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CENTER FOR STUDY OF SCIENCE, TECHNOLOGY & POLICY

Decarbonising the MSME Manufacturing Sector in India

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Disclaimer

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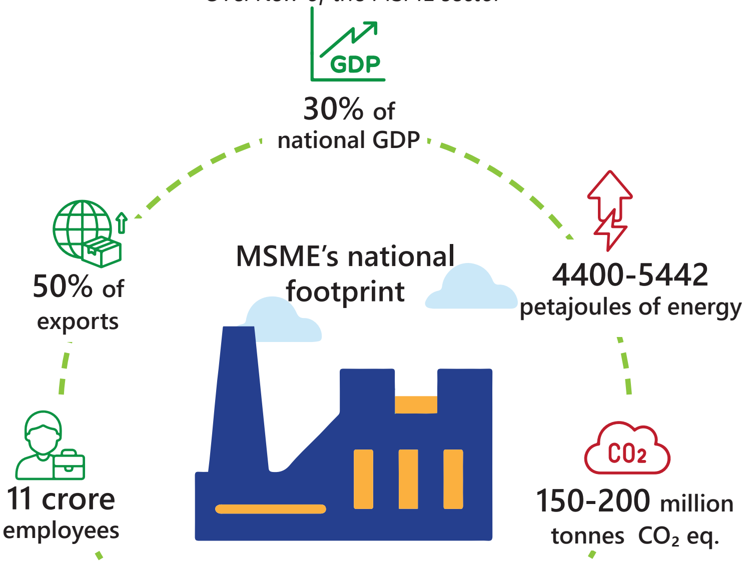
Introduction

Small industries or micro, small, and medium enterprises (MSMEs) are a crucial sector in India's development. With about 31% of MSMEs in India operating in the manufacturing sector (e.g. pharmaceuticals, steel forging, and textiles sectors), MSMEs are estimated to contribute to 20%–25% of India's industrial energy consumption. They have a large carbon footprint, partly because of the nature of energy consumption, with over 80% of the energy consumed being required for thermal processes to produce heat (e.g. in boilers and furnaces). These thermal energy demands have traditionally been met through fossil fuel sources (such as coal, natural gas, and pet coke), making MSMEs a hard-to-abate sector. Thus, emission reduction in the MSME sector is necessary for achieving India's ambitious net-zero targets by 2070.

Overview of the MSME sector



Decarbonisation, the process of reducing or eliminating polluting fossil-fuel consumption, is a potential route to reducing the energy and emission burden in MSMEs. In addition to climate benefits, decarbonisation measures will bring down the manufacturing costs in MSMEs, as energy costs are a major contributor to the manufacturing costs in MSMEs.

Energy efficiency (EE) technologies are widely accepted as energy-saving measures in industries. Research studies and energy audits are regularly conducted in MSME clusters to identify measures to reduce waste energy consumption. However, these EE measures have certain technical limitations in terms of emission reduction. Thus, deep decarbonisation measures for the MSME manufacturing sector need to be further explored.

Study

The Center for Study of Science, Technology and Policy (CSTEP) conducted a 2-year study to assess the technical feasibility and financial viability of deep decarbonisation technologies in selected MSME clusters, covering a range of sectors and geographies across the country.

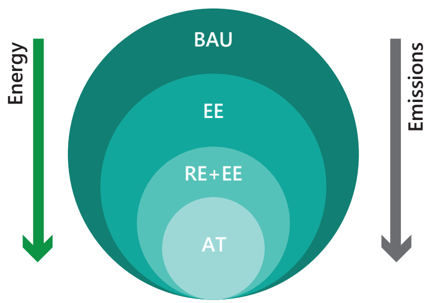
Selected MSME clusters and their respective sectors

Location	Sector	Number of units
Alathur (Chennai)	Pharmaceuticals	10
Tiruppur	Textiles	10
Ludhiana	Textiles	12
Asansol–Chirkunda	Refractories	8
Bengaluru	Aluminium die casting	10
Delhi NCR	Aluminium die casting	10
Coimbatore	Bakeries	6
Total units		**66**

For the 66 units, data on the energy usage and the associated costs and emissions were collected through detailed energy audits. Data were collected on parameters such as fuels used; equipment used (e.g. boilers; furnaces; air compressors; and heating, ventilation, and air conditioning [HVAC] systems); and their energy consumption patterns, operating efficiency, cluster parameters, and production details.

A techno-economic analysis was performed for selected units, for which energy, emissions, energy costs, and initial investments were modelled across four scenarios (Business as Usual [BAU], Energy Efficiency [EE], Energy Efficiency with Renewables [EE + RE], and Advanced Technologies [AT]). The analysis showed the impact of various levels of decarbonisation.

Scenarios considered in this study



Business as Usual (BAU): Without any interventions

Energy Efficiency (EE): Implementation of EE measures for existing equipment

Energy Efficiency with Renewables (EE + RE): Use of EE measures and renewables for electricity generation

Advanced Technologies (EE + RE + AT): Implementation of EE + RE measures and advanced decarbonisation technologies (such as use of clean fuels and process electrification)

Insights

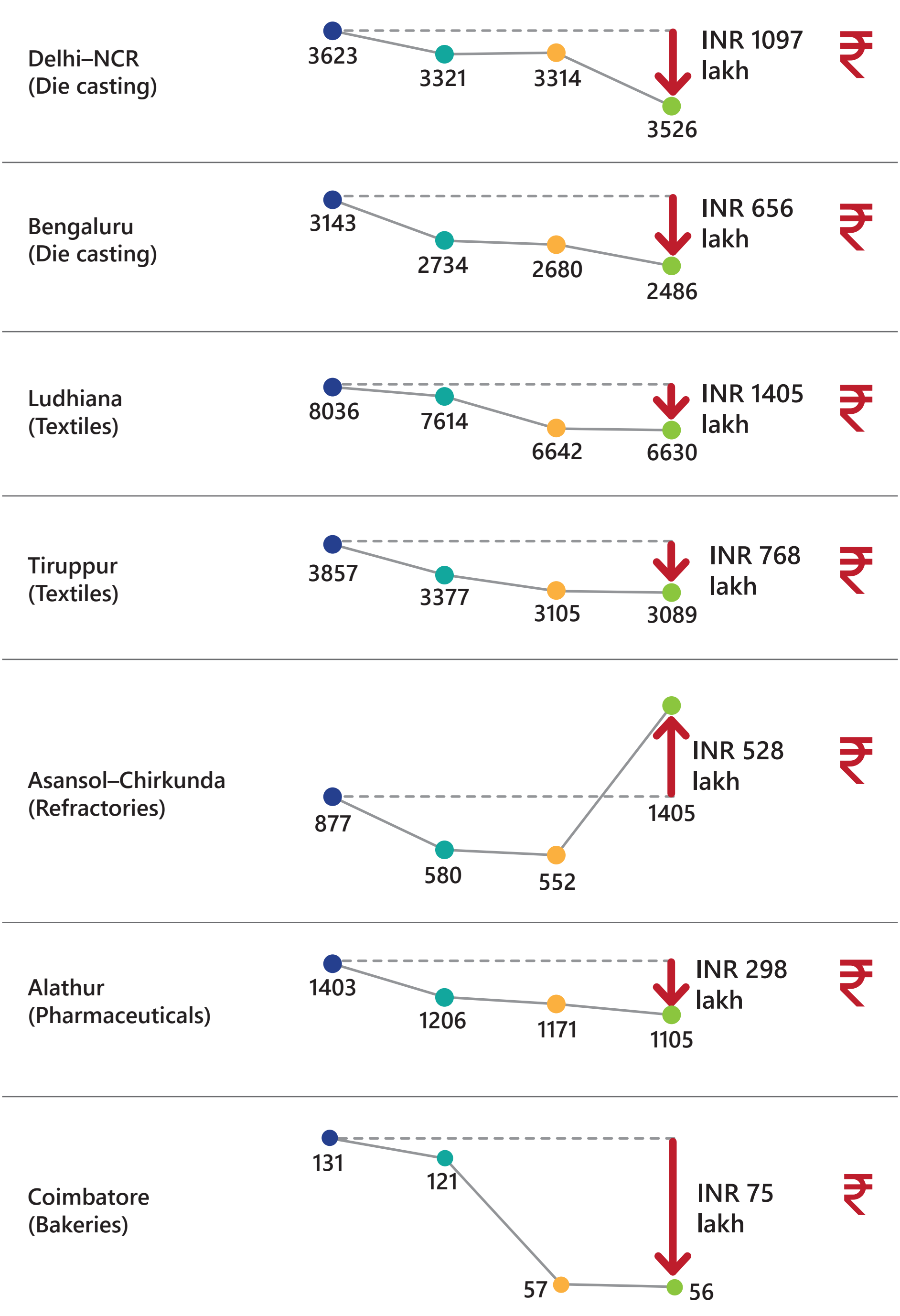
Quantifying the potential for decarbonisation and its most noticeable measurement (reduction in emissions) is not always a straightforward process. This potential is a function of various parameters such as the technical limits of the manufacturing processes for the given sector, the current efficiency levels within the sampled units, and size of the units.

The results of our study highlighted the overall potential for impact on implementing the suggested decarbonisation measures across the selected units.

Potential impact across the selected clusters

Clusters	Potential impact		
	Energy savings (%)	Emissions savings (%)	Emissions savings (tCO_2/year)
Delhi NCR (Aluminium die casting)	36%	21%	3,123
Bengaluru (Aluminium die casting)	26%	13%	4,106
Ludhiana (Textiles)	6%	79%	91,876
Tiruppur (Textiles)	13.5%	87%	31,302
Asansol–Chirkunda (Refractories)	57%	27%	3,583
Coimbatore (Bakeries)	5.5%	25%	283
Alathur (Pharmaceuticals)	12.9%	50%	2,308

Energy cost savings across the selected clusters



Across the seven clusters, with an initial investment of INR 90 crore, approximately 1,37,000 tCO_2, 3,85,000 GJ, and INR 37 crore savings in emissions, energy, and cost, respectively, can be achieved annually.

- In four of the seven locations, the ***non-electrical emissions*** were significant (45%–95% of a unit's emissions). This could be attributed to the polluting nature of the fossil fuels used, the lower efficiencies of several thermal equipment, and the extensive thermal requirements in various manufacturing processes.
- The Delhi-NCR cluster showed a higher usage of natural gas-based melting and holding furnaces, whereas the Bengaluru cluster showed a higher usage of electricity-based furnaces. This highlights the diversity in results among locations of the same sector.
- ***EE measures*** for the electric drives and HVAC equipment in the pharmaceutical sector, boilers and thermic fluid heaters in the textile sector, furnaces and die-casting machines in the aluminium die-casting sector, kilns in the refractory sector, and ovens in the bakery sector offer the **highest energy saving potential**. Policies and schemes directed at these specific equipment will play a crucial role in reducing energy consumption within their respective sectors.
- With the scope of research extending beyond energy efficiency, there was an observable ***disassociation between energy and emission savings***.
  > **Electrification** of thermal processes (e.g. in kilns in refractories and melting furnaces in aluminium die-casting) also results in energy savings owing to the higher operational efficiencies of the equipment. However, this does not always translate into emission savings because of the higher grid emission factor of the electrical grid in the country.

  > **Clean fuel switching** (in the form of solar photovoltaic (PV) electricity generation and biofuels replacing gas/coal/pet coke usage in thermal equipment) automatically reduces the emissions of the manufacturing processes without altering efficiencies.
- In six of the seven locations, **decarbonisation** of the industries also results in ***energy cost savings***. Given the high share of current energy (fuel) costs to operational and manufacturing costs in several sectors, this is an important step towards industrial development. However, in the Asansol–Chirkunda refractories cluster, deep decarbonisation (in the form of an electric tunnel kiln) has extremely high operating costs (because of the relative difference in the current coal prices and expected electricity prices).
- The study observed an approximate **potential capacity of 8.3 MW rooftop solar PV** (RTPV) in the units surveyed. However, the recent amendment to reduce the minimum sanctioned loads for open-access solar to 100 kW can have significant ramifications by allowing a much higher share of MSMEs to have open-access solar to meet their electrical demands.

Advanced technologies

In addition to the use of energy-efficient equipment and renewable energy sources (such as RTPV and solid biomass), deeper decarbonisation measures (advanced technologies) were also explored. These measures include electrification of thermal equipment (e.g. boilers, furnaces, kilns, and thermic fluid heaters) as well as the use of bio-diesel, bio-compressed natural gas (CNG), hydrogen etc.

Advanced technologies and the feasibility of their implementation in various equipment used in the clusters

Equipment	Decarbonisation measure	Energy reduction	Emission reduction	Investment cost	Payback period
Boiler	Pet-coke boiler to biomass briquettes	None	High	Low	0.2–4 years*
Boiler	Diesel boiler to biomass briquettes	None	High	Low	<4 years**
Furnace	Conversion of gas to electric furnace	High	Medium	High	<4 years
Furnace	Use of bio-CNG in gas furnaces	-	High	Low	Immediate
Kiln	Downdraft to tunnel kiln (coal)	Medium	Medium	High	<5 years
Thermic fluid heater (TFH)	Pet coke TFH to biomass briquettes	None	High	Low	0.2–4 years*
Tumbler dryer	Liquefied petroleum gas (LPG) to biogas	None	High	Low	Immediate
Oven	Biodiesel blending (20%) in diesel ovens	-	Medium	Low	Immediate
Cooking stove	Electric heater instead of LPG stove	Medium	-		<2 years
Cooking stove	Biomass gasifier instead of LPG stove	-	High	High	<2 years
Diesel generator (DG) set	Biodiesel blending (20%) in DG set	-	Medium	Low	Immediate
DG set	Use of 100% biodiesel generator	-	High	Medium	<3 years

***** depending on pet coke prices**

***** depending on boiler utilisation***

Recommendations

Improving access to financing options for MSMEs
(Collateral-free, low-interest financing; reviewing eligibility criteria of loans; capacity building for financial institutions; indirect assistance in the form of credit guarantees or risk-sharing facilities; and exploring the use of the upcoming carbon market and other international carbon financing options)

Tailoring regional or sectoral MSME policies to include emission reduction targets and roadmap
(Conducting energy audits, research and development, and pilots and demonstrations; providing financing and aggregation schemes for the present demand of common EE/RE equipment; and tailoring decarbonisation roadmaps for regions)

Development of a reliable ecosystem for the production and supply of biofuels
(Expansion of biomass briquette/pellet policies to boilers/thermic fluid heaters, inclusion of biodiesel under the Pradhan Mantri JI-VAN Yojana, and facilitation measures for bio-CNG sales to units/clusters)

Increase in the usage of renewables such as RTPV and open-access systems
(Rationalisation of open-access charges, aggregation of unit demand, net billing/feed-in tariff arrangements, and the use of cluster development schemes for common RTPV systems)

Provision of regulatory incentives from governments and clients to nudge MSMEs towards fuel switching
(Easing procedures from pollution control boards for clean fuel adoption and Scope 3 emission* monitoring)

*** Indirect emissions that are a consequence of the company's activities (upstream and downstream of the manufacturing site)**

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