5. Niti Aayog Reports on Green Transition - Reports

NITI Aayog has released three reports outlining decarbonisation roadmaps for the cement, aluminum and MSME sectors

Decarbonisation of India's Cement, Aluminium and MSME Sectors - India's net-zero pathway is increasingly determined by "hard-to-abate" sectors where emissions arise from core industrial processes and/or high-temperature heat and electricity demand. Cement and aluminium are foundational to India's infrastructure and manufacturing growth, while MSMEs dominate the industrial base and employment—hence the need for a sector-specific decarbonisation roadmap.

A. Decarbonisation of Cement Sector

1) Growth and emissions profile

Demand trajectory- Cement production is projected to rise from ~391 Mt (2023) to ~2,100 Mt (2070), driven by urbanisation and infrastructure needs.

Global positioning- India is the 2nd-largest cement producer after China and contributes a significant share of global output.

Emission significance- Cement contributes materially to India's industrial emissions because-

1. Process emissions (calcination of limestone) are intrinsic to clinker making.
2. Energy emissions arise from kiln fuel (coal/petcoke) and electricity use.

2) Decarbonisation target (intensity reduction) - Roadmap vision- reduce carbon intensity from about 0.63 tCO_2e/tonne of cement to ~0.09–0.13 tCO_2e/tonne by 2070.

3) Key decarbonisation strategies (what each achieves)

Fuel switch- Refuse-Derived Fuel (RDF) and alternative fuels

1. Objective- reduce coal/petcoke dependence in kiln heat.
2. Co-benefit- links industrial decarbonisation with municipal solid waste management.
3. Constraint- quality consistency of RDF, logistics, co-processing infrastructure.

Clinker substitution (lower clinker-to-cement ratio)

1. Strategy- increase Supplementary Cementitious Materials (SCMs) such as fly ash/slag/calcined clay (where feasible).
2. Why it matters- clinker is the main emission hotspot (process + thermal energy).
3. Constraints- SCM availability, standards, supply chain, regional variability.

CCUS (Carbon Capture, Utilisation and Storage)

1. Role- addresses residual process emissions that remain even after fuel and clinker strategies.
2. Constraints- high capex/opex, transport & storage infrastructure, utilisation market depth, MRV.

Carbon market signal- Carbon Credit Trading Scheme (CCTS)- CCTS compliance mechanism sets GHG emission intensity targets for "obligated entities"; overachievers earn tradable Carbon Credit Certificates (CCCs).

B. Decarbonisation of Aluminium Sector

1) Production outlook and why emissions are hard-to-abate- Aluminium production is projected to rise from ~4 Mt (2023) to ~37 Mt (2070). Aluminium's emissions are dominated by electricity-intensive smelting, and in India a large share of that power has historically been coal-based captive power.

2) Phased decarbonisation pathway (roadmap logic) - Short term- RE–RTC (Renewable Energy–Round the Clock) + stronger grid connectivity/reliability

1. Focus- rapidly reduce power emissions without disrupting industrial operations.
2. Needs- firming solutions, storage, transmission upgrades, reliable contracting.

Medium term- nuclear power for stable low-carbon baseload - Rationale- smelters require **continuous, stable** electricity; nuclear can provide low-carbon baseload at scale (subject to policy and project execution).

Constraints- long gestation, regulatory/social license, financing.

Long term- CCUS for remaining emissions

1. Helps address residual emissions across remaining fossil-linked processes and harder residual sources.
2. Constraints similar to cement- infrastructure, costs, MRV.

3) Market driver (why industry will move) - Global buyers (automotive, construction, packaging) are increasingly seeking low-carbon aluminium, creating competitiveness incentives.

C. Decarbonisation of MSME Sector

1) Why MSMEs are central to the transition - MSMEs contribute ~30% of GDP, employ 250 million+, and account for ~46% of exports (as cited in the roadmap release). MSMEs are numerous, dispersed, and diverse—so the challenge is diffuse emissions and limited capacity for technology and finance.

2) Three-lever green transition model - The MSME roadmap is built around three core decarbonisation levers

Energy efficiency

1. Replace/retrofit inefficient motors, boilers, furnaces, compressors; adopt process optimisation and waste-heat recovery where viable.
2. Benefit- fastest paybacks, immediate cost reduction; also improves competitiveness.

Alternative fuels

1. Shift from coal, furnace oil, and traditional biomass to cleaner options (context-specific)- biomass pellets, biogas, PNG, electrified heat (where feasible).
2. Constraint- fuel availability, burner compatibility, upfront retrofit cost.

Green electricity

1. Renewable procurement via open access, group captive, rooftop solar, and cleaner grid supply.
2. Constraint- contract complexity, grid reliability, small-ticket financing.

3) Expected outcomes (as per roadmap framing) - The roadmap projects large potential benefits over the next decade, including substantial emissions reduction, private investment mobilisation, and green jobs.

D. Key initiatives already taken by India

Perform, Achieve and Trade (PAT) - Energy-efficiency market mechanism for designated consumers in energy-intensive sectors; relevant to cement and other heavy industries.

MSME sustainability and quality frameworks - Udyam Registration + ZED (Zero Defect Zero Effect) encourage resource efficiency and cleaner production in MSMEs.

Grid and renewable procurement enablers - National Smart Grid Mission and Green Open Access Rules (2022) facilitate renewable procurement, relevant for MSMEs and large industrial consumers.

Carbon Credit Trading Scheme (CCTS) - Operates through Compliance (intensity targets for obligated entities with CCC trading) and Offset mechanisms. Coverage of multiple hard-to-abate sectors has been expanding through notifications/updates, signalling an increasingly operational compliance carbon market.

E. Challenges in the green transition

1) Hard-to-abate emissions

Cement- limestone calcination creates unavoidable process CO_2; deep decarbonisation needs CCUS and clinker substitution.

Aluminium- smelting is electricity-intensive; decarbonisation hinges on firm low-carbon power at scale.

2) High capital costs and long payback cycles - CCUS, RE–RTC procurement, storage, transmission upgrades, and nuclear integration all involve high capex and long project cycles, especially challenging under uncertain carbon price signals.

3) Green finance constraints (especially MSMEs) - MSMEs face weak collateral, high cost of capital, limited technical capacity to develop bankable projects, and high transaction costs for small-ticket loans.

4) Clean power availability and grid constraints - Achieving reliable round-the-clock low-carbon power requires grid strengthening, storage and firming, and improved contracting—otherwise industrial users revert to captive fossil sources.

5) Implementation capacity and MRV - Effective carbon markets need credible Monitoring, Reporting and Verification (MRV), transparent baselines, and enforcement—otherwise credit integrity suffers.

F. Way ahead

1) Scale green finance (especially for MSMEs)- Expand blended finance, credit guarantees, concessional lines via DFIs, and standardised energy-service models (ESCO-type aggregation) to reduce transaction cost.

2) Technology development and localisation - Accelerate domestic manufacturing and deployment capability for

1. waste-to-fuel/RDF supply chains,
2. calcined clay and other SCM ecosystems,
3. industrial electrification equipment,
4. CCUS components and CO_2 transport infrastructure.

3) Strengthen carbon markets (CCTS credibility) - Ensure

1. robust baselines and intensity metrics,
2. transparent target-setting,
3. high-integrity MRV,
4. credible compliance and trading infrastructure (including exchanges).

4) Build "cluster-based" MSME decarbonisation - Use industrial clusters (textiles, foundries, food processing, etc.) for

1. demand aggregation,
2. common renewable procurement,
3. shared testing/quality infrastructure,
4. shared audits and advisory support.

5) Plan CCUS as national infrastructure - Treat CO_2 transport and storage as shared infrastructure (like pipelines/ports) to reduce unit costs and enable scale in both cement and aluminium.

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