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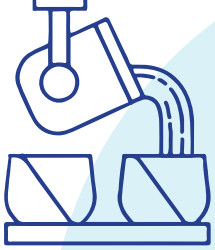
Scope for deep decarbonisation in MSME manufacturing sectors: Cluster report

Aluminium Die Casting, Bengaluru

Cluster Profile

Aluminium die casting is an important process for manufacturing metal alloy parts. Aluminium castings are a critical component in industries such as automobiles, aerospace, railways, mobiles, and IT. One of the identified aluminium die-casting clusters is located in urban Bengaluru, with about 30 MSME units spread across various industrial parks.



Location: Bengaluru, Karnataka

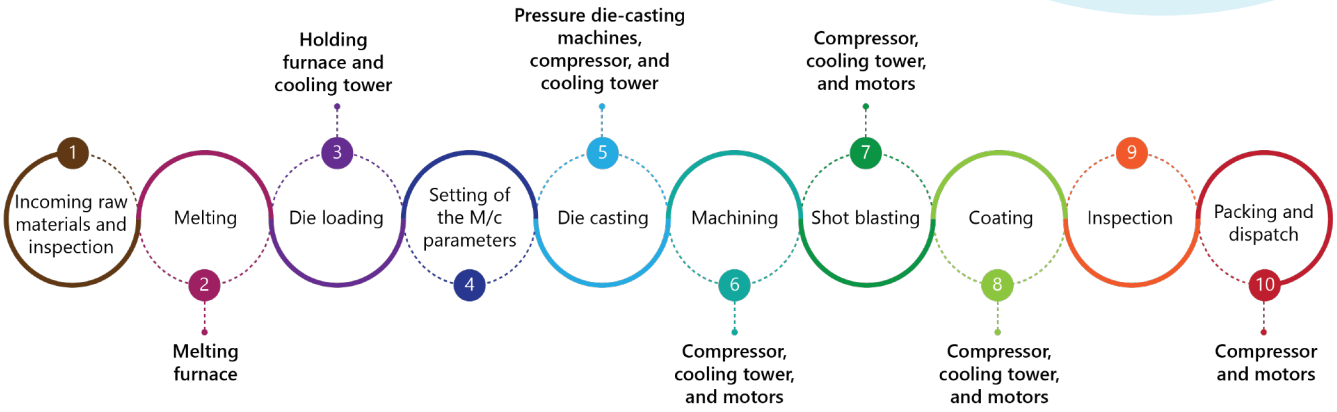
Sector: Aluminium die casting

MSME sample size: 10 (mix of micro, small, and medium)

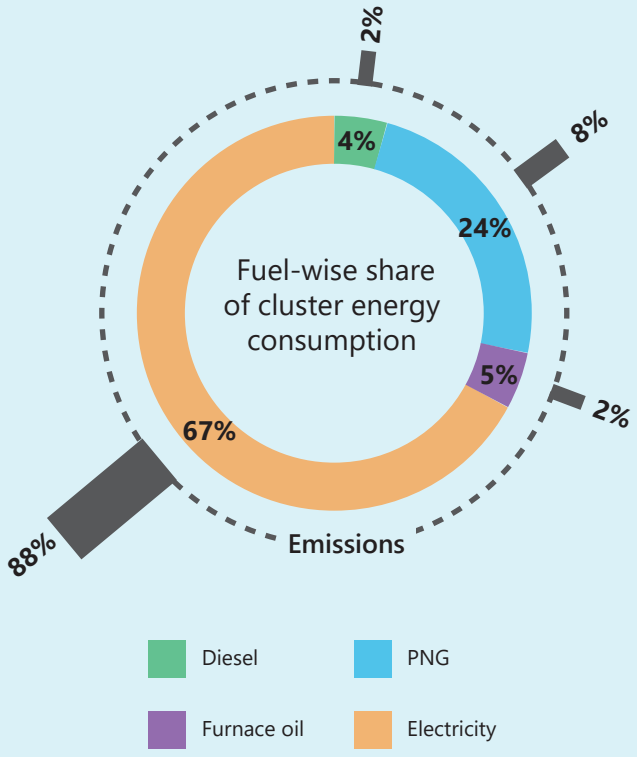
Products: Automotive components, process control parts, sub-assemblies, electrical and medical components, machinery spare parts, and specialised products

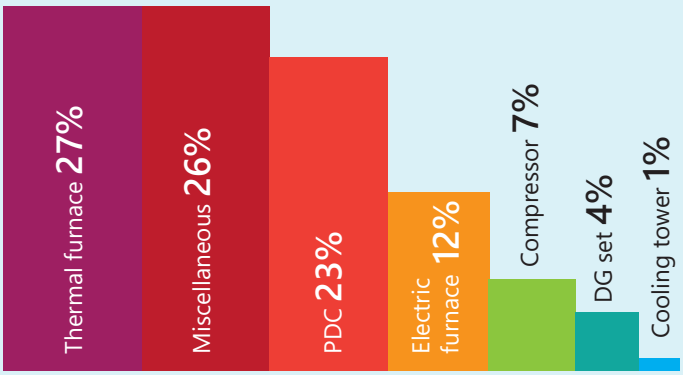
MSME classification	Turnover (in INR crore)	Investment (in INR crore)
Micro	0–5	0–1
Small	5–50	1–10
Medium	50–250	10–50

Unit process diagram



Energy Consumption Profile





Equipment-wise share of cluster energy consumption

Note: Miscellaneous equipment consists of CNCs, lathe machines, sand blasting, lighting, fans, etc.

Energy- and Emission-Intensive Equipment

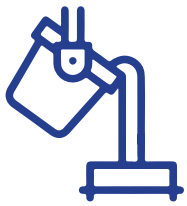
Furnace (melting and holding)

A furnace is the largest energy-consuming component in the die-casting process. In the study, the MSME units are divided based on the type of furnace used—electric or thermal. The electric furnace is of resistance type while the thermal furnace is either powered by furnace oil or PNG.

Recorded SEC

Thermal furnaces: 4.52–13.41 GJ/tonne

Electrical furnaces: 1.62–6.54 GJ/tonne

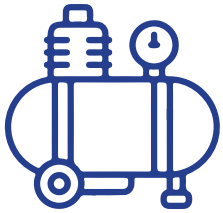


Pressure die-casting machine

Pressure die-casting (PDC) machines also consume a large quantum of electricity. This is because of the high pressure (in excess of 30 MPa) required to produce high precision and intricate castings. The die-casting units have both fully and semi-automatic horizontal cold chamber machines.

Recorded SEC

PDC machines: 5–11.3 GJ/tonne



Air compressor

Air compressors are power guzzlers in most aluminium die-casting units. Compressed air is a reliable means of running a variety of pneumatic actuators, ejection processes and other tools in machining. Ideally, 0.16–0.18 kW is required for every cubic feet per minute (CFM) of compressed air, given the pressure requirements of the sector.

Recorded SEC

Air compressors: 0.18–0.2 kW/CFM

Cooling towers

Cooling water systems are a requirement for furnaces, compressors, and PDC machines. The heat is rejected from equipment using cooling towers, which consist of components such as pumps and fans.

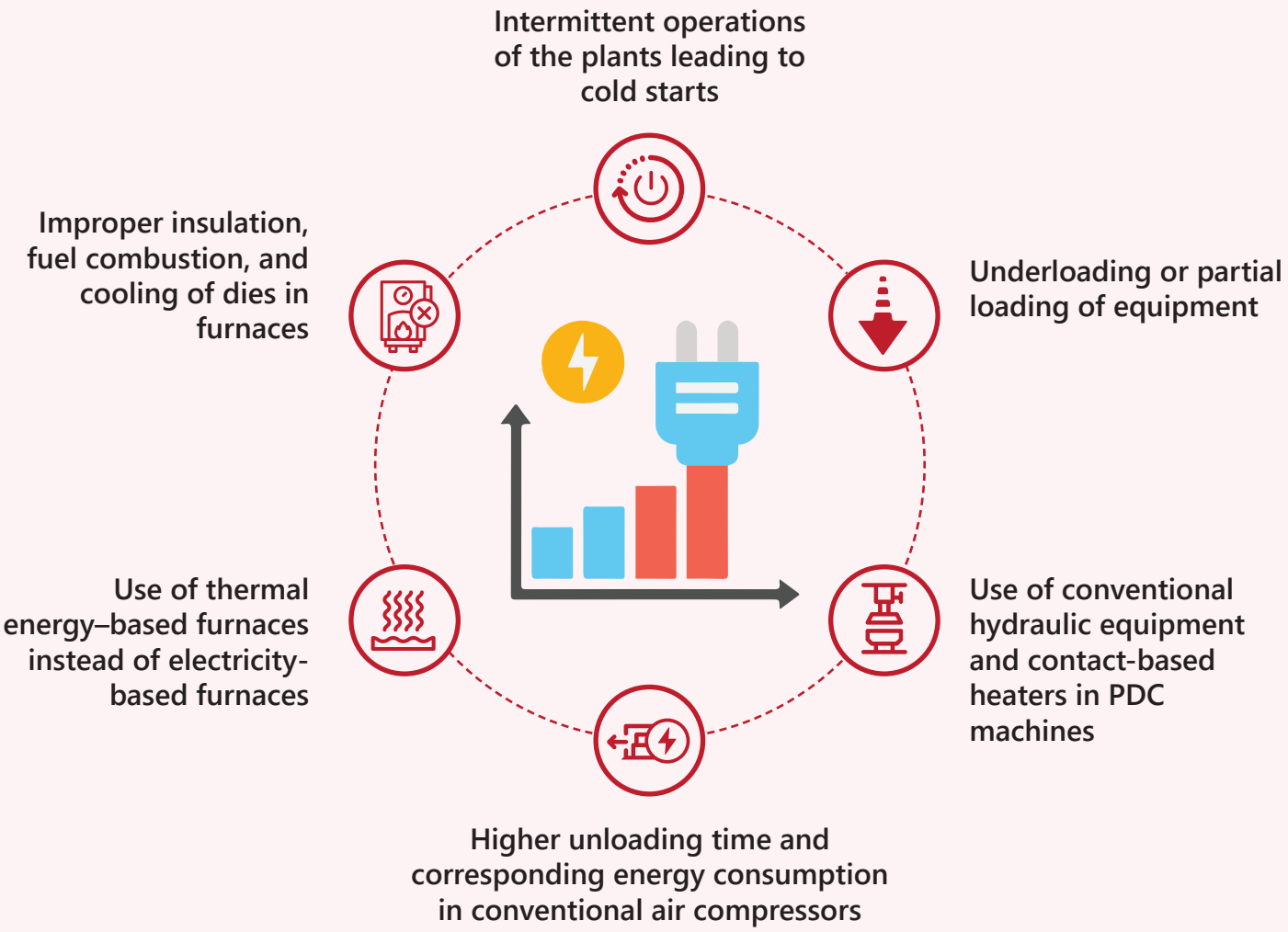
Tool room machinery (CNC, lathe, etc.)

Several machines and finishing processes are required after the casts are prepared. These processes are run by compressed air and motors with (often) intermittent requirements of electricity use.

Diesel generator sets

A diesel generator (DG) set is primarily used for backup power if there is a power outage. It is a large consumer of HSD in units, operating with typical efficiencies of 25%–45% depending on the age of the equipment.

Reasons for High Specific Energy Consumption (SEC)



Energy Efficiency (EE) Recommendations

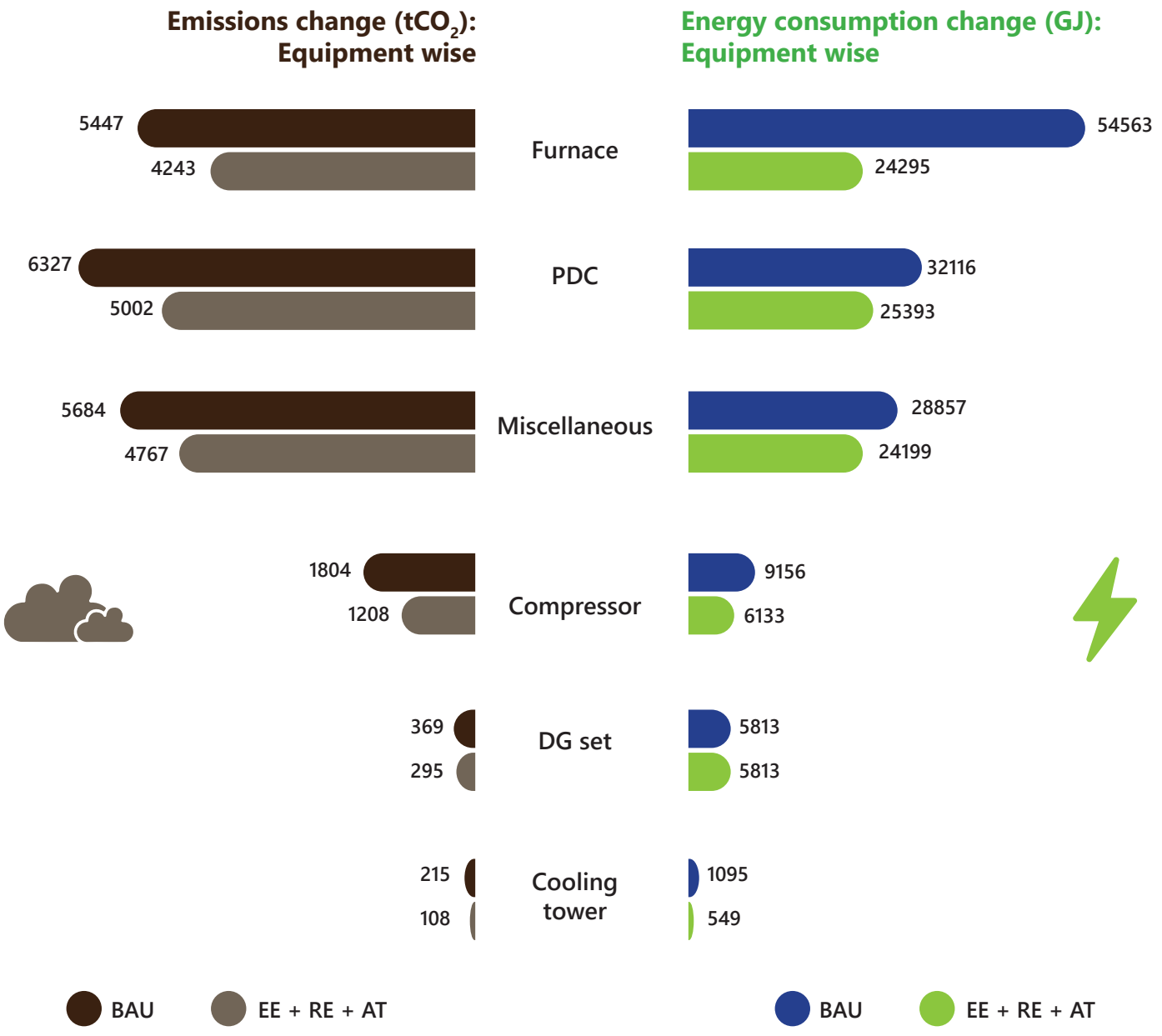
- Reducing compressor air leakage **(short term)**
- Compressor pressure optimisation **(short term)**
- Installing VFD to ensure no power consumption during compressor unloading **(short term)**
- Replacing electric heater with thyristor **(long term)**
- Utilising servo motor pumps for PDC machines **(long term)**
- Replacement of cooling tower fans and pumps with efficient equipment **(long term)**
- Air preheater for PNG furnaces **(short term)**

Decarbonisation measure	Short term: <1 year	Medium term: 1-2 years	Long term: >2 years

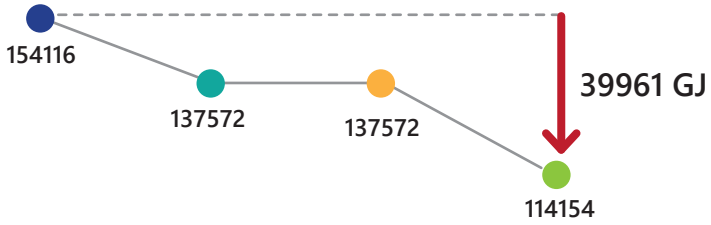
Techno-economic Analysis

A techno-economic analysis is carried out for a sample size of 10 units where energy, emission, and energy cost are modelled across four scenarios. The analysis shows the difference in each scenario and the impact of decarbonisation measures at various levels. The scenarios are as follows:

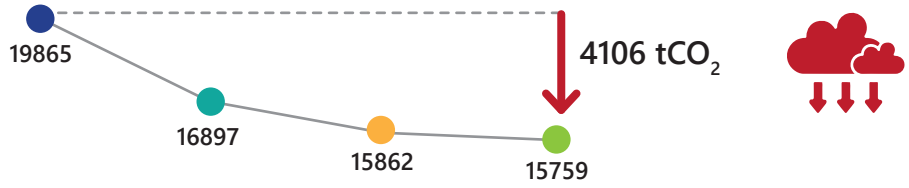
- **Business as Usual (BAU):** Without any interventions
- **Energy Efficiency (EE):** EE measures on existing equipment
- **Energy Efficiency with Renewables (EE + RE):** EE measures and renewables for electricity generation
- **Advanced Technologies (EE + RE + AT):** EE + RE measures and advanced decarbonisation technologies (clean fuels, process electrification)



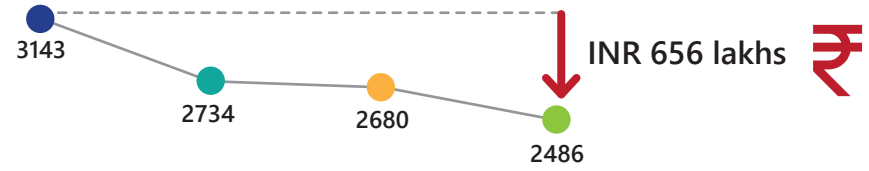
Scenario-wise reduction in cluster energy consumption (GJ)



Scenario-wise reduction in cluster GHG emissions (tCO_2)



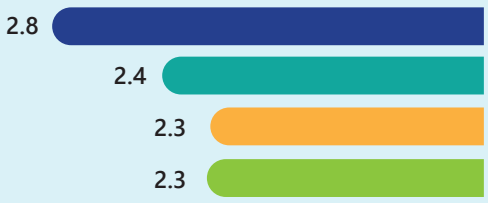
Scenario-wise reduction in energy cost within cluster (INR in lakhs)



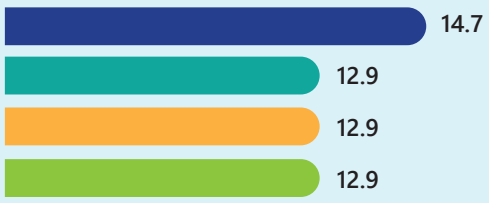
BAU EE EE + RE EE + RE + AT

For a typical unit in the cluster, the change in energy and emission intensity of production is given:

Scenario-wise reduction in emission intensity (tCO_2/tonne)



Scenario-wise reduction in Specific energy consumption (GJ/tonne)



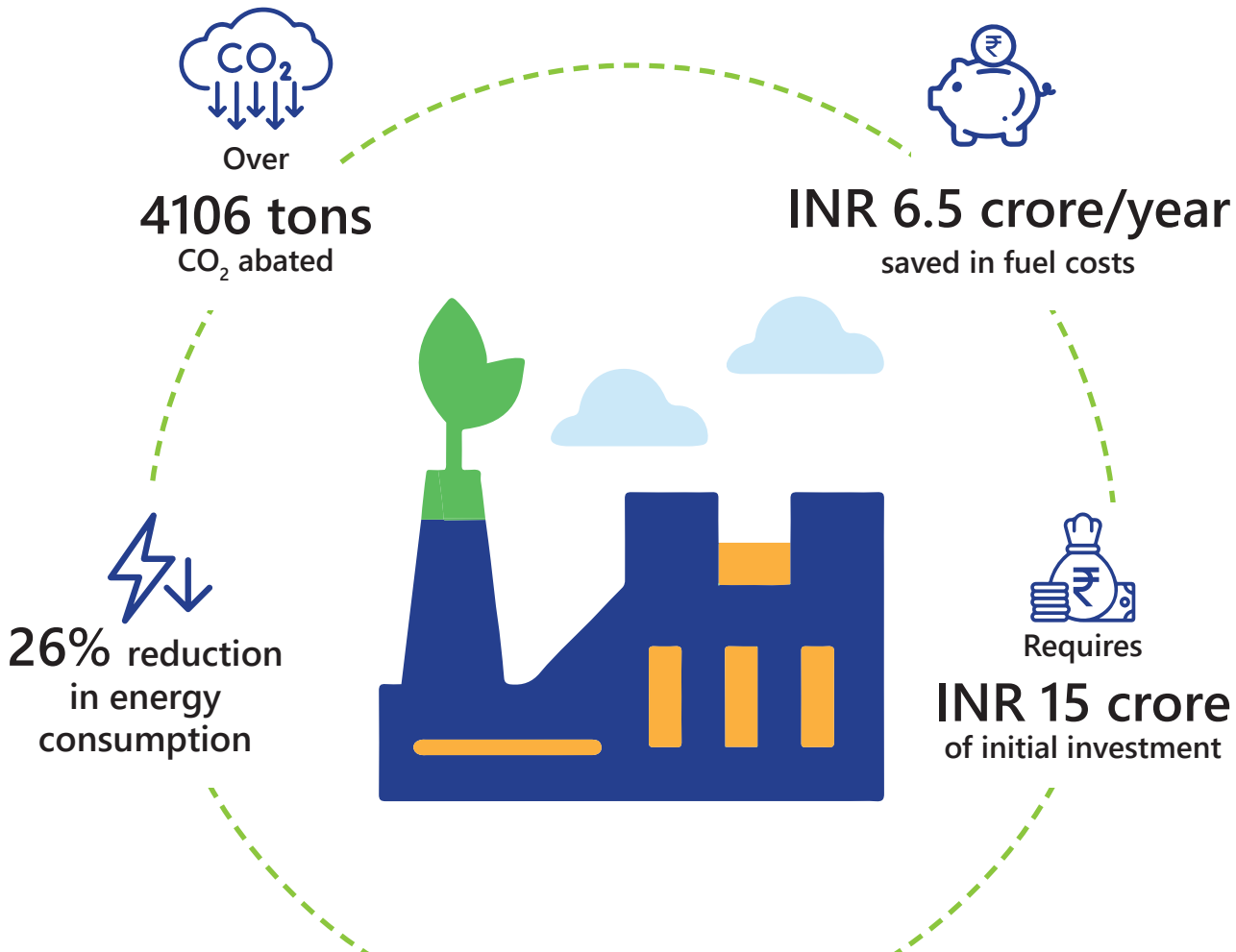
BAU EE EE + RE EE + RE + AT

Note: 'Unit' here represents the individual 10 units sampled as part of the study. Not all units were able to provide production data. Moreover, due to high prevalence of electric furnaces in the cluster, there is limited SEC reduction beyond the EE scenario.

Advanced technology measures for cluster and impact

Equipment	Decarbonisation measure	Energy reduction	Emissions reduction	Investment cost	Payback period
Furnace	Conversion of gas to electric furnace	High	Medium	High	<4 years
Furnace	Use of bio-CNG in gas furnaces	-	High	Low	Immediate
All electric equipment	Installing rooftop solar	-	High	High	<5 years
All electric equipment	Using open access green energy from grid	-	High	Low	Immediate
DG set	Biodiesel blending (20%) in DG set	-	Medium	Low	Immediate
DG set	Use of 100% biodiesel generator	-	High	Medium	<3 years
DG set	Conversion of DG set to battery	Medium	Low	High	Not feasible

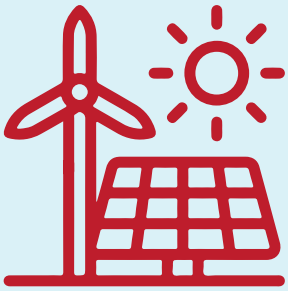
Potential impact of decarbonisation measures



Way Ahead

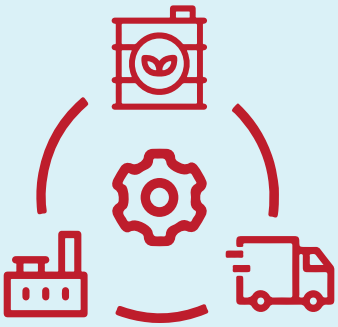
Considerable scope for energy efficiency measures

- Sector-specific targets for MSMEs with strategy framework (pilot programmes, energy audits mandate, and low-cost financing for EE equipment)
- Include thermal energy savings target in Karnataka's Energy Conservation and Energy Efficiency Policy 2022-27



Increasing RE usage in the sector

- Allow gross metering above the sanctioned load
- RE open access / virtual net metering
- MSME unit demand aggregation



Strengthening the supply chain of biodiesel and bio-CNG to MSMEs

- Sell bio-CNG (from SATAT and the GOBARdhan scheme) to industrial clusters directly
- Encourage biodiesel blending in industrial sectors with high usage of HSD (e.g., DG sets)
- Include biodiesel under Pradhan Mantri JI-VAN Yojana

Incentivise the electrification of industrial thermal processes

- Provision of tariff reduction for MSME units that meet a stipulated increase in annual electrical consumption
- Extend rebate scheme of INR 0.5/kWh for MSMEs across Karnataka's ESCOMs

CENTER FOR STUDY OF SCIENCE, TECHNOLOGY & POLICY

Bengaluru
No.18, 10th Cross, Mayura Street, Papanna Layout,
Nagashettyhalli (RMV II Stage), Bengaluru-560094
Karnataka, India

Noida
1st Floor, Tower-A, Smartworks Corporate Park, Sector-125,
Noida-201303, Uttar Pradesh, India


www.cstep.in


+91-8066902500


cpe@cstep.in


@cstep_India