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Scope for deep decarbonisation in MSME manufacturing sectors: Cluster report

Refractories, Asansol—Chirkunda

Cluster Profile

Refractory materials play a critical role in several thermal processes in the industrial sector as they are capable of withstanding harsh environments (high temperatures, abrasive loading, etc). One of the identified refractory clusters is located in Asansol and its neighbouring town, Chirkunda. There are about 206 refractory industries in the cluster, of which about 200 units use downdraft (DD) kilns. The refractory materials produced are used within the country. The primary domestic market consists of large steel manufacturing industries.

Location: Asansol—Chirkunda

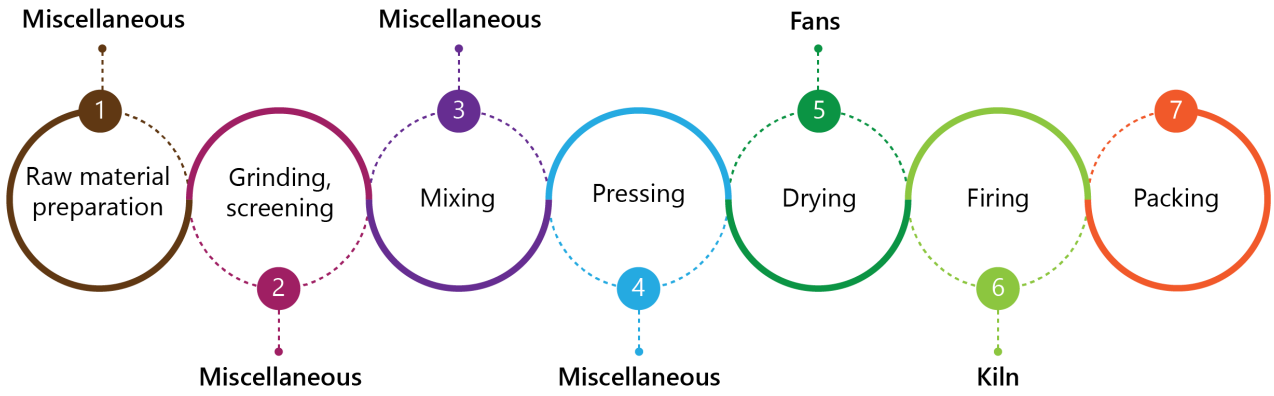
Sector: Refractories

MSME sample size: 8 (mix of micro, small, and medium)

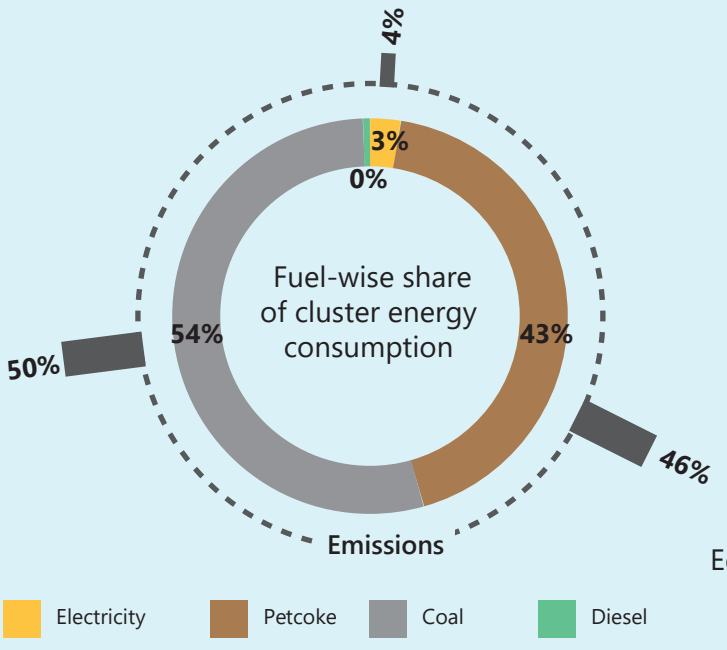
Products: Refractory blocks and bricks, graphite stopper heads, insulation bricks, refractory mortar, roof bricks, sillimanite bricks, monolithic, and silica bricks.

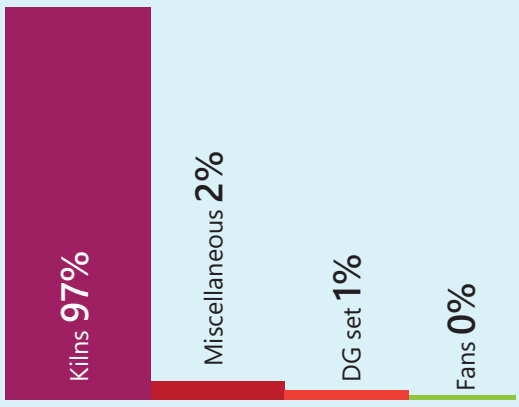
MSME classification	Turnover (in INR crore)	Investment (in INR crore)
Micro	0–5	0–1
Small	5–50	1–10
Medium	50–250	10–50

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

Kilns

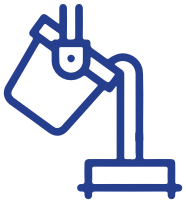
Kilns are the largest energy-consuming component in refractory manufacturing. These are specific types of furnaces used for heating of refractory materials. This heating is a crucial part of achieving the desired properties of refractory materials. The two types of furnaces in the cluster are DD and tunnel kilns.

DD kilns are an old and extensively used technology across the cluster. They have batch-wise production, are powered by coal, and are not efficiently designed, resulting in additional losses. Tunnel kilns in the cluster are continuous production, powered by petcoke, and designed with better heat distribution, efficiency, and so on. They have lower energy losses but are suited for larger production capacities.

Recorded SEC

DD: 5.79–17.42 GJ/ton

Tunnel: 3.36–4.97 GJ/ton



Fans

Fans are used for multiple purposes in units, such as to dry green bricks, create a draft, and cool the working environment.

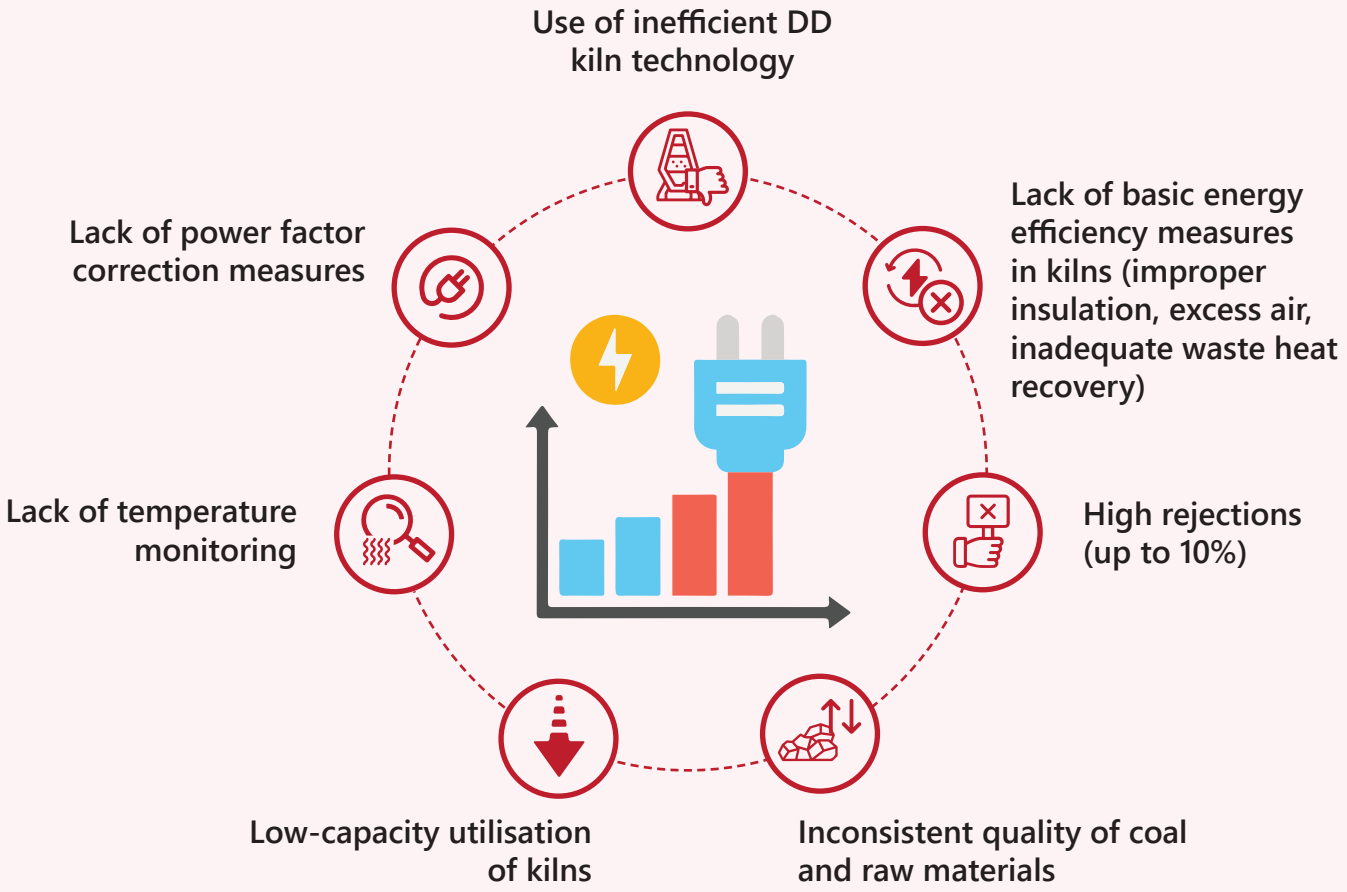
Miscellaneous

These consist of process equipment such as mixers, grinders, and hydraulic press machines to prepare refractory bricks before the drying and firing processes.

Diesel generator sets

A diesel generator (DG) set is primarily used as 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.t.

Reasons for High Specific Energy Consumption (SEC)



Energy Efficiency (EE) Recommendations

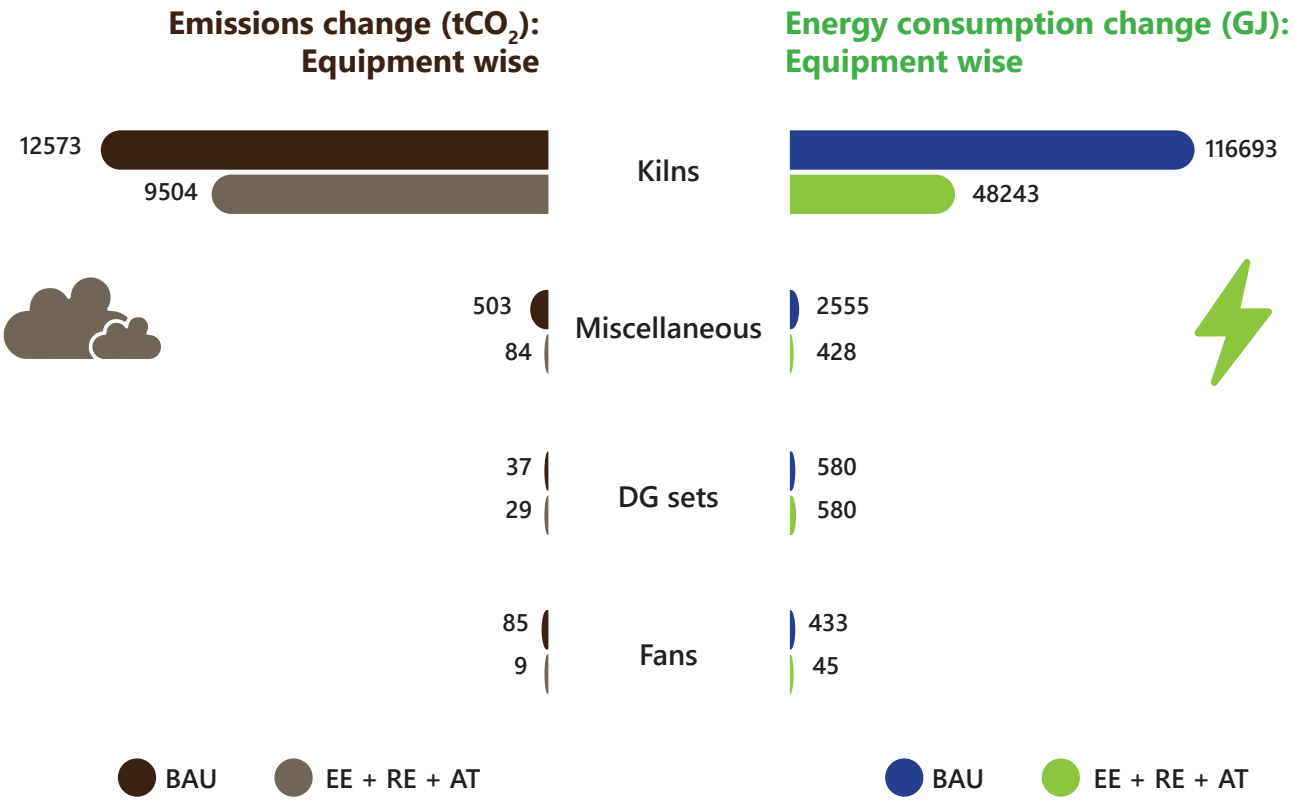
- Improvement in the operating power factor **(short term)**
- Insulation of the heating zone surface in kilns **(short term)**
- Reducing rejection rates **(short term)**
- Installation of waste heat recovery systems in kilns **(medium term)**
- Installation of temperature controllers in kilns **(medium term)**
- Installation of IE3 energy efficient motors with VFDs **(medium term)**
- Installation of tunnel kiln furnaces in place of DD furnaces **(long term)**
- Optimisation of the air-to-fuel ratio by installing online oxygen analysers **(long term)**
- Replacement of pipe burners with swirl burners **(long term)**

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

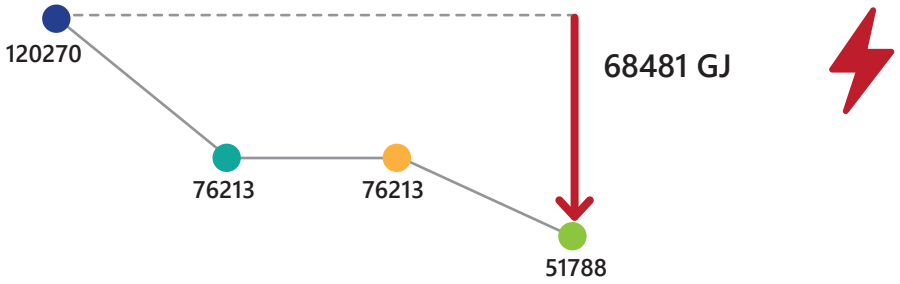
Techno-economic Analysis

A techno-economic analysis is carried out for a sample size of 8 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:

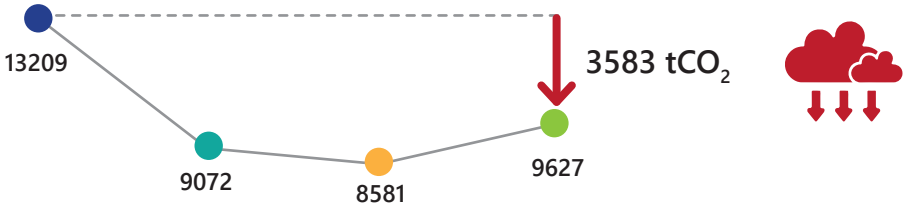
- **Business as Usual (BAU):** Without any interventions
- **Energy Efficiency (EE):** EE measures on existing equipment
- **Energy Efficiency with Renewables (EE + RE):** EE measures and renewables for electricity generation
- **Advanced Technologies (EE + RE + AT):** EE + RE measures and advanced decarbonisation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



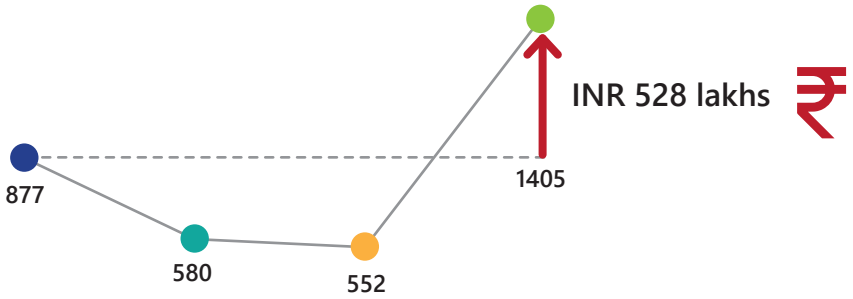
Scenario-wise reduction in cluster energy consumption (GJ)



Scenario-wise reduction in cluster GHG emissions (tCO_2)



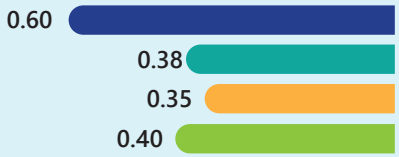
Scenario-wise reduction in energy cost within cluster (INR in lakhs)



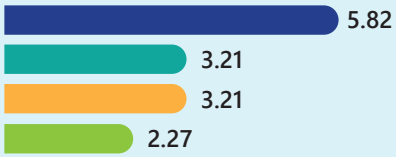
Note: Rise in overall energy costs in the EE + RE + AT scenario because of the use of electricity-powered kilns

BAU EE EE + RE EE + RE + AT

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



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



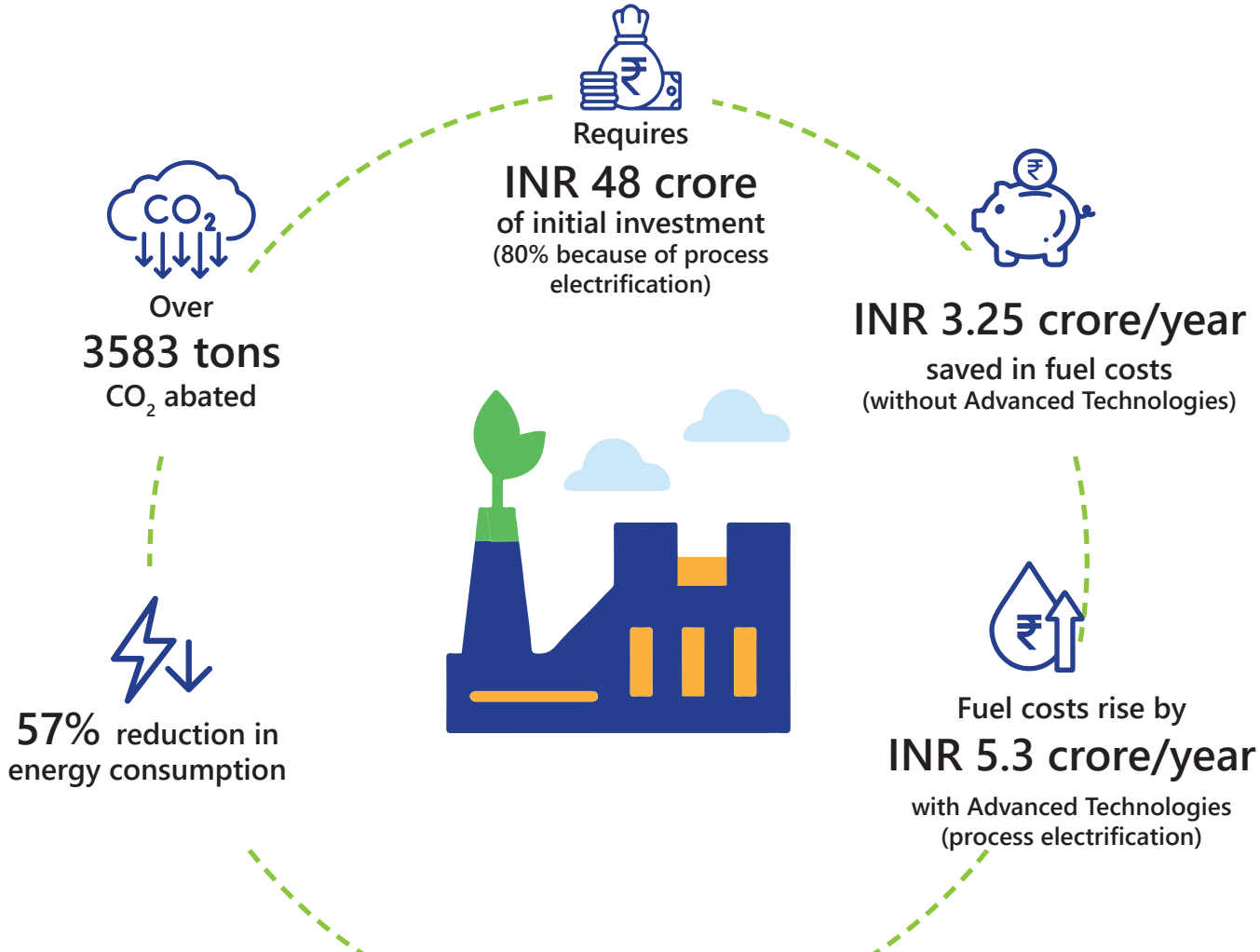
BAU EE EE + RE EE + RE + AT

Note: Rise in overall energy costs in the EE + RE + AT scenario because of the use of electricity-powered kilns

Advanced technology measures for cluster and impact

Equipment	Decarbonisation measure	Energy reduction	Emissions reduction	Investment cost	Payback period
All electric equipment	Installing rooftop solar	-	High	High	<5 years
All electric equipment	Using open access green energy from the grid	-	High	Low	Low
DG set	Biodiesel blending (20%) in DG sets	-	Medium	Low	Immediate
DG set	Use of 100% biodiesel generator	-	High	Medium	<3 years
DG set	Conversion of DG sets to battery	Medium	None	High	Not feasible
Kiln	DD to tunnel kiln (coal)	Medium	Medium	High	<5 years
Kiln	DD to tunnel kiln (coal to electric)	High	Low	High	Not feasible
Kiln	Tunnel kiln (petcoke to electric)	High	Low	High	Not feasible

Potential impact of decarbonisation measures



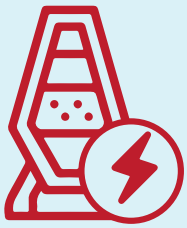
Way Ahead

Energy efficiency measures

Conversion of DD to tunnel kiln has the potential to reduce emissions by 40%—45%, but investment costs >INR 1.5 crore per unit

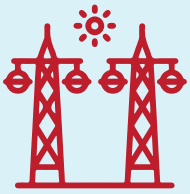
- SIDBI 4E and SRIJAN financing schemes are applicable. Relaxing collateral and profitability criteria could increase the adoption
- Use of credit guarantee and larger financing schemes (e.g., SIDBI Green Finance Scheme) to empower ESCOs in the area
- State government support through the upcoming RAMP scheme

Process electrification



Electric tunnel kilns reduces energy, emissions. However, payback cannot be achieved currently because of high investments and high fuel costs. Closing this viability gap requires

- Low electricity rates (through tariff revision or RTPV/RE open access)
- Low-cost financing by stakeholders (>80% equipment capital subsidy necessary presently)



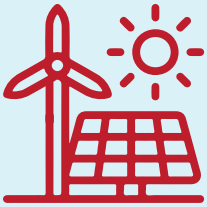
Changes to the grid infrastructure or the regulatory environment

- Grid infrastructure upgrades by DISCOMs (DTs and transmission lines)
- Introduce power factor correction incentives in energy bills
- Subsidies and rebates for industrial connections

Alternative fuels

Bio-CNG-powered kilns can meet the process heating requirements at a lower expense than electric kilns. However, wider adoption of technology requires

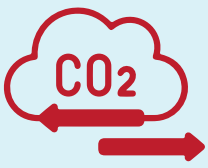
- Design and R&D in technology centres, training institutions, and DST
- Pilot projects for proof of demonstration
- Possible technology transfer/licensing (use of the TIFAC-SIDBI programme)
- Building bio-CNG supply chains for MSMEs (through SATAT and GOBARdhan schemes)



Increasing RE use in the sector

- Rooftop solar installation and the use of RE-specific financing schemes (e.g., MNRE)
- Utilising RE open access and aggregating demand from multiple MSME units

MSMEs carbon trading



Use of the upcoming carbon market as a potential source to reduce the payback period of decarbonisation measures

- Regulations and framework on market design
- Sensitisation and awareness building in the MSME community

Note: Stakeholders include several central and state government bodies, financing institutions (such as SIDBI), MSME Development Institutes (DIs), and the Ministry of MSME.

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