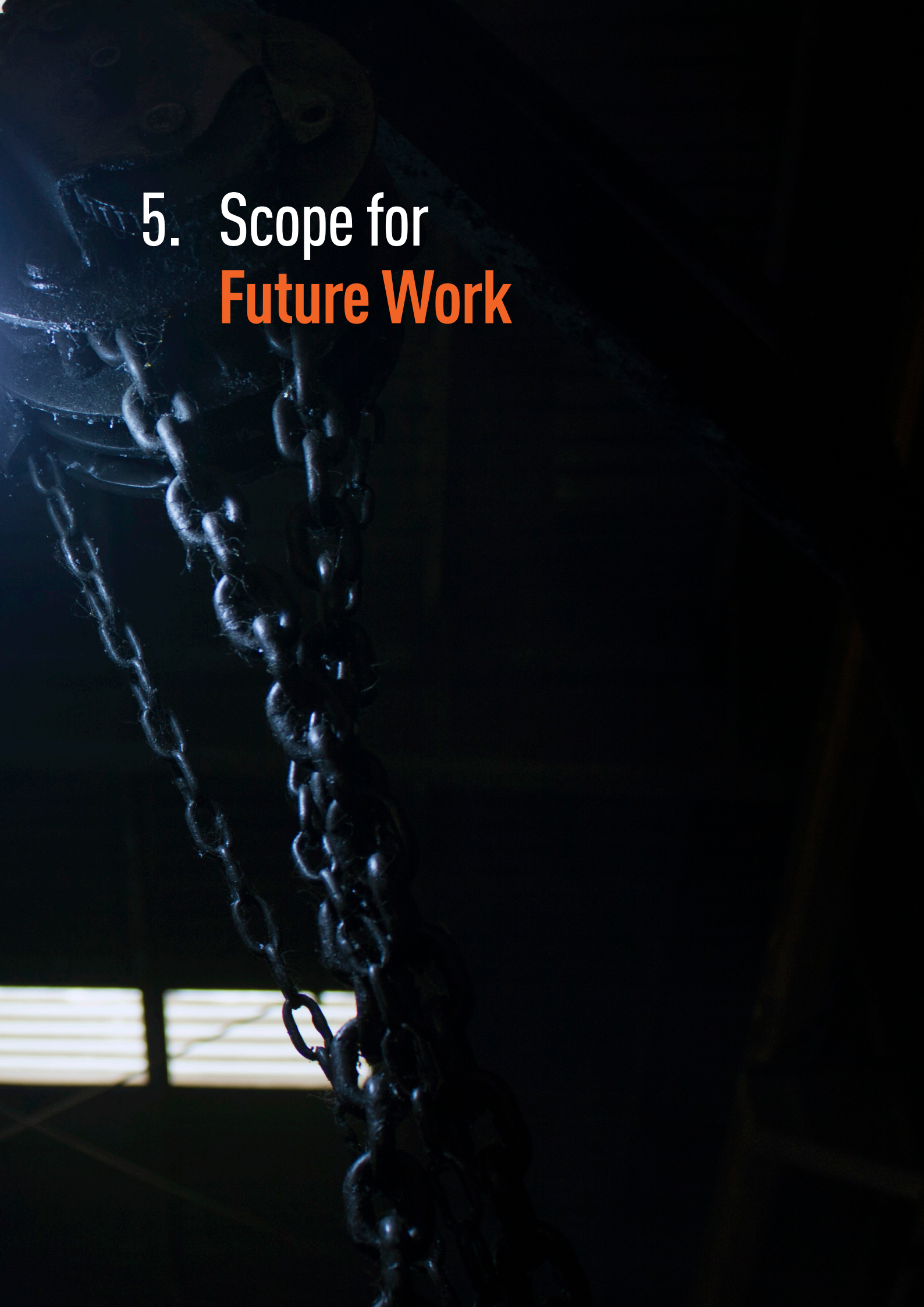
Table 10: Policy Roadmap for improving energy efficiency in the MSME sector

Recommended measures	Timeline: Short-term (0-2 Y)	Timeline: Medium-term (2-5 Y)
Pilot and Technology Demonstration	■ Identifying and creating implementing agencies with budgetary support for pilot and technology demonstration ■ Creating linkages between agencies, TDI/TDC and other R&D labs to act on the feedback from MSMEs and provide relevant technical inputs on EE ■ Tie up with financial institutions and technology providers for commercially scalable projects	■ Review of the programme considering the number of projects demonstrated, uptake of such processes and technologies by MSMEs ■ Creation of an online resource pool of information on performance benchmarks for various technologies across different processes; successful case studies of enterprises implementing EE technologies ■ Creation of more such bodies or affiliates (not limited to government), at the state level enabling higher outreach to cluster associations and MSMEs
Energy Benchmarking for MSMEs	■ Promote voluntary energy data reporting through MSME Databank by offering soft-incentives ■ Strengthening of survey, studies and policy-research division of MoMSME in conducting studies to evaluate the performance of the sector with respect to energy use and processes ■ Enabling co-ordination and resource sharing with MOSPI in establishing best practices in data gathering and validation	■ Review of voluntary energy data reporting measure and its cost benefit analysis ■ Mandating energy data reporting to MSME databank ■ Creation of additional reporting channels through states for wider reach and more effective implementation
Targeted Energy Audit Programme	■ Linking energy audits to the availability of support from public funded programmes (interest rate subventions, capital subsidies) to provide a soft-push for energy audits targeting energy intensive manufacturing enterprises having annual turnover above INR 25 crore ■ Creation of sector specific standardised energy audit reporting formats	■ Extending the programme to all enterprises having annual turnover above INR 25 crore ■ Voluntary energy audits for enterprises having turnover below INR 25 crores ■ Financial assistance towards implementation of energy audit recommendations with a sunset clause
Energy Savings Targets Programme	■ Adoption of MEPS at equipment level and phasing out of manufacturing of less efficient equipment through regulations ■ Clubbing energy efficient equipment loans with existing CAPEX loans taken by the MSMEs. Thus, reducing the additional transaction costs associated with smaller energy efficiency loans	■ Roll out of energy savings targets programme in energy intensive processes and clusters as identified through energy benchmarking programme ■ Mandating disclosure of energy consumption across the vendor chain for large companies towards "Greening the Supply Chain" initiative ■ Creation of a savings trading platform linking EScerts from PAT and ESCerts from MSMEs ■ Allowing clubbing of smaller savings credits between different MSMEs to enable registry of such saving certificates easily and effectively thereby reducing registry costs
Addressing risks associated with financing of EE in MSMEs	■ Capacity building of financial institutions in evaluating EE investment proposals ■ Supporting public sector banks to adopt innovative mechanisms (by leveraging utility payment mechanisms, GST filings etc.) to evaluate the credit worthiness of an enterprise ■ Regulatory framework to enable partnership between fintech companies and traditional financing institutions	■ Innovative financial instruments allowing aggregation of small ticket size loans
Institutional Reforms	■ Creation of linkages between State Designated Agencies, MSME-DI and DIC ■ Increasing levels of funding to be commensurate to the goals described in Centre and State government schemes ■ Capacity building of DIC officials for Energy Efficiency in MSME with a focus on technical up-skilling	
Creating Awareness and training on Energy Efficiency and Energy monitoring	■ Increase in budgetary allocation for EE workshops for MSMEs towards wider outreach in the sector ■ Setting of targets/KRAs/KPIs for bodies consulting such trainings and workshops ■ Use of ICTs for effective implementation of such workshops ■ Review of EE workshop and training programmes	

Long-term

	Key stakeholders
■ Seamless access to R&D labs/technology support centres for major industrial clusters	MoMSME; DST; SIDBI; Research institutions#
■ Review of the energy consumption data reporting programme ■ Revising benchmarks so as to reflect the actual state of technology and setting of energy saving targets	MoMSME; MoSPI; BEE
■ Assess quality of energy audits, and adopt a mechanism for independent verification of quality of audits and recommendations provided and follow up from audits	MoMSME; BEE; State Ministry of Industries; and State Ministry of Energy/Power
■ Review of effectiveness of the programme for effective implementation and setting of targets for immediately next target period	MoMSME; BEE; SIDBI
■ Assess impact of lending to MSME on asset quality of FIs. Identifying vulnerable sectors with risky exposure and create safeguards for lenders	MoF; BEE
■ Review and overhaul (as necessitated) of the effectiveness of these linkages in programme implementation	MoMSME; State Ministry of Industries; and State Ministry of Energy/Power
	MoMSME; BEE; State Ministry of Industries; and State Ministry of Energy/Power

Image: Sachin Sharma/CEEW



5. Scope for Future Work

This study attempted to answer questions pertaining to the low uptake of energy efficiency measures in the diverse MSME sector. By deploying more resources and by involving multiple institutions, it is desirable to capture a greater variation in manufacturing processes, outputs and geographical spread associated with these clusters. It is important to validate these findings in settings that have not been covered by this study. Furthermore, reviewers and experts alike expressed a need for overhauling energy efficiency interventions and to move beyond mere appliance and technology efficiency. Instead, they urge a focus on productivity and process innovations. This will again require a multi-institutional effort to bring together the existing body of work to explore the possibility of what energy efficiency can truly deliver for small manufacturing in India. The role of anchor clients-those higher up in the value chain-in driving energy efficiency among supplier units was also stressed. This is an important driver of sustainability and requires separate exploration, particularly on how corporate India is able to drive energy efficiency and sustainable manufacturing among their myriad of vendors. The most important task, which requires an inter-sectoral approach, would be to identify the prospects for MSMEs in the years ahead. Low growth in demand and poor levels of support were a common feature in the landscape we surveyed. However, a prosperous MSME sector could spell economic growth and jobs, driving prosperity in hitherto underdeveloped areas of the country. This scenario could generate competition and, in turn, drive investments in efficient manufacturing. Putting MSMEs first and using them as the engine for economic growth could yield surprising results for efficient manufacturing as well. A macro-economic assessment of this paradigm of economic growth is imperative before we embark on further policy reform in the MSME space.

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Supplementary Information Section

Supplementary information – I

Table 11: Significance of proportions test for impact of awareness of energy audit subsidies on decision to conduct energy audits; hypothesis (Ha): diff > 0

Sample 1(x): Enterprises aware of energy audit subsidies; total observation = 83; percentage of enterprises that conducted audits = 53.7%

Sample 2 (y): Enterprises not aware of energy audit subsidies; total observations = 346; percentage of enterprise conducting audits = 55.2%

Two-sample test of proportions					x: Number of obs = 83 y: Number of obs = 346	
Variable	Mean	Std. Err.	z	P > |Z|	[95% Conf.	Interval]
x	0.537	0.0547317			0.4297279	0.6442721
y	0.552	0.0267344			0.4996015	0.6043985
diff	-0.015	0.0609121			-0.1343855	0.1043855
Under Ho		0.06816	-0.25	0.805		
	diff : prop(x) - prop(y); Ho: diff = 0; z = -0.2466 Ha: diff<0; Pr(Z < z) = 0.4026 Ha: diff != 0; Pr(|Z| < |z|) = 0.8052 Ha: diff > 0; Pr(Z> z) = 0.5974					

Source: CEEW analysis

Table 12: Significance of proportions test for impact of formality on an enterprise for availing commercial loans; hypothesis(Ha): diff > 0

Sample 1(x): Formal sector enterprises; total observation = 260; percentage of enterprises availing commercial loans for CAPEX = 38.5%

Sample 2 (y): Informal sector enterprises; total observations = 169; percentage of enterprises conducting audits = 30.2%

Two-sample test of proportions					x: Number of obs = 260 y: Number of obs = 169	
Variable	Mean	Std. Err.	z	P > |Z|	[95% Conf.	Interval]
x	0.385	0.0301774			0.3258535	0.4441465
y	0.302	0.0353173			0.2327793	0.3712207
diff	0.083	0.0464541			-0.0080484	0.1740484
Under Ho		0.0472001	1.76	0.079		
	diff : prop(x) - prop(y); Ho: diff = 0; z = 1.7585 Ha: diff<0; Pr(Z < z) = 0.9607 Ha: diff != 0; Pr(|Z| < |z|) = 0.0787 Ha: diff > 0; Pr(Z> z) = 0.0393					

Source: CEEW analysis

Table 13: Significance of proportions test for impact of availability of formal finance on investments towards energy-efficient technologies; hypothesis (Ha): diff > 0

Sample 1(x): Enterprises availing commercial loans for CAPEX requirements; total observation = 151; percentage of enterprises investing in EETs = 19.9%

Sample 2 (y): Enterprises availing other form of finances for CAPEX requirements; total observations = 278; percentage of enterprises investing in EETs = 16.2%

Two-sample test of proportions					x: Number of obs = 151 y: Number of obs = 278	
Variable	Mean	Std. Err.	z	P > |Z|	[95% Conf.	Interval]
x	0.199	0.0324903			0.1353201	0.2626799
y	0.162	0.0220982			0.1186883	0.2053117
diff	0.037	0.0392932			-0.0400132	0.1140132
Under Ho		0.0384137	0.96	0.335		
	diff : prop(x) - prop(y); Ho: diff = 0; z = 0.9632 Ha: diff<0; Pr(Z < z) = 0.8323 Ha: diff != 0; Pr(|Z| < |z|) = 0.3354 Ha: diff > 0; Pr(Z> z) = 0.1677					

Source: CEEW analysis

Table 14: Equations for the logistic regressions

Regression Model 1
Enterprises conducting energy audits =
Age of the enterprise + Annual turnover + Enterprises competing with large industries + Annual average capacity utilisation + Access to formal finance + Presence of regulatory compliance + Energy efficiency as a driver for fuel selection + Energy efficiency of production process + Participation in energy efficiency workshops + Awareness towards subsidised energy audit programmes + Primary source for getting information on technology, programmes,and schemes + Relative level of energy prices in the state
Regression Model 1
Enterprises investing in energy-efficient technologies=
Age of the enterprise + Annual turnover + Enterprises competing with large industries + Annual average capacity utilisation + Access to formal finance for capital investments + Presence of regulatory compliance + Energy efficiency as a driver for fuel selection + Energy efficiency of production process + Participation in energy efficiency workshops + Awareness towards TEQUP programme + Awareness towards energy-efficient technologies + Primary source for getting information on technology,programmes,and schemes + Relative level of energy prices in the state
Regression Model 1
Enterprises investing in process modifications=
Age of the enterprise + Annual turnover + Enterprises competing with other MSMEs + Annual average capacity utilisation + Access to formal finance + Presence of regulatory compliance + Energy efficiency as a driver for fuel selection + Energy efficiency of production process + Participation in energy efficiency workshops + Presence of equipment level energy monitoring + Primary source for getting information on technology, programmes,and schemes + Relative level of energy prices in the state

Source: CEEW analysis

Table 15: Description of variables

Variable name	Variable type	Variable value
age of the enterprise	Categorical	It takes a value of 1 if the operational age is less than 5 years
turnover	Categorical	If the turnover less than 5 crores, the variable takes a value of 0
primary market competitor	Categorical	It takes a value of 1 if the enterprise competes with larger industries
competitive_pricing	Categorical	It takes a value of 1 if the enterprise's product pricing is competitive
capacity_utilisation	Categorical	It takes a value of 1 if the enterprise has an annual average capacity utilisation of more than 80 per cent
access_formal_finance	Categorical	For regression 1 and 3: It takes a value of 1 if the enterprise has access to formal financing for both OPEX and CAPEX requirements For regression 2: It takes a value of 1 if the enterprise has access to formal financing for CAPEX investments
driver_compliance	Categorical	It takes a value of 1 if the enterprise has stated regulatory compliance as the primary reason for current fuel selection
driver_fuel efficiency	Categorical	It takes a value of 1 if the enterprise has stated achieving fuel efficiency as the primary reason for fuel selection
energy_inefficiency	Categorical	If takes a value of 1 if the energy costs of production for the enterprise is higher than that of the median observed for the cluster
eeworkshop	Categorical	It takes a value of 1 if the enterprise has participated in an energy efficiency workshop
awareness_subsidised_EA	Categorical	It takes a value of 1 if the enterprise is aware of subsidised energy audits
awareness_TEQUP	Categorical	It takes a value of 1 if the enterprise is aware of the TEQUP scheme
awareness_EETs	Categorical	It takes a value of 1 if the enterprise is aware of the relevant energy-efficient technologies for this process
source of information	Categorical	It takes a value of 1 if the enterprise's source of information related to schemes and programmes is other enterprises
equipment-level monitoring	Categorical	It takes a value of 1 if the enterprise carries out equipment-level monitoring of energy

Source: CEEW analysis

Table 16: Results of regression model 1

Iteration 0: Log likelihood = -279.88233
Iteration 1: Log likelihood = -249.14658
Iteration 2: Log likelihood = -248.92461
Iteration 3: Log likelihood = -248.92449
Iteration 4: Log likelihood = -248.92449

Logistic regression; Log likelihood = -248.92449

Number of obs = 429
LR chi2(11) = 59.92
Prob > chi2 = 0.0000
Psuedo R2 = 0.1074

Audit	Odds ratio	Std. err.	z	P > |Z|	[95% conf.	interval]
age_ent	0.4058608	0.1261549	-2.90	0.004	0.2206966	0.7463776
turnover	1.1290100	0.3128123	0.44	0.661	0.6559301	1.9432940
competition_industries	2.8711490	1.1297170	2.68	0.007	1.3277970	6.2083990
capacity_utilisation	0.9239647	0.2222371	-0.33	0.742	0.5766598	1.4804410
access_formal_finance	1.0001360	0.3113894	0.00	1.000	0.5433006	1.8411040
driver_compliance	0.8013230	0.3468182	-0.51	0.609	0.3430849	1.8716030
driver_fuel_efficiency	0.5054006	0.1270959	-2.71	0.007	0.3087304	0.8273555
energy_inefficiency	1.3336190	0.3783355	1.01	0.31	0.7648099	2.3254650
eeworkshop	2.2112840	0.6408398	2.74	0.006	1.2530340	3.9023530
awareness_subsidised_ea	1.0065980	0.2987760	0.02	0.982	0.5626065	1.8009750
source_of_info_other_ent	3.3939090	1.1053550	3.75	0.000	1.7925620	6.4257840
_cons	0.5841209	0.1461309	-2.15	0.032	0.3577302	0.9537836

Source: CEEW analysis

Table 17: Results of regression model 2

Iteration 0: Log likelihood = -198.8223
Iteration 1: Log likelihood = -166.11764
Iteration 2: Log likelihood = -161.13152
Iteration 3: Log likelihood = -161.02577
Iteration 4: Log likelihood = -161.02566
Iteration 5: Log likelihood = -161.02566

Logistic regression; Log likelihood = -248.92449

Number of obs = 429
LR chi2(12) = 75.59
Prob > chi2 = 0.0000
Psuedo R2 = 0.1901

implementation_eets	Odds ratio	Std. err.	z	P > |Z|	[95% conf.	interval]
age_ent	0.5399054	0.2229383	-1.49	0.136	0.240347	1.212821
turnover	1.1781260	0.4738584	0.41	0.684	0.535584	2.591533
competition_industries	3.4796560	1.4953550	2.90	0.004	1.498784	8.078550
capacity_utilisation	1.4811150	0.4617020	1.26	0.208	0.803984	2.728540
access_formal_finance capex	1.6275150	0.5632705	1.41	0.159	0.825906	3.207151
driver_compliance	0.5935735	0.3392175	-0.91	0.361	0.193654	1.819375
driver_fuel_efficiency	0.8720647	0.2950739	-0.40	0.686	0.449298	1.692635
energy_inefficiency	0.3712545	0.1726407	-2.13	0.033	0.149227	0.923628
eeworkshop	0.6849837	0.2762514	-0.94	0.348	0.310738	1.509964
awarenesstequp	0.6886585	0.3316844	-0.77	0.439	0.267937	1.770008
awareness_eet	1.9055550	0.6178773	1.99	0.047	1.009297	3.597693
source_of_info_other_ent	7.2687070	2.6402840	5.46	0.000	3.566703	14.813150
_cons	0.0910946	0.0358305	-6.09	0.000	0.042139	0.196924

Source: CEEW analysis

Table 18: Results of regression model 3

Iteration 0: Log likelihood = -206.38279
Iteration 1: Log likelihood = -181.3674
Iteration 2: Log likelihood = -179.30263
Iteration 3: Log likelihood = -179.29199
Iteration 4: Log likelihood = -179.29199

Logistic regression; Log likelihood = -179.29199

Number of obs = 429
LR chi2(11) = 54.18
Prob > chi2 = 0.0000
Psuedo R2 = 0.1313

implementation_process_mods	Odds ratio	Std. err.	z	P > |Z|	[95% conf. interval]	
age_ent	0.377509	0.1646628	-2.23	0.026	0.160564	0.887578
turnover	0.709228	0.2473610	-0.99	0.325	0.358020	1.404959
competition_industries	1.516018	0.6848910	0.92	0.357	0.625399	3.674950
capacity_utilisation	1.194530	0.3529540	0.60	0.547	0.669403	2.131601
access_formal_finance	0.569305	0.2291569	-1.40	0.162	0.258654	1.253058
driver_compliance	1.437300	0.6921266	0.75	0.451	0.559312	3.693520
driver_fuel_efficiency	0.700562	0.2166200	-1.15	0.250	0.382162	1.284238
energy_inefficiency	0.988549	0.3554141	-0.03	0.974	0.488613	2.000001
eeworkshop	0.939587	0.3349199	-0.17	0.861	0.467222	1.889520
source_of_info_other_ent	1.852473	0.6970378	1.64	0.101	0.886067	3.872907
equipment_level_monitoring	5.577835	1.6318320	5.88	0.000	3.143701	9.896696
_cons	0.142713	0.0479839	-5.79	0.000	0.073836	0.275842

Source: CEEW analysis

Supplementary information – II

Table 19: List of schemes being implemented by MoMSME

The Ministry of MSME has implemented as many as 26 schemes to promote and develop MSME units in India(MoMSME, 2016-17):[5]
▪ Scheme for Providing Financial assistance on International Cooperation
▪ Scheme for providing financial assistance for performance and credit rating
▪ Scheme for providing establishment of new institutions (EDIs) and strengthening the infrastructure for EDIs under the ATI scheme
▪ Scheme for providing financial assistance on marketing reports under the Marketing Assistance Scheme
▪ Scheme of Fund for Regeneration of Traditional Industries (SFURTI)
▪ A Scheme for Promotion of Innovation, Rural Industry & Entrepreneurship (ASPIRE)
▪ Scheme for providing insurance cover to khadi artisans under AamAdmiBima Yojana (AABY)
▪ Coir workers Group Personal Accident Insurance Scheme
▪ Scheme for providing financial assistance to khadi institutions under MPDA
▪ Scheme for providing financial assistance for R&D activities of the Coir Board under Central Sector Plan Scheme of Science & Technology (S&T) of the Coir Board
▪ Scheme for providing financial assistance to Coir units under Coir Udyami Yojana (CUY)
▪ Coir Vikas Yojana
▪ Marketing Assistance & Technology Upgradation (MATU) scheme (Revised w.e.f. 29.06.2016 vide O.M. No. 5(1)\2016-MDA dated 29.06.2016)
▪ Scheme for entrepreneurial and managerial development of SMEs through incubators
▪ Building awareness on intellectual property rights (IPR) for MSME
▪ Lean Manufacturing Competitiveness Scheme
▪ Funding support for implementing design projects
▪ Technology and Quality Upgradation (TEQUP) support to MSMEs
▪ Scheme for promotion of ICT in the Indian manufacturing sector
▪ Financial support to MSMEs in ZED certification
▪ Scheme for Micro & Small Enterprises Cluster Development Programme (MSE-CDP)
▪ Credit Linked Capital Subsidy Scheme (CLCSS)
▪ Credit Guarantee Fund Scheme – provision of collateral free credit for MSME's
▪ Scheme for national awards
▪ Trade Related Entrepreneurship Assistance and Development (TREAD) Scheme for women
▪ Scheme for Entrepreneurship Skill Development Programmes (ESDP)
▪ Scheme for promotion of MSMEs in Sikkim and the North East
▪ Central Rice Research Institute, Cuttack

Source: CEEW compilation

[5] Annual Report 2016-17, Government of India, Ministry of Micro, Small, and Medium Enterprises

Supplementary information – III

Table 20: Comparison matrix of various state government policies

Type of Intervention	AP	MAH	GUJ	TN	TEL	KAR	RAJ	WB
Capital investment subsidy	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Interest subsidy on term loan	Yes	No	Yes	Yes	Yes	No	No	Yes
Seed capital assistance for micro enterprises	Yes	No	Yes	Yes	Yes	Yes	Yes	No
Rebate on electricity charges	Yes	Yes	Yes	Yes	Yes	No	No	Yes
Rebate on electricity duty	No	Partially	No	No	No	Yes	Yes	Yes
Rebate on land cost	Yes	No	No	No	Yes	No	No	No
Quality certification/ trademark registration subsidy	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Rebate on expenses incurred for energy audit	Yes	Yes	Yes	Yes	No	No	No	Yes
Practising energy conservation measures	No	Yes	Yes	Yes	Yes	Yes	No	
VAT/CST/GST incentives	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Marketing assistance	Yes	Yes	Yes	Yes	No	Yes	Yes	No
Rebate on skill upgradation costs	Yes	No	No	No	Yes	Yes	No	No
Work force welfare assistance	No	No	No	No	No	No	No	Yes
Awards scheme for better performing MSMEs	Yes	Yes	Yes	Yes	No	Yes	Yes	No

AP - Andhra Pradesh (Government of Andhra Pradesh, 2015)[6]

MAH - Maharashtra (Government of Maharashtra, 2013)[7]

GUJ - Gujarat (Government of Gujarat, 2017)[8]

TN - Tamil Nadu (Government of Tamil Nadu, 2013)[9,10]

TEL - Telangana (Government of Telangana, 2011)[11]

KAR - Karnataka (Government of Karnataka, 2014)[12]

RAJ - Rajasthan (Government of Rajasthan, 2015)[13]

WB - West Bengal (Government of West Bengal, 2013)[14]

Source: CEEW compilation

[6] A MSME Policy, 2015–2020, Government of Andhra Pradesh
[7] Industrial Policy of Maharashtra, 2013
[8] Gujarat Industrial Policy, 2013
[9] State Industrial Profile of Tamil Nadu, 2014-15
[10] Micro, Small and Medium Enterprises Department, Policy Note 2016-17, Government of Tamil Nadu
[11] Industries and Commerce Department;incentives for setting up of new industrial enterprises in Telangana state: T-IDEA (Telangana State Industrial Development and Entrepreneur Advancement) Incentive Scheme 2014
[12] Karnataka Industrial Policy, 2014-19
[13] Rajasthan MSME Policy, 2015
[14] MSME Policy, 2013-18, Department of Micro & Small Scale Enterprises and Textiles, Government of West Bengal

Supplementary information – IV

Table 21: Details of energy efficiency programmes conducted for the MSME enterprises in India

Scheme nName	Time period	Target area	Target clusters	No of clusters	No. of MSMEs benefitted	Funds utilised
ADB-IDBI	1995-2000	Pan India			26	USD 150 million
GEF, UNDP-MoS	2004-2013	14 states	Steel		16	USD 14.03 million
UNDP, AusAid-MoS	2013-2016	Pan India	Steel		287	USD 2.44 million
GEF, UNDP, GOI	2008-2012	Karnataka and Kerala	Tea estates	3	200	USD 2.05 million
UNDP, GEF-TERI	2009-2016	Karnataka, Punjab and neighbouring regions	Brick Industries	5	25	USD 2.7 million
USAID, BEE-MoP	2009	Punjab and Gujarat	Dyeing, re-rolling, textile and mixed industries	4		No Information
JICA-SIDBI	2008-2016	Pan India			6000	USD 57 million
BEE	2007-2012	Pan India		35	375	No Information
GEF, UNIDO, Cleantech Open-BEE	2011-2017	Jagadhri, Jamnagar, Khurja, Morbi, Thangarh, Belguam, Coimbatore, Indore, Jalandhar, and Nagaur		12	44	USD 2 million
GEF, WB, SIDBI-BEE	2010-ongoing	Ankleswar, Faridabad, Kohlapur, Pune, and Tirunelveli		5	1200	USD 11.3 million

Source: CEEW compilation

Supplementary information – V

Table 22: List of semi-structured interviews and meetings carried out

Locations where interviews with clusters have been carried out

State	District	Cluster name
Uttar Pradesh	Varanasi	Varanasi Brick Cluster
Haryana	Faridabad	Faridabad Mixed Cluster
	Panipat	Panipat Textile Cluster
West Bengal	Howrah	Howrah Foundry Cluster
Gujarat	Ankleswar	Ankleswar Chemical Cluster
	Tarapur	Tarapur Mixed Cluster
Punjab	Jalandhar	Jalandhar Forging Cluster

Locations where interviews with MSME-DI and DICs centres have been carried out

State	District	Cluster name
Uttar Pradesh	Firozabad	CGDI, DIC Centre
	Agra	MSME-DI Office
Haryana	Panipat	NITR-Panipat
West Bengal	Kolkata	MSME-DI Office
Maharashtra	Mumbai	MSME-DI Office
	Thane	DIC Centre
Punjab	Jalandhar	DIC Centre
	Ludhiana	DIC Centre

Source: CEEW analysis

Supplementary information – VI

Table 23: Background data for impact of access to formal credit on enterprises investing in energy-efficient technology

Cluster	Financing source	EET implemented	EET not implemented
Bahadurgah	Commercial banks	2	1
	Other sources	9	6
Bargarh	Commercial banks	2	23
	Other sources	1	9
Belgaum	Commercial banks	4	31
	Other sources	2	15
Jamnagar	Commercial banks	2	8
	Other sources	13	26
Jhajjar	Commercial banks	1	
	Other sources	12	8
Ludhiana	Commercial banks		10
	Other sources	1	39
Malegaon	Commercial banks		1
	Other sources		48
Morbi	Commercial banks	14	36
	Other sources	1	
Surat	Commercial banks		3
	Other sources		27
Tirupur	Commercial banks	4	6
	Other sources	3	11
Varanasi	Commercial banks	1	2
	Other sources	3	44

Source: CEEW analysis

Supplementary information – VII

Table 24: Key research institutes in the MSME sector

Key Research Institutes
▪ **Foundry Informatics Centre**
▪ **Institute of Indian Foundrymen**
▪ **National Institute of Foundry and Forging Technology**
▪ **Confederation of Indian Institutes**
▪ **PHD Chamber of Commerce**
▪ **ATIRA** - Ahmedabad Textile Industry's Research Association
▪ **BTRA** - Bombay Textile Research Association
▪ **SITRA** - South India Textile Research Association
▪ **NITRA** - Northern India Textile Research Association
▪ **SASMIRA** - Synthetic and Art Silk Mills Association
▪ **MANTRA** - Man Made Textiles Research Association
▪ **IJIRA -** Indian Jute Industries Research Association
▪ **Wool Research Association**
▪ **Central Silk Technological Research Institute**
▪ **CSIR -** Central Glass and Ceramic Research Institute
▪ **IIRR -** Indian Institute of Rice Research
▪ **Central Rice Research Institute, Cuttack**

Source: CEEW compilation

Image: Sachin Sharma/CEEW

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