सत्यमेव जयते
NITI Aayog

Roadmap for Green Transition of MSMEs

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NITI Aayog

Roadmap for
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Preface

At the 26th UN Climate Change Conference (COP26), India committed to achieving net-zero emissions by 2070, reducing carbon intensity by 45% by 2030, and increasing non-fossil energy capacity to 500 GW by 2030. Achieving these ambitious targets will require significant efforts across all sectors, with industrial decarbonisation playing a crucial role. Given the diversity of the industrial landscape, a sector-specific approach has been adopted as the pathway toward a green transition.

To enable a comprehensive strategy and develop tailored decarbonisation roadmaps, NITI Aayog has constituted a Technical Working Committee for the Micro, Small, and Medium Enterprises (MSME) sector, comprising stakeholders from a wide range of backgrounds:

- **Central Government** – Ministries of Micro, Small and Medium Enterprises; Power; Petroleum and Natural Gas; New and Renewable Energy; and the Bureau of Energy Efficiency;
- **Industry Associations** – Experts representing Small-Scale Industries, Small and Medium Industries, Manufacturers' Associations, and various state-level industry bodies.

The Committee was guided by a clear set of Terms of Reference (TOR), which included:

i) Identifying key emission sources and establishing baseline sectoral emissions across production value chains.

ii) Assessing existing government and private-sector strategies.

iii) Analysing international market trends and preparing a sectoral outlook on India's competitiveness.

iv) Prioritizing decarbonisation levers such as the circular economy and resource efficiency.

v) Developing sector-specific abatement curves outlining emission reduction potential and associated costs.

vi) Reviewing relevant policy and regulatory frameworks.

vii) Evaluating technology options and their commercial feasibility.

viii) Mapping potential capital and funding sources.

ix) Formulating a sector-specific action plan with suitable financial mechanisms.

This report draws on the Committee's work as well as extensive consultations with government agencies, industry associations, financial institutions, and technical experts. It aims to present a practical, action-oriented roadmap focused on the key technological and financial interventions required to enable the MSME sector's green transition.

The report also recommends the establishment of institutional mechanisms, governance structures, and a robust Monitoring, Reporting, and Verification (MRV) framework, along with a dedicated Regulatory Impact Assessment (RIA) body. It seeks not only to chart comprehensive energy pathways for decarbonizing existing MSME units but also to ensure that new and upcoming MSMEs adopt low-carbon strategies from inception.

Positioned at the intersection of global climate commitments, national development priorities, and local livelihood needs, MSMEs have the potential to emerge as both beneficiaries and key drivers of India's sustainable industrial transformation.

Foreword and Acknowledgement

Micro, Small, and Medium Enterprises (MSMEs) are the backbone of India's industrial landscape, contributing nearly 30% to the national GDP, 46% to exports, and providing jobs to over 250 million people. As the world moves towards a low-carbon future, MSMEs stand at a crucial juncture—facing both unprecedented opportunities and significant challenges.

Despite their vital role, MSMEs often grapple with structural barriers, including limited awareness, outdated technologies, restricted access to finance, and inadequate institutional support. These challenges hinder their ability to adopt sustainable, energy-efficient practices. In light of India's commitment to achieving net-zero emissions by 2070 and the growing global demand for green products, decarbonizing the MSME sector is not merely desirable—it is necessary.

To address this, NITI Aayog constituted a Technical Working Committee for the MSME sector to develop a sector-specific decarbonisation roadmap. The Committee brought together representatives from the Central and State Governments, industry associations, technology providers, financial institutions, and think tanks. This report is the outcome of multiple rounds of in-depth consultations with these diverse stakeholders.

As Chairperson of the Technical Working Committee for the MSME sector, I am deeply grateful to all members for their valuable contributions in shaping this report.

At the outset, I express my sincere gratitude to Shri B.V.R. Subrahmanyam CEO NITI Aayog for entrusting this responsibility to the Committee and for his continued guidance. I also extend my heartfelt thanks to Shri S.C.L. Das, Secretary, Ministry of Micro, Small and Medium Enterprises, and Dr. Anshu Bharadwaj, Programme Director for Green Transition and Climate at NITI Aayog, for their insightful suggestions and constant support throughout the process.

I acknowledge with appreciation the contributions of the MSME Technical Working Committee members whose in depth knowledge of the subject and recommendations have been instrumental in framing the roadmap for the green transition of MSMEs. Special thanks are due to Shri Ateesh Kumar Singh, Joint Secretary, Ministry of MSME; Shri Rajnath Ram, Adviser, NITI Aayog; and Ms. Neha Nautiyal, Deputy Secretary, NITI Aayog, for their active participation and contributions. I also recognize the valuable inputs from Shri Manoj Kumar Upadhyay, Deputy Adviser, NITI Aayog, and Shri Aman Hans, Resident Fellow, NITI Aayog, particularly in relation to the energy ecosystem.

I wish to highlight the insights provided by Shri S.C. Gupta, Director, Petroleum and Natural Gas Regulatory Board; Shri D.K. Srivastava, Chief Engineer, Ministry of Power; Shri Ashok Kumar, Deputy Director General, Bureau of Energy Efficiency; and Shri P. Shyam Sunder, Director, Bureau of Energy Efficiency, on the operational realities of India's power network. I also thank representatives from the State Governments of Tamil Nadu, Maharashtra, and Haryana; financial institutions such as the Small Industries Development Bank of India (SIDBI), State Financial Corporations, and microfinance organizations; as well as MSME and industry association representatives, technology partners, OEMs, service providers, and research organizations for their valuable contributions.

I would also like to acknowledge the exceptional work of Shri Deepak Krishnan, Shri NGR Kartheek, Shri Ashim Roy, and Shri Abhishek Bharadwaj from the WRI India, whose expertise significantly enriched the preparation of this report.

Finally, I extend my appreciation to Ms. Aashwita Lal, Director, NITI Aayog; Shri Ankur Kushwaha, Consultant, Ms. Gayatri Pande; Ms. Sandal Agrawal; and Ms. Vrushali Lokhande, Young Professionals at NITI Aayog, along with the supporting team. Their tireless efforts in coordinating interactions with Working Group members and stakeholders, and their consistent input, have been invaluable in bringing this report to its present form.

This report offers a practical and inclusive roadmap for advancing the green transition of MSMEs by identifying sector-specific solutions. I hope it serves as a strategic guide for collaborative action, enabling MSMEs to play an active role in building a resilient, inclusive, and sustainable Indian economy.

Ishtiyaque Ahmed
Programme Director, Industry and Foreign Investment
Chair, Technical Working Committee on Roadmap for Green Transition of MSMEs
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Azadi Ka Amrit Mahotsav

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Message

At the 26th United Nations Climate Change Conference in Glasgow, Prime Minister Narendra Modi articulated India's resolve to address climate change through the *Panchamrit* commitments. These include achieving net zero emissions by 2070, reducing the emissions intensity of GDP by 45 percent by 2030, and expanding non fossil fuel based energy capacity to 500 gigawatts by 2030. These ambitious commitments reflect India's deep commitment to sustainable development and underscore the need for collective action across all sectors of the economy.

Micro, Small and Medium Enterprises occupy a central place in India's economic architecture through their contribution to output, employment, and exports. Their transition towards low carbon and resource efficient practices is therefore indispensable for achieving national climate objectives as well as for strengthening long term industrial competitiveness. Recognising both the economic significance of MSMEs and their share in industrial emissions, NITI Aayog has undertaken the task of designing a Roadmap for the Green Transition of the MSME sector.

The MSME ecosystem, however, faces several structural constraints, including limited awareness of green technologies, restricted access to finance, fragmented value chains, ageing capital stock, and inadequate technical capacity. These challenges have slowed the adoption of climate smart solutions and call for a coordinated and structured policy response.

This report, *Roadmap for Green Transition of MSMEs*, addresses these constraints through a comprehensive framework that strengthens enabling ecosystems across technology, energy, governance, and finance. It proposes actionable interventions, supportive policy measures, and institutional mechanisms aimed at empowering MSMEs to undertake an effective and economically viable green transition.

As global climate commitments gather momentum, sustainability is rapidly becoming a prerequisite for market access and competitiveness. With MSMEs accounting for more than ninety percent of enterprises worldwide, their role in shaping greener economies is pivotal. This report seeks to position Indian MSMEs to meet domestic climate goals while integrating successfully into global green value chains, where environmental standards are increasingly non negotiable.

India's efforts to decarbonise its MSME sector place the country firmly on the path of international leadership in inclusive and responsible climate action. By embracing decarbonisation, MSMEs can future proof their operations and enhance resilience. With sustained policy support and collaborative action, the MSME sector can lead a transformation that drives competitive, inclusive, and climate resilient industrial growth for the nation.

(Suman Bery)

Place- New Delhi
Dated- 16th December 2025

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एक कदम स्वच्छता की ओर

राजीव गौबा
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Message

The Micro, Small, and Medium Enterprises (MSMEs) in India form the backbone of the country's industrial production and exports, playing a vital role in economic growth and employment generation. They are also significant consumers of energy and contributors to industrial carbon emissions, making them a key focus area in India's transition towards achieving its net-zero emissions goal by 2070.

India's MSME sector stands at a pivotal moment, where economic growth and environmental responsibility can go hand in hand. In this context, this report underscores the strategic importance of MSMEs in achieving national climate goals. Decarbonizing the sector is vital not only for emission reductions but also for enhancing energy efficiency, competitiveness, and long-term business sustainability, particularly as global supply chains shift toward greener partners. India's commitment to achieve net-zero emission target and the increasing demand for green products in global supply chains make the green transition of MSME sector all the more imperative.

Despite their importance, MSMEs face several challenges, including limited access to modern technologies, inadequate financing for clean energy solutions, low awareness of technical knowledge, and fragmented institutional support. The Roadmap for Green Transition of MSMEs aims to address these barriers through actionable and inclusive solutions. This report focuses on three levers of energy efficiency equipment, adoption of alternative fuels, and integration of green electricity to present a comprehensive roadmap for MSME sector decarbonisation. The proposed solutions offer a scalable, cost-effective, and future-ready approach to green transition, aligning MSME growth with India's climate goals. The green transition is not a burden but a strategic investment in long-term viability and prosperity of MSME sector.

This report offers a way forward for MSMEs to thrive by drawing in private investments, generating green jobs, and strengthening their long-term competitiveness on a global scale. It emphasizes that with the right support mechanisms and stakeholder collaboration, MSMEs can transition into resilient, energy-efficient, and globally competitive enterprises that will play a pivotal role in India's economic growth and climate action targets.

(Rajiv Gauba)

New Delhi
12th December 2025

बी. वी. आर. सुब्रह्मण्यम
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MESSAGE

India's vision of Viksit Bharat 2047 and reaching $30 trillion economy requires sustained growth of manufacturing sector. The government has plans to increase the share of manufacturing to 25% of GDP. In this context, Micro, Small and Medium Enterprises (MSMEs) will play an important role. The MSMEs contribute nearly 30% to GDP and employ over 250 million people forming the backbone of industrial activity. Looking ahead, MSMEs will remain central to India's manufacturing expansion, value-chain participation, and job creation.

However, the growth of MSMEs will also have to keep in mind India's commitment to Net Zero greenhouse gas emissions. MSMEs in the global supply chain are increasingly under scrutiny for carbon footprint. Indian MSMEs generate approximately 135 million tonnes of CO_2 emissions annually and the energy demand in this sector is projected to rise by 50% by 2030. Therefore, it is important to look at low carbon growth of this sector.

Recognizing the importance of MSME sector in India's green transition, NITI Aayog has undertaken this study. We have engaged in detailed consultations with diverse stakeholders from government, industry, and experts to design a strategy for sustainable growth of MSME sector. The report ***"Roadmap for Green Transition of MSMEs"*** outlines strategy to enable the sector's transition to low-carbon pathways.

This report addresses three main levers namely, energy efficiency, green electricity, and alternate fuels. The energy efficiency lever aims to reduce the specific energy consumption of the MSME clusters by deploying high energy efficient equipment. Under the green electricity lever, the objective is to reduce the carbon intensity of the products manufactured by MSMEs. The third lever of alternate fuels aims to shift the MSMEs to zero or less emission-intensive fuels.

I commend the collaborative efforts of research institutions, industry stakeholders, government bodies and the NITI Team in shaping this forward-thinking framework. I thank Shri Ishtiyaque Ahmed who chaired the working group, and appreciate the support provided by the Green Transition, Energy & Climate Change division under Dr. Anshu Bharadwaj, Programme Director, and all working group members. I also thank our knowledge partners, World Resources Institution (WRI) for their excellent efforts.

Dated: 15th January, 2026

[B.V.R. Subrahmanyam]

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एक कदम स्वच्छता की ओर

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Secretary

सत्यमेव जयते

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GOVERNMENT OF INDIA
MINISTRY OF MICRO, SMALL AND MEDIUM ENTERPRISES

Message

India today stands at an inflection point in its development journey, where the twin goals of accelerated economic growth and ecological stewardship need to go hand in hand. As one of the world's most dynamic and rapidly expanding economies, India is witnessing transformative shifts across its industrial and urban landscapes. This momentum also brings with it challenges related to sustainability. In this context, Government of India is committed to a development paradigm that is inclusive, innovation-led, globally competitive and environmentally sustainable. The micro, small and medium enterprises (MSME) sector remains central to this agenda. Accounting for about 30% of India's GDP, MSME sector is an engine of growth and plays a decisive role in economic resilience and environmental transition.

The future competitiveness and resilience of our MSME sector is poised to get significantly enhanced by integrating sustainability into their operations, supply chains, and growth strategies. With global markets moving toward stricter environmental standards and a rising demand for eco-friendly products, adopting sustainable practices also presents a valuable opportunity, including for innovation, market expansion, and long-term success.

The release of report on *Roadmap for Green Transition of MSMEs* by NITI Aayog represents a timely and strategic initiative. This also represents a paradigm shift in how India's MSMEs engage with sustainability. It extends beyond compliance to key aspects of capacity-building, technology upgradation, and market readiness. The report aims to provide a roadmap for MSME access to cleaner technologies, facilitate adoption of low-carbon practices, build institutional frameworks that support green entrepreneurship and innovation. Sustainability should indeed be viewed as a lever for competitiveness, productivity, and global integration.

Actuated and guided by the vision of Viksit Bharat @2047 articulated by the Hon'ble Prime Minister, the proposed roadmap seeks to position India's MSMEs as torchbearers of a new green industrial revolution, one that prioritizes climate responsibility while unlocking new opportunities for growth, employment generation and value creation. The transition to a green economy is an opportunity to reimagine India's manufacturing landscape in a manner that is future-ready, equitable, and environmentally aligned.

(S.C.L. Das)

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Message

Green transition represents a structural shift toward sustainable, low-carbon, and resource-efficient economic systems and has become priority for the global industrial landscape. As one of the world's fastest-growing economies and a signatory to the Paris Agreement, India faces the dual imperative of sustaining economic growth while significantly reducing environmental emissions.

MSMEs play a critical role in this transition, given their centrality to value chains, production, employment generation, and regional development. However, they remain disproportionately exposed to climate-related risks, including resource constraints, rising energy costs, regulatory tightening, and changing market preferences. Their transition is constrained by limited access to information, technical expertise, affordable green finance, and compliant markets for sustainable products, underscoring the need for targeted and differentiated policy support. This report positions MSMEs at the core of India's green transition agenda and addresses the risk of their exclusion from sustainability-driven global value chains. It provides evidence-based analysis and actionable pathways to enable MSMEs to adopt low-carbon practices, enhance competitiveness, and contribute meaningfully to India's climate commitments and inclusive development objectives.

Dr. Anshu Bharadwaj
Programme Director
Green Transition, Energy and Climate Change
NITI Aayog

Message

The Micro, Small, and Medium Enterprises (MSME) sector plays a crucial role in India's economic landscape. MSMEs contribute 45% to manufacturing output, and consume over 25% of energy use in the industrial sector. Green transition in MSMEs is not only essential for meeting India's climate goals but also for enhancing energy security, competitiveness, and long-term resilience.

This report presents a comprehensive framework to support the MSME sector in its journey toward decarbonisation and energy efficiency improvement. It defines the possible interventions across technology, finance, policy, and institutional ecosystems to support low-carbon growth in MSME sector. I extend gratitude to the Working Group for their rigorous analysis and strengthening of the key recommendations of the report.

Shri Rajnath Ram
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Message

India's journey towards becoming a developed economy by 2047, will be fundamentally green, inclusive, and resilient. As the nation accelerates on this path, the role of the Micro, Small and Medium Enterprises (MSME) sector is indispensable. With over 63 million enterprises contributing close to 29 percent of GDP, generating 250 million jobs, and accounting for 46 percent of exports, MSMEs form the backbone of India's industrial and entrepreneurial landscape. Yet, they are also highly vulnerable to the impacts of climate change, resource constraints, and evolving global expectations, demanding a strategic transition, with balanced developmental and climate imperatives.

The question is not whether MSMEs should transition to a greener, more sustainable model, but how they can do so swiftly, affordably, and equitably.

This report, Roadmap for Green Transition of MSMEs, responds to that challenge with purpose and pragmatism. It sets out a vision for MSMEs which is not just compatible with climate action but is powered by it. It presents a path forward that enables MSMEs to thrive in the green economy, attracting private investment, creating thousands of new green jobs, and building long-term global competitiveness.

At the core of this strategy are three levers for decarbonisation: energy efficiency, green electricity, and alternate fuels. Together, they are projected to reduce 75 to 87 million tonnes of CO2 equivalent ($MtCO_2e$) over the next decade, mobilise over INR 2 lakh crore in private investment, generate over 55,000 green jobs, and contribute up to INR 4,700 crore in annual tax revenue. These outcomes not only support India's climate goals but will also improve the long-term competitiveness and resilience of our MSMEs.

These efforts are underpinned by a strong institutional and financial architecture, including National Project Management Agency, innovative financing tools, and targeted capacity building. A comprehensive Monitoring, Reporting and Verification (MRV) framework will ensure accountability, while the inclusion of Regulatory Impact Assessments (RIA) protects MSMEs from disproportionate compliance burdens, reflecting a commitment to both ambition and equity.

This strategy is not just about emissions reduction; it is about economic transformation. It enables Indian MSMEs to lower energy costs, build resilience, and unlock new opportunities in a climate-conscious global economy. It aligns growth with sustainability and prepares Indian enterprises to compete and lead in the green industrial revolution.

The coming decade offers an unprecedented opportunity. With the right support systems in place, India's MSMEs can emerge as global champions of sustainable manufacturing. This program marks a bold and necessary step in that direction, translating ambition into action and vision into results.

(Madhav Pai)
CEO, WRI India

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List of Abbreviations

APPC Average Pooled Power Purchase Cost
AIF Alternative Investment Fund
APM Administered Pricing Mechanism
BEE Bureau of Energy Efficiency
BRSR Business Responsibility and Sustainability Reporting
BTM Behind-the-Meter
CBAM Carbon Border Adjustment Mechanism
CEA Central Electricity Authority
CERC Central Electricity Regulatory Commission
CGD City Gas Distribution
CLCS Credit Linked Capital Subsidy Scheme
COP Conference of the Parties
CSR Corporate Social Responsibility
DHM District Health Mission
DISCOMs Distribution Companies
DPIIT Department for Promotion of Industry and International Trade
DPR Detailed Project Report
EE Energy Efficiency
EESL Energy Efficiency Services Limited
EPG Empowered Programme Committee
ESCO Energy Service Company
FIs Financial Institutes
FAME Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India
GE Green Electricity
GCC Gross Cost Contract
GEF Global Environment Facility
GHG Greenhouse Gases
GOA Green Open Access
GoI Government of India

GST Goods and Services Tax
GIFT Green Investment and Financing for Transformation
HPHT High Pressure, High Temperature
ISTS Inter-State Transmission System
ICAI The Institute of Chartered Accountants of India
KPI Key Performance Indicators
LoS Line of Sight
LCT Low Carbon Transition
MCA Model Concession Agreement
MIDC Maharashtra Industrial Development Corporation
MoU Memorandum of Understanding
MRV Monitoring, Reporting and Verification
MoEFCC Ministry of Environment, Forest and Climate Change
MHI Ministry of Heavy Industries
MNRE Ministry of New and Renewable Energy
MoPNG Ministry of Petroleum and Natural Gas
MoP Ministry of Power
Mt Million Tonnes
$MtCO_2e$ Million Tonnes of carbon dioxide equivalent
MtOe Million Tonnes of Oil Equivalent
MSEs Micro and Small Enterprises
MSME Micro, Small and Medium Enterprises
MSG Mission Steering Group
NBFC Non-Banking Financial Company
NHAI National Highway Authority of India
NIMSME National Institute for MSME
NSIC National Small Industries Corporation Limited
OEM Original Equipment Manufacturers
PAT Perform, Achieve and Trade Scheme
PAYS Pay as You Save

PE Procuring Entity
PNGRB Petroleum and Natural Gas Regulatory Board
PLI Production Linked Incentive
QCI Quality Council of India
RBI Reserve Bank of India
RE Renewable Energy
REC Renewable Energy Certificates
RESCO Renewable Energy Service Company
RFP Request for Proposal
RFQ Request for Quotation
RIA Regulatory Impact Assessment
RPO Renewable Purchase Obligation
RTP Request for Technical Proposal
RTS Roof Top Solar
ROW Right of Way
SCM Swiss Challenge Methodology
SDG Sustainable Development Goal
SEBI Securities Exchange Board of India
SEC Specific Energy Consumption
SECI Solar Energy Corporation of India
SERC State Electricity Regulatory Commission
SFCs State Financial Corporations
SIDBI Small Industries Development Bank of India
SIDCUL State Industrial Development Corporation of Uttarakhand
SPICE Scheme for Promotion and Investment in Circular Economy
SPICOT State Industries Promotion Corporation of Tamil Nadu
UNFCCC United Nations Framework Convention on Climate Change
UNIDO United Nations Industrial Development Organisation
WACC Weighted Average Cost of Capital
WBCSD World Business Council for Sustainable Development

Executive Summary

There are 69 million (6.9 crore) Micro, Small, and Medium Enterprises (MSMEs) in the country. Of these, there are about 68.6 million, 0.48 million and 0.036 million micro, small and medium units respectively. The share of exports from MSMEs in India's overall exports is 45.7% and its share in Gross Value Add (GVA) in GDP is 30%. MSMEs share in manufacturing is 36.2% and the sector provides 250 million (25 crore) employment. The "Zero Defect Zero Effect" (ZED) initiative by Government of India primarily targets MSMEs to promote quality manufacturing with minimal environmental impact. To fulfil the green 'level' product requirement of developed countries and regions specially Europe and the Americas etc., MSME processes (manufacturing etc.) need to be decarbonised. Further, to fulfil 'Viksit Bharat' goals by 2047, MSMEs need to be supported in terms of technology upgradation, market access, and green transition.

MSMEs rely heavily on fossil fuels to meet their energy and process requirements, resulting in approximately 135 million tonnes of carbon emissions ($MtCO_2e$) in 2022 alone. MSMEs face a range of challenges in terms of capacity to undertake green projects, access to reliable finance for the energy transition, lack of awareness on policies and schemes, absence of scalable models, and niche market dynamics that create uncertainty in investment decisions. Thus, they seek additional support from governments to cater to the sector's clean energy transition. This report proposes to create a dedicated institutional mechanism that prioritises areas of deployment by establishing incentives and funding opportunities. These interventions are tailored to accelerate an enabling ecosystem leading to a seamless transition of MSMEs towards sustainability.

Climate change presents significant risks to businesses, particularly MSMEs, which may have fewer resources to adapt and respond. Understanding these risks is critical for developing mitigation strategies and ensuring long-term sustainability. This involves protecting businesses from potential harm as well as identifying evolving opportunities. MSMEs can ensure their long-term viability by managing these risks proactively. Transition risks are particularly concerning for MSMEs because the impact of policy changes, litigation, shifting market expectations, and technological advancements significantly affect them. Upcoming regulations may necessitate changes to manufacturing processes or products and reshape long-term marketing strategies, affecting supply chains, insurance costs, and increasing financial and political risks.

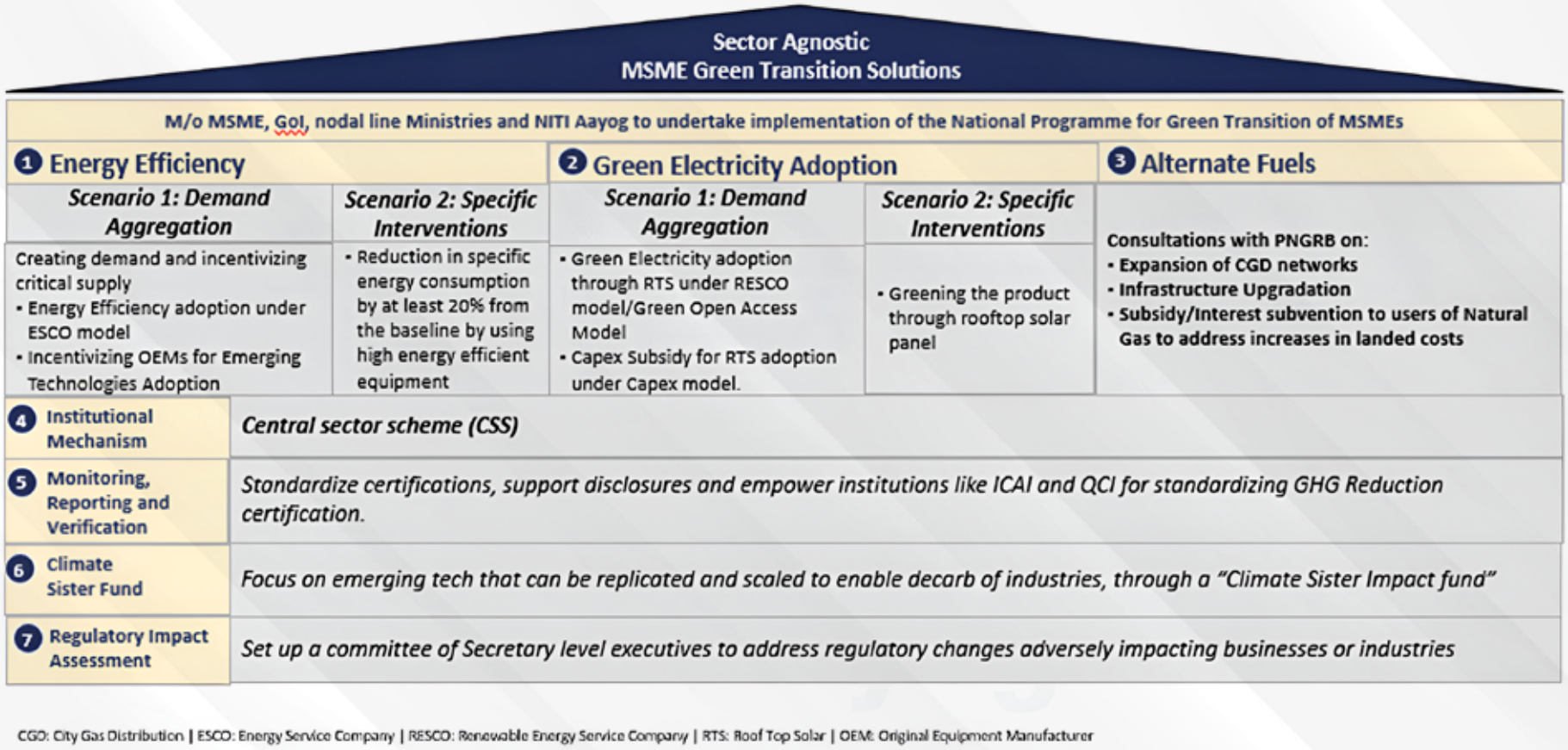


Figure 1: Overview of the program framework

Figure 1 provides an overview of the recommendations outlined in this report, following which we can create a holistic environment aiding the green transition in MSMEs. Proper implementation of the program will require a robust governance structure to ensure that interested parties, especially those acting voluntarily, can rely on established institutional mechanisms to ensure inclusion, accountability, and effectiveness. The report provides for the implementation of the three levers identified for green transition through different approaches. Under the primary approach, the report recommends setting up a National Project Management Agency (NPMA) to implement the National Programme for Green Transition of MSMEs. Under the second approach, the different levers identified for the green transition roadmap will be implemented through the line ministries as detailed in the report under Energy Efficiency, Green Electricity and Alternative Fuels sub-sections.

The various roles and functions of the NPMA under the primary approach are:

- The NPMA to be an independent consultative and advisory entity, to be monitored through an inter-ministerial committee.
- The NPMA to be responsible for driving the on-ground implementation of the Programme by closely working with MSME clusters through an effective and transparent cluster selection process.
- The NPMA to identify interested MSME clusters and industrial associations by floating an expression of interest (EoI) that details the cluster selection process for the implementation of identified solutions. MSME clusters can form Special Purpose Vehicles (SPVs) to take part in the Green Transition programme.
- The NPMA to also lead the demand aggregation efforts to maximise the uptake of green transition efforts in selected MSME clusters. This will involve capacity building on the three identified levers/solutions to be done in close consultation with the MSME National Level Institute for Energy and Greening stated to be created under the Raising and Accelerating MSME Performance (RAMP) Programme by Ministry of MSME.
- The NPMA to prepare a Detailed Project Report (DPR) for one or all of the levers identified. Implementing agencies could also be invited through a transparent tendering process based on the lines of the Swiss challenge methodology for implementing the levers and preparing the DPR.
- The NPMA can support the bidding process identified in this report and could determine a list of prequalified/approved implementing agencies under the three levers to participate in the bidding process.
- After providing adequate time for bidders to prepare the final project scope under a tender, the NPMA can evaluate the financial bids according to specified timelines. The bid requiring the lowest (L1) subsidy from the NPMA will be selected. The maximum subsidy will be determined by whichever is lower: the absolute amount defined in the bidding document, or a fixed percentage of expected sales (X years for typical implementing payback), calculated according to the MSME cluster's risk profile as determined by past loan delinquency rates.
- A tripartite concession agreement with performance payouts to be signed between the implementing agency, the Ministry of MSME, and the MSME cluster SPVs to mitigate financial risks from potential payment defaults of participating MSMEs. If a MSME defaults on payments to the implementing agency, the agency

will receive compensation directly linked to achieving certain Key Performance Indicators (KPIs) (e.g., reducing Scope 1 GHG emissions intensity from baseline targets aligned with global Science Based Targets (SBTi) calculated over a standard X-year payback with built-in periodic price escalations). The disbursement of funds to the implementing agency will consider the expected payback period on investment for the implementing agency, current valuation of the machinery, and total payments already made (if any) as per the service agreement. The Credit-Guarantee Fund (8-9%) under the MSME Credit Guarantee Scheme will provide the necessary funding to cover payment default risks. The 8-9% share of the credit-guarantee fund value to be allocated specifically for the Green Transition Roadmap.

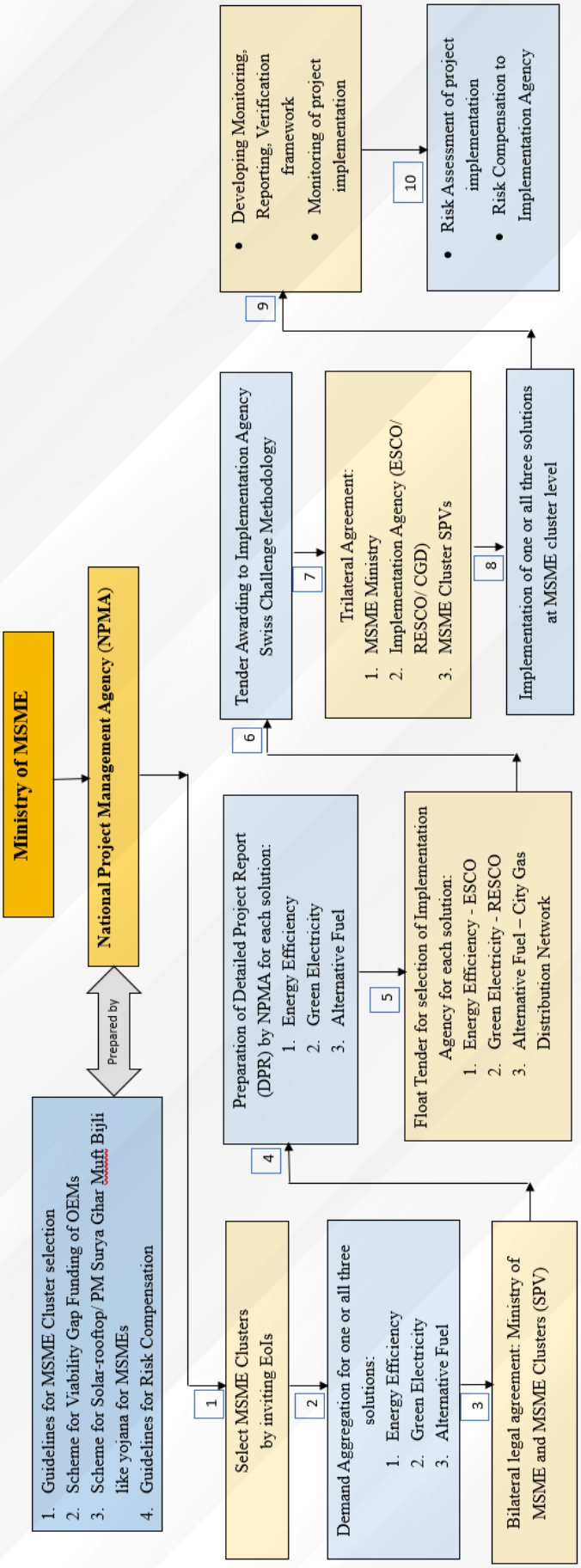


Figure 2: Operational flow of the National Project Management Agency

The green transition of MSMEs can be achieved through the application of three levers i.e. enhancement of energy efficiency, adoption of green electricity and alternate fuels. Under each of the three levers, the following recommendations are provided:

1. **Energy Efficiency:** Scaling up of Energy Efficiency (EE) in MSME clusters will be implemented through either of the two approaches:

   A. **Primary Approach**

      (i) **Demand side-retrofitting with proven energy-efficient equipment:** Following demand aggregation, relevant implementing agencies (Energy Service Company- ESCOs) will be selected as per the Swiss challenge methodology and bidding process elaborated above. The ESCOs 'Pay as You Save (PAYS) model' will be preferred to enhance the uptake of proven technologies in the MSME clusters. The ESCOs can leverage aggregated demand within industrial clusters to retrofit and replace outdated equipment with proven energy efficient alternatives. The new EE equipment will lead to savings from lower electricity/ fuel usage, reducing the operational costs for MSMEs. These savings can be used to repay ESCOs over time. This eliminates the need for upfront costs from the MSMEs initially, as ESCOs mobilize the financing for the retrofitting process. The Credit Guarantee Fund can be operationalised to mitigate any financial risk from potential payment defaults by the MSMEs, on the retrofitted equipment.

      (ii) **Supply Side- Deployment of emerging energy-efficient technologies in MSME clusters:** The Roadmap will prioritise five energy-intensive MSME sub-sectors for adoption of emerging and innovative energy-efficient technologies that provide substantial gains if scaled. BEE and the Ministry of MSME will provide a list of specific technologies that can provide substantial gains if scaled across MSME subsectors. Once identified, the Programme can provide Viability Gap Funding (VGF) through a competitive bidding mechanism to certified OEMs of key 6-7 high-impact solutions (>20% savings) for providing these technologies at competitive rates. An amount of ₹ 6,000 crore will be needed to provide VGF support for effective uptake of emerging and innovative energy-efficient technologies under the phase I of the National Roadmap. This could involve OEMs directly undertaking the manufacturing and assembling of these technologies within the country, which significantly reduces the selling price of these technologies.

   B. **Secondary Approach**

      Energy Efficiency improvements will be targeted in Small and Medium Enterprises (SMEs) with the overall aim of reduction in specific energy consumption by at least 20% from the baseline by using high energy efficient equipment (boilers, heat pumps, heat exchangers, rolling, milling, cooling devices etc.). This approach will be specifically applicable to UDYAM registered SMEs. The identification and selection of sector specific energy efficient equipment or technology will be carried out by Bureau of Energy Efficiency (BEE) and Ministry of MSME. Capital subsidy of upto 15% on the cost of eligible plant and machinery will be needed for individual SMEs for the implementation of identified technology; or to the Original Equipment Manufacturer (OEM) for manufacturing the identified technology in the country in form of a Production Linked Incentive (PLI) or a financial incentive. The subsidy disbursal can be credited based on the reduction in overall energy consumption of the SME as per the pre and post energy audit results carried out by the empanelled energy auditor. A sum of INR 6000 crore is needed under this approach for a period

of 5 years. This approach will be directly implemented by the Ministry of MSME. Specific guidelines on this approach will be released by the Ministry later.

The estimated impact through this lever is as follows:

- In the next 10 years, the overall potential GHG emissions reduction through the energy efficiency lever is around 36 $MtCO_2e$.
- Five key sectors and the top 10 MSME clusters based on GHG emissions reduction potential of 12 $MtCO_2e$ and high export orientation have been proposed for immediate action in the first phase of the Programme.
- More than 10000 jobs are expected to be created in the ESCO market with a potential peak annual tax revenue of around ₹1,200 crore (based on the corporate tax on ESCO profits).

2. **Green Electricity**: Adoption of Green electricity will be implemented through either of the two approaches:

   A. **Primary Approach:**

      (i) **The Behind the Meter (BTM) RESCO Model and/or Green Open Access:** The programme proposes scaling green electricity across MSME clusters in India through demand aggregation for Roof Top Solar (RTS) systems under the Renewable Energy Service Company (RESCO) model, or uptake of green electricity via Green Open Access (GOA) Rules, 2022. RESCOs facilitate the installation of rooftop/ground-mounted solar at the customer's premises. Here, customers purchase electricity generated at a predefined tariff. One of the key advantages of the RESCO model is that it eliminates the need for any upfront capital cost by the customer. The GOA, Rules 2022 establish a process that allows consumers to access renewable electricity, such as solar and wind power, directly from generators or through power exchanges. Under this model, electricity can be generated anywhere across the country and can be accessed by any grid-connected consumer including MSMEs provided the combined demand is greater than or equal to 100 kW. Since these solutions involve no upfront payments by MSMEs to the implementing agencies and are charged based on the service provided, any potential payment defaults by the MSMEs will be covered under the Credit Guarantee Fund.

      (ii) **PM Suryaghar like initiative for individual MSME units:** To enhance the uptake of RTS among individual MSME units, the Programme recommends a direct capital subsidy for adoption of RTS systems up to 3kW. The Programme initially recommends an allocation of Rs. 7000 crore for phase I implementation.

   B. **Secondary Approach:**

      Green electricity adoption will be targeted in micro enterprises with an overall aim to reduce the carbon intensity of the final manufactured product through the adoption of RTS systems in their facilities. This will involve designing a new scheme or the extension of PM Surya Ghar Muft Bijli Yojana to micro enterprises. Direct capital subsidy upto a 3 kW RTS system can be provided to micro units. Under this approach, a sum of INR 7000 crore can be allocated for a period of 5 years with a target of covering around 1-1.5 million micro units. This approach will also explore the implementation of Renewable Energy Service Companies (RESCOs) 'rent a roof' model at relevant micro units according to the interest and applicability. The approach will also look at fast tracking of vendor certification to allow credible

and reliable vendors operate installation in the micro units that adhere to standards and regulations as prescribed. This approach will be directly implemented by the Ministry of New and Renewable Energy. Specific guidelines on this approach will be released by the Ministry later.

The estimated impact through this lever is as follows:

- In the next 10 years, the overall potential GHG emissions reduction as MSMEs transition to green electricity is 30-35 $MtCO_2e$ with a total private capital investment of around ₹1,50,000 crore needed.
- The top 10 electricity-intensive clusters across five MSME sub-sectors with a GHG emissions reduction potential of 12.9 $MtCO_2e$ and high export orientation have been identified for immediate action in the first phase of implementation.
- More than 45,000 jobs are expected to be created in the RESCO market with a potential peak annual tax revenue of ₹2,500-3,500 crore approximately.

3. **Alternative Fuels**: MSMEs rely heavily on coal, pet coke, furnace oil, etc. to meet process-based requirements, resulting in high GHG emissions. Several alternate fuels that are zero or less emission-intensive, including biomass, natural gas, compressed biogas, and electrification of the process using green electricity, can be used to meet their energy requirements. Considering the limited availability of several biomass-based alternate fuels as well as the current market conditions, the first phase of the Programme proposes direct support for natural gas uptake and usage in MSMEs. Natural gas is a lesser emission-intensive fuel that MSMEs can use to meet their process-based requirements. Under Phase I, PNGRB will be consulted for building an ecosystem that promotes uptake of natural gas in MSME clusters by providing support towards retrofitting equipment and extension of CGD (City Gas Distribution) networks. If demand is created, NPMA will act as a facilitator to mobilize existing licenses of CGD units in respective geographical areas for increasing the uptake of natural gas across MSME clusters.

The estimated impact through this lever is as follows:

- In the next 10 years, the overall potential GHG emissions reduction through the alternate fuels lever is 9-16 $MtCO_2e$, largely driven by shifts towards using natural gas/biogas and biomass instead of fossil fuel-based fuel sources.
- Key sectors that contribute significantly to exports and have high emission intensity, such as textiles, steel, forging, and foundry, may be considered for immediate action in the first phase of implementation.

A comprehensive Monitoring, Reporting and Verification (MRV) mechanism is essential for understanding the impacts of the listed recommendations. The MRV's importance assumes greater significance considering that the risk removal mechanism depends on achieving specific KPIs. Hence, the MRV framework must be designed to capture data in an easy and transparent manner. The roadmap proposes creating a platform and a tool that enables the documentation of these emissions, the stipulated reduction targets, and achievements. This will enable measurement of the roadmap's reach and impact by directly linking the results in terms of emissions reduced, monetary savings achieved, energy saved etc. An effective MRV mechanism will play a critical role in reducing the risk perception among implementing agencies when engaging with MSME units. The MRV tool can track any payment defaults by MSMEs to implementing agencies, which will be compensated as per the stipulated terms and agreements.

Industries, including the hard-to-abate sector, and MSMEs are required to be decarbonised to meet the domestic and international targets. Decarbonisation can be achieved through the adoption of emerging low-carbon technologies (LCT). Adoption of these LCTs is expected to result in additional costs for these industries and to scale up its adoption, it is proposed to set up a Climate Sister Impact Fund (CSIF). The proposed CSIF will make strategic investments in LCTs, while generating modest financial and high social returns. GoI can provide financial support in terms of equity capital of specific amounts in setting up an equity fund as an Alternative Investment Fund (AIF) category I/II, registered under Securities and Exchange Board of India (SEBI) Regulations, 2012. Additionally, a hybrid debt fund is also proposed to be created at concessional terms by either investing in debt/ debt securities of existing entities or through a newly incorporated Non-Banking Financial Companies (NBFC), as per the directives of SEBI and RBI. The funding will be used to financially incentivise and mobilise private capital towards climate change mitigation and adaptation interventions in industries, including MSMEs. It will also facilitate capital for initiatives to help the industries decarbonise. CSIF's objective will be to offer holistic one-stop financing solutions at attractive blended cost of capital (e.g., by combining a modest Weighted Average Cost of Capital (WACC) with high-risk investments) and enable capital support at concessional rates towards financing of emerging high-potential climate change mitigation and/or adaptation technologies and/or business models that are scalable and replicable among industries.

Keeping in mind the price sensitivity, climate litigation charges, changing policy landscape and their material impact on MSMEs, Regulatory Impact Assessment (RIA) will be essential before any demand-side regulatory mandates are imposed on MSMEs. Increased compliance burden on MSMEs could lead to net negative economic effects. RIAs can provide decision-makers with vital information about whether and how to regulate to accomplish public policy objectives. Moreover, RIA helps inform policymakers' choices to refrain from making changes in markets when doing so would be more expensive than advantageous. RIA further supports the decisions made by policymakers by proving the advantages of a regulation. RIA is specifically recommended since MSMEs have been kept out of several stringent mechanisms such as GST compliance, CSR obligations, and PAT Scheme. It is recommended to conduct a thorough RIA before introducing any specific mandates under the roadmap for MSMEs.

In alignment with the Government's vision of promoting sustainable industrial development, a dedicated 'MSME National-Level Institute for Energy and Greening' will be required to be established under the aegis of the Ministry of MSME.

The Programme aims to support and accelerate the decarbonisation and green transition of MSMEs across a 10-year period. These measures are intended to result in reduction of emissions from the MSME sector; benefit the MSMEs by helping them upgrade to new technologies at minimum costs, providing opportunities for reduction in electricity bills, and possible improvements in competitiveness. Further, establishing funds that cater to manufacturing of energy-efficient technologies in the country and low-carbon transition will streamline the transition in MSMEs and boost the country's manufacturing capacity. Together with this, awareness-building exercises will play a key role in maximising the scale of adoption of the green technologies. MSMEs are at a crucial juncture where they must meet sustainability standards to enhance their profits and productivity, and the green transition roadmap provides these units with the required framework and support for their green transition.

Introduction to the MSME Technical Working Committee

To access the global markets, MSMEs needs:

- To increase productivity and efficiency through adoption of modern machinery and green energy.
- To improve competitiveness.
- To comply with regulatory standards (CBAM, BRSR, Eco Mark) for avoiding penalties, retaining export eligibility and meeting ESG norms which are increasingly expected by regulators and buyers.

To cater to the above requirement and with the objective of taking a comprehensive approach and formulate a sectoral decarbonisation roadmap for MSME sector, NITI Aayog has constituted a technical working committee for preparing Roadmap for Green Transition of MSMEs. The composition of the MSME technical working committee is as follows:

Table 1: The sectoral technical working committees on MSMEs

No.	Composition	
1	Shri Ishtiyaque Ahmed, Sr. Advisor, NITI Aayog	Chairman
2	Shri Rajnath Ram, Adviser, NITI Aayog	Member
3	Shri Ateesh Kumar Singh, Joint Secretary, Ministry of MSMEs	Member
4	Ms. Neha Nautiyal, Deputy Secretary, NITI Aayog	Member
5	Representative from the Bureau of Energy Efficiency (BEE)	Member
6	Representative from the Federation of Small Scale Industries (FSSI)	Member
7	Representative from the Karnataka Small Scale Industries Association (KASSIA)	Member
8	Representative from Federation of the Small and Medium Industries (FOSMI)	Member
9	Representative from SIDCUL Manufacturers Association of Uttarakhand (SMAU)	Member
10	Representative from the Federation of Indian Micro, Small and Medium Enterprises (FISME)	Member
11	Representative from Laghu Udyog Bharti	Member
12	McKinsey & Company	Knowledge Partner
13	Shri Aman Hans, Resident Fellow, NITI Aayog	Member-Secretary

Terms of reference for the committee were:

- Identifying the sources of emissions along the production value chains and establishing baseline sectoral emissions.
- Analysing the current strategies of the government and private sector.
- Analysing the international market trends and preparing the sector outlook on competitiveness.
- Identifying and prioritising the various decarbonisation levers for each sector, including circular economy and resource efficiency.
- Developing sector-specific abatement curves to illustrate decarbonisation levers, their potential abatement, and associated costs.
- Identifying key projects and enablers required to achieve aspired decarbonisation pathways including:
  - » Policy and regulatory frameworks
  - » Technology interventions, with high-level assessment on commercial viability
  - » Sources of capital and funding
- Formulating a sector-specific action plan and associated financial funding mechanism.
- Any other measures/activities required for achieving the objectives of the Committee.

Methodology

The MSME sector is one of the fastest-growing sectors in India and ranks second in terms of employment generation. NITI's MSME working group, has been created to lead efforts that enable green transition in MSMEs and comprises experts from the government, industry, think tanks, and private organisations who have varying experience with different facets of decarbonisation of the MSME sector in India. The report also comprises views and opinions from different stakeholders such as central government ministries and agencies like the Ministry of MSME, Ministry of Power, Central Electricity Authority (CEA), Niti Aayog, Ministry of Environment, Forests and Climate Change (MoEFCC), Ministry of New and Renewable Energy (MNRE), Ministry of Petroleum and Natural Gas (MoPNG), and Bureau of Energy Efficiency (BEE). It also considers inputs from various experts in regional and state departments, DISCOMs, financial institutions like Small Industries Development Bank of India (SIDBI), State Financial Corporations (SFCs), and micro-financing organisations; MSME unit owners and industrial associations (cluster associations); MSME development organisations, namely MSME Development Institute, National Small Industries Corporation Limited (NSIC), National Institute for MSME (NIMSME), technology partners, Original Equipment Manufacturers (OEMs) and service providers; and research organisations and academic institutes while building this report.

A detailed list of stakeholders and representatives from organisations has been provided in Annexure 1. The following approach was adopted to derive the results and recommendations:

- **Primary research**: The research involved conversations with different stakeholders to gather their opinions and suggestions around the core topics that this report has covered. This research focused only on a few specific issues to obtain solutions for them. The purpose of these consultations was to get information about the real-world difficulties associated with the green transition of MSMEs, the viability of suggested solutions, and the possible effects of different policy options. The stakeholders' feedback was crucial in helping narrow the study's scope and ensuring that the suggested recommendations are practical and in line with market demands.
- **Secondary research**: Existing research published in renowned journals, meta-analyses, and databases and datasets from publicly available sources have been considered and cited in this report. Academic studies, industry reports, government publications, and case studies on decarbonisation strategies, technological advancements, and policy interventions were all included in this review. The literature review served as a basis for identifying important trends, obstacles, and opportunities in the MSME sector, which shaped the study's structure.
- **Analysis**: An in-depth data analysis was conducted using suitable mathematical models and industry data. The analysis revolved around calculating the potential impact of various interventions, evaluating the carbon footprint of Indian MSMEs, and determining the viability of various green transition

strategies from a financial perspective. Data-driven insights helped identify the most efficient green transition levers, which were also crucial to creating a practical and attainable industry roadmap. In addition, this analysis compared India's performance to international standards in the areas of energy efficiency, carbon intensity and the uptake of cutting-edge technologies to assess the country's relative standing.

The green transition of MSMEs is a key area where a huge potential for energy reduction of GHG emissions is observed, providing several benefits for MSMEs. The following published research pieces, reports, and other documents have been considered while framing the guidelines and methodology for the green transition of the MSME sector:

- **Energy and resource mapping** of bricks, foundry, pharma, textile, leather, chemical, glass, and paper subsectors, sectoral roadmap for MSMEs (2021-2023). These reports focused on achieving energy efficiency across the sub-sectors. These reports contain observations from benchmark studies across various sectors and evolving suitable policy recommendations along with an implementation roadmap to make these sectors in India energy- and resource-efficient. The scope of these studies involves estimating the production and energy consumption patterns in the specified MSME clusters across the nation, estimating the scale of energy demand and opportunities for energy conservation, evaluating existing technologies and energy-saving potential in the identified clusters through energy audits, assessing the readiness of the sector for adoption of identified energy efficiency technologies and reviewing of the existing institutional arrangements for energy efficiency improvement in the identified clusters.
- **BEE-SME program:** Situation Analysis in 35 SME Clusters (2010): To address the energy efficiency improvement in the MSME segment, BEE had formulated the BEE-SME program that aimed at accelerating the adoption of energy efficiency technologies and practices in a few chosen industry clusters through focused studies, knowledge sharing, preparing DPRs and facilitating the process of developing innovative financing mechanisms. A situational assessment of 35 pre-selected industry clusters was conducted to assess their present status related to the number of operating units in a cluster, their turnover, energy usage patterns, production processes, major energy-consuming equipment, local service providers, etc. BEE prepared a list of the most promising clusters for further action.
- Implementing **demand aggregation for rooftop solar systems** in MSME clusters by WRI India (2020). This publication aims to demonstrate a pilot implementation model for demand aggregation of rooftop solar (RTS) projects in two MSME industrial clusters in western India. The publication also presents the processes evolved to overcome the challenges and barriers that arose during the implementation of the project. Currently, limited empirical data is available to inform policy and guide practice on energy usage and demands (including renewables) within MSME clusters. The practice note aims to consolidate learning from the previous WRI India projects as well as to develop a model for demand aggregation implementation through on-ground insights.

- Scope for **deep decarbonisation in the MSME manufacturing sector** by Centre for Study of Science, Technology and Policy (2024). Decarbonisation of MSMEs is necessary to reduce fossil fuel dependence in the industrial sector. However, this potential currently remains unrealised due to factors such as low awareness and lack of access to low-cost finance. Moreover, energy efficiency technologies have technical limitations, which constrain their decarbonisation potential. Thus, the need for examining deep decarbonisation measures is imperative.
- **Scaling up of investments through ESCO mechanism** in MSME clusters by deploying Standard Energy Efficient Technologies (SEET) by the Global Green Growth Institute (GGGI) (2023). In the absence of a structured framework to support the proliferation of energy efficiency technologies and practices in the MSME sector, this project was conceived with the objective of developing a framework, which can enable Energy Efficiency Services Limited (EESL) to create a viable Energy Service Company (ESCO) market in the MSME sector and develop a roadmap for operationalising the EESL MSME Revolving Fund (EMRF). Keeping in view the typical nature of MSME clusters around the country, based on product types and technological diversity, clusters involved in food processing, textiles, engineering, and services were deemed appropriate for scaling up the implementation of energy efficiency technologies.
- **Scaling up rooftop solar in SME sector in India** by Deloitte and Climate Investment Funds (CIF) (2019): This study attempts to understand the reasons for slow growth and low investments in the solar rooftop space by MSMEs in India by, inter alia, a) assessing key barriers to scaling up rooftop solar in the MSME sector; b) identifying possible mitigants for the associated barriers; and c) identifying and evaluating appropriate financial instruments that can be considered to balance lenders' concerns with MSMEs' needs.
- Identifying barriers for rooftop solar uptake in MSMEs and development of a mitigating financial framework by Ernst & Young (2020): The study aims to identify and analyse barriers faced by MSMEs in undertaking rooftop solar projects, with a special focus on the issues MSMEs face in financing rooftop solar and to create a financial instrument, which can mitigate these barriers and lead to rooftop solar propagation among MSMEs.
- **Financing Low Carbon Transition (LCT) in India's MSME Sector** by TERI (2022): This study uses qualitative research methods to explore the status of financial assistance towards MSMEs LCT. This includes the existing institutional arrangements, cooperation mechanisms, and policy landscape for MSME LCT. Through this review of the existing structure, the study identifies major barriers faced by the sector in accessing finance for MSMEs. The study uses case studies from Gujarat and Maharashtra to get a more detailed understanding of the policies and instruments available to MSMEs at the state level. Additionally, the study illustrates state and centre policy linkages by applying the theory of convergence and divergence as a policy analysis tool and analyses its implications and future scope.
- Decarbonising India - charting a pathway for sustainable growth by McKinsey (2022): This report identifies the optimal uses of more than 100 emissions reduction levers in these sectors, across two scenarios. The report attempts to be comprehensive across sectors, examining them in depth, highlighting

linkages across them while taking a practical, yet aspirational, view of the abatement levers. It attempts to define two possible roadmaps for an orderly transition for India in the context of its continued expected growth. Finally, it proposes a set of actions that could be executed for an orderly transition.

- RIA toolkit- a practitioner's guide in developing countries by CUTS International (2015): An RIA toolkit provides a detailed guide for the assessment of regulatory proposals to arrive at the most optimal solution. It discusses the way governments can use Regulatory Impact Assessment (RIA) as a tool to improve the regulatory mechanisms along with the application of the tool. The process of RIA can be conducted while developing policies as well as reviewing regulations. The former ensures the selection of a regulatory proposal that produces good results at reasonable costs, while the latter helps in course correction on evaluation of actual impact, and identification of potential regulatory alternatives. Principles of RIA can be extremely helpful in evaluating existing regulations and correcting errors. Thus, RIA can be extremely helpful for developing countries.
- Energy service companies in China - the role of social networks and trust by Frankfurt School of Finance and Management (2011): China's ESCOs have developed only modestly despite favourable political and market conditions. With sophisticated market institutions still evolving in China, trust-based relations between ESCOs and energy customers are essential for the successful implementation of energy efficiency projects. Chinese ESCOs, predominantly small and private enterprises, perform poorly in terms of trust-building because they are disconnected from local business, social, and political networks. It concluded that in the current institutional setting, the ESCO model based on market relations has serious limitations and is unlikely to lead to large-scale implementation of energy efficiency projects in China.
- MSME pulse report by State Industrial Development Bank of India (SIDBI) (2024): The quarterly comprehensive report detailing MSMEs, which have access to formal credit, with live credit facilities in the Indian banking system. The report further provides insights to policymakers with an aim of providing the credit industry with trends and insights for making information-oriented business decisions.

1. Overview of the MSME Sector and Drivers for Green Transition

1.1 Background

The projected 69 million MSMEs in India are responsible for more than 45.73% of exports, 250 million jobs, 28.9% of the country's GDP, and 25% of the energy used by the industrial sector (PIB 2021; TERI 2022; GoI 2023a). Based on their annual turnovers and investments in plant and machinery, MSMEs have been classified into three categories as shown in Table 2 (GoI 2023b) (PIB 2025a). A significant component of MSMEs is manufacturing, which employs more than 36 million people in India, and accounts for nearly 20 million units (Indusland Bank 2022) and represents an estimated 57% of all employment in the manufacturing sector, thereby having a significant societal influence.

Table 2: Categorisation of MSMEs (PIB 2025a)

Classification	Micro	Small	Medium
Manufacturing enterprises and enterprises rendering services	• Investment in plant and machinery or equipment not more than Rs. 2.5 crore and • Annual turnover not more than Rs. 10 crores	• Investment in plant and machinery or equipment not more than Rs. 25 crore and • Annual turnover not more than Rs. 100 crores	• Investment in plant and machinery or equipment not more than Rs. 125 crore and • Annual turnover not more than Rs. 500 crores

In India, MSMEs are commonly found in clusters. The clustering of units can be attributed to a variety of historical factors, including the accessibility of semi-skilled labour pools, the availability of fuels and raw materials, and the proximity of markets. Around 17% of the (approximately 6,500 MSME) clusters are industrial clusters, and the remaining clusters are low-technology, micro-enterprise clusters (BEE 2010). With at least 100 registered units in each, there are more than 140 clusters in India that are located inside or outside of metropolitan areas. The size of these urban clusters varies greatly; some clusters are so big that they produce 70-80% of a certain item produced in the entire nation. The MSME sector is emissions and energy intensive. The issue is further made worse using antiquated machinery, such as furnaces, motors, boilers, etc., which consume more fuel than the average. MSMEs also tend to use the cheapest locally available fuels to meet their industrial energy needs. These fuels may include coal, pet coke, and diesel, which produce high Green House Gas (GHG) emissions when burned. Moreover, MSMEs depend heavily on electricity supplied by the grid. Furthermore, in 2022, 79% of the electricity produced was generated from fossil-fuel-based brown energy sources (CEA 2022), thus making the electricity grid predominantly brown. All these factors make MSMEs a highly emission-intensive sector. GHG emissions for MSMEs are classified under three broad categories, Scope 1, Scope 2, and Scope 3:

1.1.1 **Scope 1: Direct GHG emissions:** Direct GHG emissions occur from sources that are owned or controlled by the MSME, for example, emissions from combustion in owned or controlled boilers, furnaces, vehicles, etc., emissions from chemical production in owned or controlled process equipment (USA National Grid 2024).

1.1.2 **Scope 2: Indirect GHG emissions from purchased energy:** Scope 2 accounts for GHG emissions from the generation of purchased electricity, steam, heating, and cooling consumed by an MSME. Purchased electricity is defined as electricity that is purchased or otherwise brought within the organisational boundary of the company. Scope 2 emissions originate physically at the electricity generation facility.

1.1.3 **Scope 3: Other indirect GHG emissions:** Scope 3 is an optional reporting category that includes all other indirect emissions. Scope 3 emissions are a consequence of activities of a business that occur from sources not owned or controlled by the company. It includes indirect emissions, such as those from suppliers and the use of the organisation's products. Emissions from external parties that procure, manufacture, and transport the raw materials and components used by businesses are considered upstream emissions. Other upstream categories include emissions from waste generated and leased assets, employee commuting, and business travel. Emissions from the company's product usage, transportation, and disposal fall under the downstream category (Jeremy Gregory 2024). These upstream and downstream emissions are accounted for as Scope 3 emissions. MSMEs, which largely form a part of the entire product value chain, are usually covered and reported under this category by large corporations.

MSMEs emitted around 135 $MtCO_{2_e}$ of carbon emissions in 2022[1]. Figure 3 illustrates the sectoral energy consumption among MSMEs with an emphasis on the Specific Energy Consumption (SEC) for each of the five sub-sectors paper, textiles, steel rerolling, foundry and forging. These subsectors alone account for more than 60% of the total MSME emissions. Coal and electricity, which together comprise approximately 54 percent of the fuel mix, are responsible for around 90% of the overall emissions. The details of the calculations have been presented as Annexure 2. Figure 4 illustrates the fuel composition and contributing emission intensities of the top five emission-intensive MSME sub-sectors. The complete calculation methodology is outlined in Annexure 3.

1 Source: Press search - https://energy.economictimes.indiatimes.com/news/renewable/opinion-how-india-can-empower-msmes-to-achieve-net-zero-a-perspective/101271017 ; taking 3% emission increase YoY from 2015 baseline data of 110 MtCO2e as per https://climatetrace.org/inventory?country=IND&year_from=2022&year_to=2022&gas=CO2e100

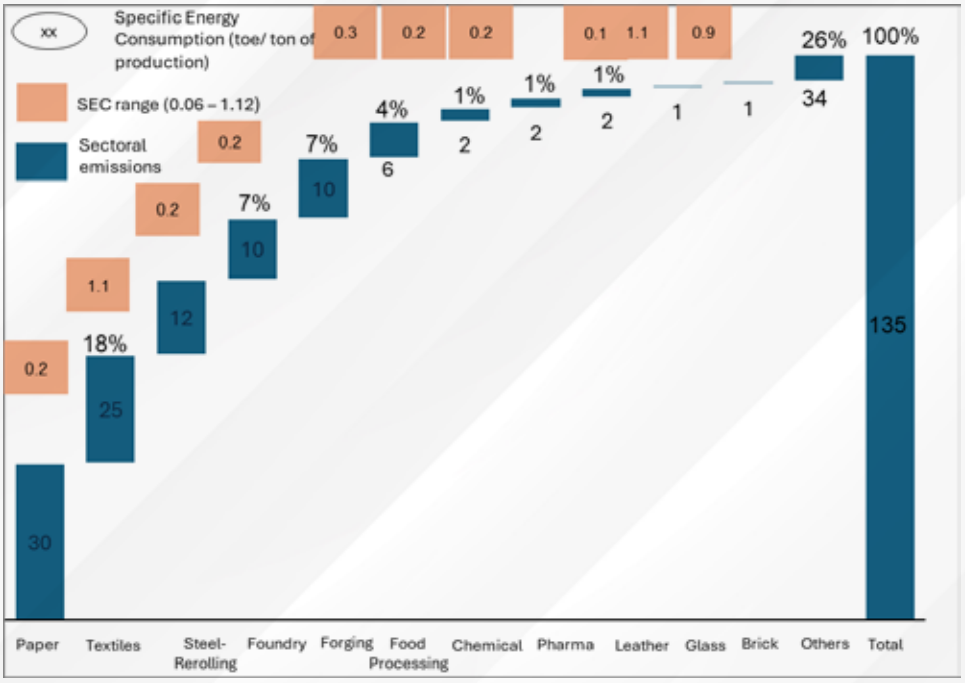
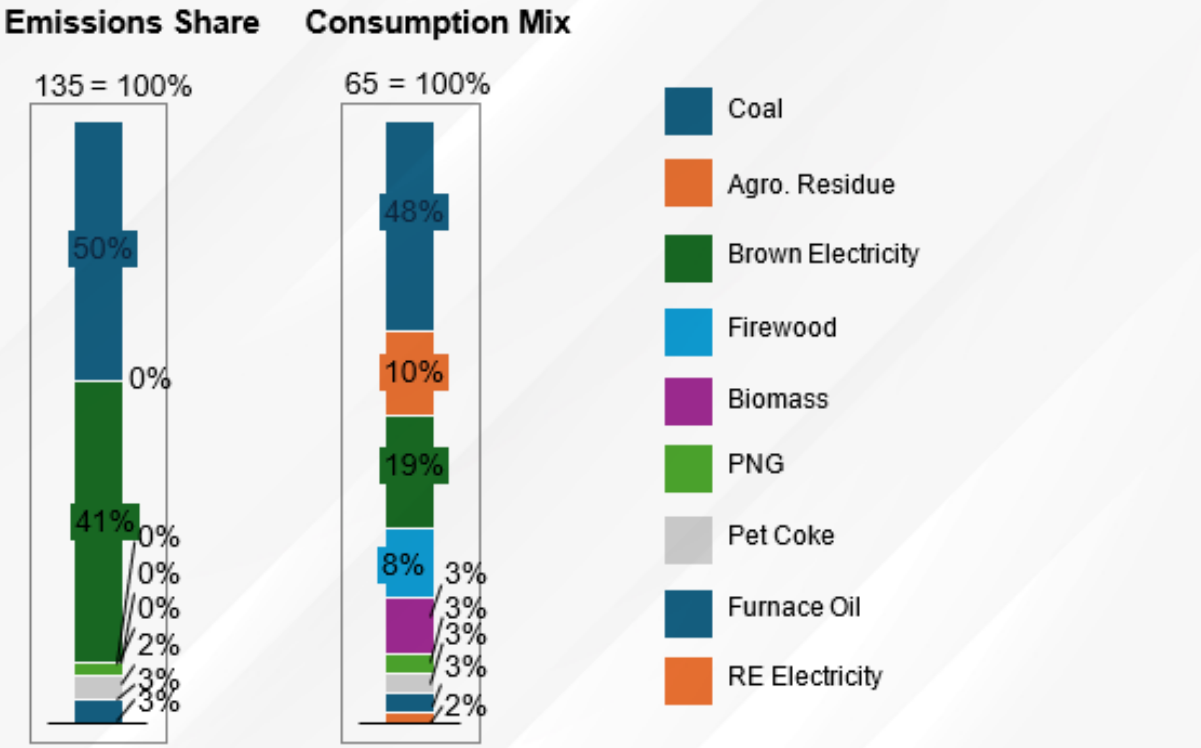


Figure 3: Sector-wise specific energy consumption and emissions contributions of MSMEs



*135 million tons of carbon emissions by the MSME sector in the year 2022

*65 million tons of oil equivalent is the total energy consumption by the MSME sector in the year 2022

Figure 4: GHG emissions vs consumption by fuel source in the top five MSME emission-intensive sub-sectors

1.2 Need for a Green Transition

India presented its long-term plan to reach 500 GW of renewable energy (RE) capacity by 2030 and net-zero emissions by 2070 at the 27th Conference of the Parties (COP27) to the United Nations Framework Convention on Climate Change (UNFCCC 2022). To meet these climate targets, emission reduction and renewable energy expansion will be necessary across all economic sectors, including MSMEs. Encouraging MSMEs to implement decarbonisation measures is critical for achieving the Sustainable Development Goals (SDGs), particularly SDG 9 (infrastructure, industry, and innovation), SDG 12 (responsible production and consumption), and SDG 13 (climate action). This climate transition risk is becoming evident for MSMEs and thus warrants the government's immediate attention. MSMEs stand to gain several advantages through the green transition, including:

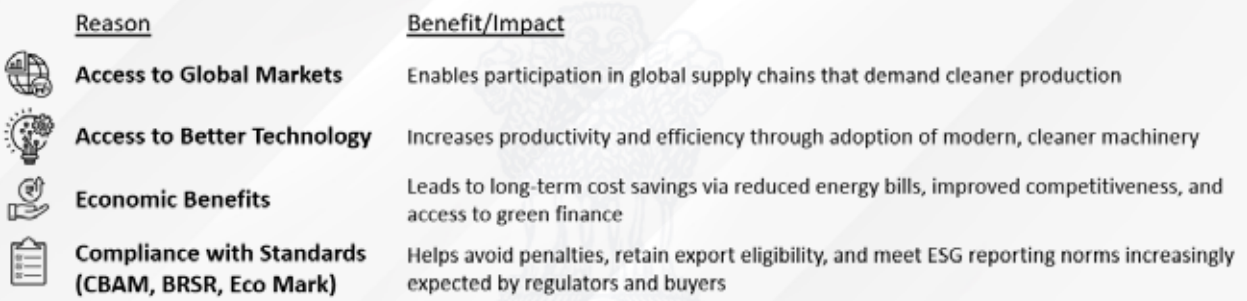


Figure 5: Importance and need for green transition in MSMEs

1.2.1 **Building Climate Resilience**: Climate change phenomena are often viewed as macro-level environmental effects, such as rising temperatures or changing rainfall patterns. Addressing these impacts of climate change is a key challenge of this century for governments, communities, and businesses alike. The consequences of climate change, including more frequent and intense floods, are already affecting Indian MSMEs, even if they are not explicitly recognised as climate-related disruptions. The reasons why Indian MSMEs are particularly affected by climate change impacts are manifold, and some are due to their inherent challenges, like financial resources and access to credit.

Climate change and associated hazards severely impair MSMEs, disrupting not only their daily operations but also the entire value chain. These enterprises face vast and multi-faceted risks, from fluctuating costs and delayed deliveries to unpredictable material availability, along with shutdowns caused by floods and degraded infrastructure. This is more pertinent for the MSMEs operating on low technology levels, as they are more severely affected by climate change than high-tech businesses and have fewer resources to cope with the impacts (WRI India 2024; GiZ India 2024). Given these risks, MSMEs must adapt and build resilience across the board. Climate adaptation is critical for their long-term competitiveness and survival.

This could be a win-win situation, with several benefits such as risk

reduction and increased resilience, cost savings, promotion of innovation, and gaining a competitive advantage. Given these global changes, it is very important to have a coherent framework and program, which can guide the industry and MSMEs over the next 10-15 years in tackling climate change, which is directly impacting policies, regulations, business models, supply chains, and global trade patterns.

Box 1: Impact of Cyclones and Heat Stress/Heat Waves on MSMEs in India

Cyclone Michaung hit Tamil Nadu in December 2023, affecting 4,800 MSME units across 24 industrial estates. This resulted in losses of at least USD 360 million. Heavy rainfall in 2022 disrupted goods movement and factory production, costing Gujarat industries approximately USD 600 million. Similarly, the Chennai floods (2015), Kerala floods (2018), and Cyclone Fani in Odisha (2019)— all caused significant losses among MSMEs, ranging from several hundred crore to tens of thousands of affected units. Between 2001 and 2020, India lost approximately 259 billion hours of labour or $624 billion (Rs 46 lakh crore) annually because of heat and humidity. According to an International Labour Organisation (ILO) 2019 report, by 2030, India could account for 34 million of the projected 80 million global job losses due to heat stress-related productivity decline. Humidity is also likely to cause inventory damage, machinery malfunctions, equipment rusting, and an increased cooling demand. Furthermore, increased heat raises the risk of industrial fire outbreaks and chemical hazards in manufacturing facilities.

1.2.2 **Achieving profitability through advanced technology**: Implementing green transition technologies can help MSMEs reduce costs and become more competitive. Adopting cleaner fuels like biomass, biofuels, biogas, and RE sources reduces emission intensity and expands access to low-emission product markets. Transitioning to lower emission-intensive fuels like Liquefied Petroleum Gas (LPG) and Piped Natural Gas (PNG) can be a crucial first step in reducing emissions, since MSMEs are heavily reliant on energy-intensive fuels like coal. Multiple incentives are also available to implement energy-efficient technologies, such as accelerated depreciation and credit-linked subsidy schemes for business expansion. MSMEs adopting greener technologies have payback periods ranging between 1-5 years.

Furthermore, adopting green electricity and alternate fuels not only reduces emissions but also decreases dependency on grid electricity and traditional emission-intensive fuels like diesel, which are used in generator sets. These significant savings can increase MSME profitability, support business expansion, generate employment, and reduce emissions. Research indicates that the willingness to purchase sustainable products at a premium is more prevalent in developing nations like India, Indonesia, Brazil, and China than in developed economies. Given the momentum from international guidelines and regional measures mandating a reduction in emissions and adoption of sustainability, MSMEs must prioritize cost savings and advance towards decarbonisation.

1.2.3 **Adhering to international standards and regulations**: Ensuring economic competitiveness of the MSME sector in an era of globalisation is crucial.

Adopting clean energy measures can play a vital role in strengthening the market position of MSMEs. A critical development is the Carbon Border Adjustment Mechanism (CBAM), a policy introduced by the European Union (EU) to impose carbon pricing on certain carbon-intensive products imported into the region (European Union 2023). After a three-year transition phase, CBAM is expected to take effect in January 2026, with the possibility of expanding its scope to other high-emitting industries and indirect emissions. This policy aims to prevent "carbon leakage," where companies relocate production to countries with less stringent carbon regulations. This will significantly impact Indian MSMEs as Indian MSME segments contribute largely to the total exports of textiles, steel, paper, and pulp for handicraft (around 40 percent), and engineered goods (over 60 percent) (Annexure 9).

Indian products have significantly higher carbon intensity than the EU and many other countries because coal dominates the overall energy consumption (The Times of India 2023). MSMEs will face increased costs for EU exports due to CBAM purchase certificates tied to product carbon emissions. Additionally, an increase in the administrative burden can be expected as CBAM involves monitoring, reporting, and verifying emissions, which can be particularly challenging for smaller businesses like MSMEs. Apart from the EU, other countries such as the UK, Canada, and Japan have also been considering similar mechanisms. Such measures could severely impact Indian MSME export prospects.

On the domestic front, Business Responsibility and Sustainability Reporting (BRSR) represents India's first framework mandating the provision of quantitative sustainability metrics from Indian companies (the top 1,000 NSE-listed companies by market capitalisation) (SEBI 2023). The new BRSR framework, created by the SEBI, oversees the country's securities markets. It was inspired by the Business Responsibility Report (BRR 2012) published by the Ministry of Corporate Affairs. The new BRSR works with other globally recognised reporting frameworks, including the Task Force on Climate-Related Financial Disclosures (TCFD), the Sustainability Accounting Standards Board (SASB), and the Global Reporting Initiative (GRI). Respect for the environment and efforts to preserve and repair it are among the guiding principles of this framework, under which 51% of India's top 100 listed companies voluntarily reported Scope 3 emissions. As large corporations report on these emissions, MSMEs serving as upstream and downstream partners in the entire value chain will face compliance obligations. Only 2-3 % of manufacturing MSMEs sell directly to retail customers, while more than 90% sell through traders and other upstream manufacturers; hence, they may soon be asked to reduce their carbon footprint. This necessitates the reduction of carbon emissions for MSMEs as regional practices aim towards sustainability. Additionally, other sustainability measures, specifically the Ecomark rules by MoEFCC, will benefit MSMEs in the long run.

Box 2: Ecomark Rules 2024

On 26th September 2024, the MoEFCC notified the Ecomark Rules, 2024 to label products that have a lesser adverse impact on the environment. The Ecomark will be granted to a product if it holds a license or a certificate of conformity to Indian Standards issued under the Bureau of Indian Standards Act, 2016, or the Quality Control Orders issued by the Central Government. Other criteria that may be considered for the grant of Ecomark include reduction of pollution by minimising or eliminating the generation of waste and environmental emissions; recyclability or recycled material or both; reduced use of non-renewable resources, including non-renewable energy sources and natural resources; reduced use of any material, which has adverse impacts on the environment. Any Ecomark, when granted, is valid for 3 years or until there is a change in the Ecomark criteria for the product. These rules imply that the use of environment-friendly 'green' products will be promoted among consumers and will be the preferred choice for producing final goods. MSMEs that are responsible for final product preparation and delivery will be benefited with Ecomark label on their products.

1.3 MSMEs Need Additional Support for Green Transition

Implementing measures that aim to reduce the Scope 1 and Scope 2 emissions of MSMEs is essential. The enhancement of energy efficiency and the adoption of green electricity and alternate fuels can be the key drivers for this transition. Despite the economic benefits and compliance with international standards, the adoption of clean energy interventions is low due to a multitude of reasons. Due to their limited manpower and inclination to focus on production and marketing processes, MSMEs are left with little capacity to adopt clean energy solutions. They require support from external entities for the adoption of clean energy solutions, including access to cutting-edge innovations, technical know-how, and best practices. MSMEs face a range of challenges in areas such as energy efficiency, green electricity adoption, and the use of alternate fuels, including the following:

Energy Efficiency (EE)	Green Electricity (GE)	Alternative fuels (AF)
• Lack of trust in the ecosystem: MSMEs fail to collaborate with Energy Service Company (ESCO) despite performance guarantees due to lack of trust/understanding of such mechanism. • Awareness and capacity to implement latest technology: MSMEs are unaware of the technologies and performance guarantee models run by energy services companies.	• Perceived risk of payment default by MSMEs: RESCOs require risk of extending services to MSMEs to be mitigated due to perceived payment defaults. • Stakeholder support: State Distribution Companies (DISCOMs) are required to extend timely support to the ecosystem to get such renewable power plants online.	• Awareness on various agro feed: MSMEs are typically unaware of the possible agro residues that can be made into brickettes and pellets for biomass firing. • Scalability issues: Many biofuels and products are perishable and thus have lower shelf life making it logistically challenging. Further, seasonality factors impact availability and may potentially lead to fuel shortage.

1.3.1 **Other issues faced by MSMEs include:**

i) **Budget constraints:** MSMEs often operate within tighter budgets and have limited access to capital compared to larger enterprises, which makes them more vulnerable to cost fluctuations. These enterprises often face a high cost of compliance that consumes a significant portion of their resources. Furthermore, MSMEs usually compete with larger firms that benefit from economies of scale, making it challenging to maintain competitive pricing for their finished goods, all of which contributes greatly towards their cost sensitivity. MSMEs in Energy Service Company (ESCO) markets often prefer cheaper alternatives (usually low quality) to ESCOs' solutions that tend to reduce the scale of impact intended.

ii) **Access to finance:** The Government has been supporting MSMEs by providing finance to upgrade machinery, infrastructure, and cluster-related developmental projects across India. Although public finance and grants from the Government and philanthropic organisations enable initial adoption of clean energy technologies, access to finance from mainstream private and public sector banks is necessary to achieve scale. However, access to such financing is limited due to the high perceived risk in lending to MSMEs, high transaction costs to service these low-value loans, low credit rating/scoring of MSMEs, low business visibility, and the lack of understanding of clean energy technologies. Even when financing options are available, MSMEs find them unviable and unattractive as they are often expensive, involving a cumbersome documentation process requiring additional collateral security to cover risks.

iii) **Cash-flow management challenges:** MSMEs face hurdles in cash flow management, which heavily impact their product delivery, operations, and overall functioning. Some of these are due to late payments from customers, inefficient invoicing and seasonal fluctuations in product demand patterns. A significant amount is usually tied as receivables, which restricts working capital, thus limiting funds for expansion or immediate needs.

2. Scope of the Report

Through this report, NITI Aayog aims to facilitate the development of policy measures that enable a green transition in the MSME sector. The report provides 10-year implementation strategies that aim to reduce GHG emissions in MSMEs through the enhancement of energy efficiency and adoption of alternative fuels and green electricity. Solutions around energy efficiency and alternate fuels address emissions from coal and other fossil fuels, while green electricity solutions address emissions from brown electricity. The report also covers the institutional mechanism that will be required to support the transition.

The Ministry of MSME along with the assistance of NITI Aayog will guide the implementation of the Green Transition Roadmap through the formation of an NPMA that looks at scaling clean energy solutions across the three levers of energy efficiency, green electricity, and alternative fuels. The roadmap details the three different levers in the green transition of the MSME sector, covering the technological aspects, implementation mechanism and the financial outlays required to enable this transition. The report also covers the building of the institutional mechanism, MRV framework, setting up of RIA body and fund mobilisation that are essential for the successful implementation of the roadmap. The report aims to provide pathways to support the holistic decarbonisation of the existing MSME units and propose steps that enable new and future MSMEs to adopt low-carbon pathways right from their inception. The three sector-agnostic green transition solutions are elaborated as follows:

- **Enhancement of energy efficiency:** The study provides a framework that facilitates the adoption of energy efficiency in the MSME sector. Energy efficiency is a key lever that can lead to an overall reduction of around 27% of the overall GHG emissions across the MSME sector. The report highlights the models to scale implementation of viable technologies and operational practices which minimise energy losses and improve resource efficiency.

- **Green electricity adoption:** Green electricity adoption (involving use of electricity that is produced from renewable sources), is another lever identified for the decarbonisation of the MSME sector. With electricity as a fuel contributing to around 41 percent share in the overall GHG emissions of the sector, it is estimated that green electricity adoption can enable a reduction of approximately 22-26% of the overall GHG emissions from the MSME sector, and the report provides for models to scale adoption of green electricity for procurement and self-generation.

- **Increase in uptake of alternate fuels:** MSMEs are heavily dependent on fossil fuels to meet their thermal energy requirements. This is due to several reasons, including cheaper prices of fossil fuels when compared with the alternatives, maturity of the technologies harnessing the energy from fossil fuels, and a near-developed consumer market. Since coal accounts for about 50% of the overall emissions produced across the MSME sector, replacing it primarily with alternate fuels that are zero or lower emission-intensive can lead to an estimated reduction of 7-12% direct emissions. Alternate fuels such

as biomass, natural gas (piped/compressed), renewable electricity (through electrification of the process) and compressed biogas can be the long-term solutions under this lever.

A robust institutional mechanism is essential for the effective implementation of the Program. The program is designed to drive deep decarbonisation in the MSME sector through an effective MRV framework that tracks ongoing efforts and integrates key learnings into future actions. Although the three components of MRV are frequently distinguished from one another, each component depends on and complements the other two. Data on Key Performance Indicators (KPIs), such as changes in energy and electricity usage, or an increase/decrease in GHG emissions, can be measured as part of the monitoring process. A well-functioning reporting system makes it easier to report data quickly, accurately, and condenses it into easily understandable formats.

The MSME sector has traditionally lagged in the uptake of green schemes and reporting on performance, which necessitates the creation of reporting mechanisms that can capture data from the MSME owners transparently. Verification is the final step in ensuring that reported data is accurate, consistent, and complies with reporting regulations. Self-certification has been considered initially to equip MSMEs for basic data verification, while inputs from external agencies will be considered for verification of data to strengthen risk mitigation based on the achievement of specific KPIs.

The report also recommends setting up of a Climate Sister Impact Fund (CSIF) that can provide financial support for emerging technologies that directly enable a green transition in industries, including the hard-to-abate sector. Additionally, budgetary support could be proposed for research and development (R&D) in technologies that reduce GHG emissions in the industrial space through innovative equity and debt instruments. The fund's investment objective would be to ensure that capital is used to promote decarbonisation and climate adaptation in a scalable manner.

2.1 Implementation of the Program: Scenarios Projected

The implementation of the three levers mentioned above is expected to reduce GHG emissions significantly. Two scenarios have been represented in the green transition of the MSME sector. The first, a Line of Sight (LoS) scenario, wherein 35% of the energy needs from coal and other high-emission intensity fuels are shifted to low-emission fuels (biomass, LNG/PNG, etc.), and 45% of brown electricity is converted to green electricity. The second is an accelerated scenario wherein 55% of energy needs from coal and other high-emission intensity fuels are shifted to low-emission fuels (biomass, LNG/PNG, etc.), and 60% of brown electricity is converted to green electricity. Both scenarios account for the implementation of energy efficiency measures, which are considered the first fuel in the energy pyramid and a foundational step in the clean energy transition in MSMEs.

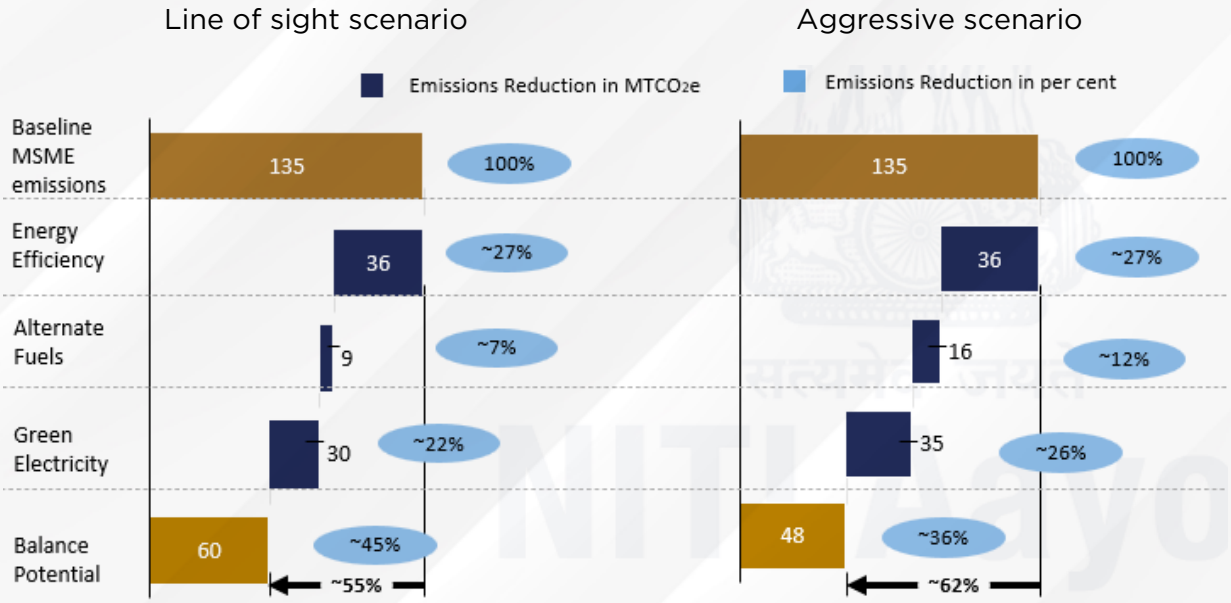


Figure 6: The reduction in emissions observed in LoS and aggressive scenarios

Figure 6 illustrates the potential GHG emission reductions achievable by MSMEs under two scenarios. In the LoS scenario, MSMEs can reduce 75 $MtCO_2e$ of GHG emissions through three key levers— energy efficiency improvements (36 $MtCO_2e$), increased green electricity penetration (30 $MtCO_2e$) and shifting to alternate fuels (9 $MtCO_2e$). Similarly, the aggressive scenario can lead to a reduction of 87 Mt of GHG emissions by the enhancement of energy efficiency (36 $MtCO_2e$), high adoption levels of green electricity (35 $MtCO_2e$), and shifting to alternate fuels (16 $MtCO_2e$). The figures have been obtained based on the current consumption patterns of different fuels across the MSME sector. The detailed calculations and assumptions used have been provided in Annexure 4. Under the program's LoS and Aggressive Scenario projections, the number of MSMEs that can be impacted are around 340 million and 409 million respectively.

2.2 Reflections from Current Schemes for the Development of a Roadmap for Green Transition

The MSME sector currently benefits from several schemes and programs that address various operational challenges. A comparison of the proposed Roadmap with the different central schemes is provided briefly in Table 3:

Table 3: Distinction between existing MSME schemes on green transition and the proposed Roadmap

Scheme name	ADEETIE (Assistance for Deployment of Energy Efficient Technologies in Industries and Establishments) Scheme (Ministry of Power)	Green Investment and Financing for Transformation (GIFT) Scheme (Ministry of MSME)	Scheme for Promotion and Investment in Circular Economy (SPICE) (Ministry of MSME)	Roadmap for Green Transition of MSMEs
Focus areas	Aims to facilitate MSMEs to upgrade with energy-efficient technologies/ measures across 60 clusters spanning 14 sectors through financial instruments and handholding them in carrying out an investment-grade energy audit, a detailed project report, monitoring, and verification of the implementation.	Provides institutional finance at concessional costs to support green technologies, clean transportation, energy-efficient projects like green buildings, and waste management initiatives, including recycling, efficient disposal, and energy conversion	Provides support to adopt circular economy practices in sectors like plastic, rubber, and electronics waste management	Provides institutional, financial support and a robust framework for sector agnostic green transition in MSMEs, with specific focus on enhancement of energy efficiency, adoption of green electricity, and alternate fuels. • Renewable Energy Service Company (RES-CO)/ Energy Service Company (ESCO) led green electricity adoption and energy efficiency enhancement in MSMEs. • PM Surya Ghar Yojana (PMSGY) like sub-scheme. • Financial Incentivization for alternate fuels adoption.
Beneficiaries	All MSMEs	Micro and small enterprises (MSEs)	Micro and small enterprises (MSEs)	All MSMEs
Benefits	Interest subvention, Streamlined project implementation	Interest subvention, Risk-sharing facility	Credit-linked capital subsidy	Financial incentives for adoption of sector agnostic solutions, Risk sharing facility, Streamlined project implementation, Boost for indigenous manufacturing of relevant technologies, Monitoring, Reporting and Verification (MRV)
Demand aggregation	×	×	×	✓

The above interventions collectively enable MSME green transition through distinct but complementary pathways. The ADEETIE scheme focuses on firm-level energy efficiency upgrades by financing, audits, and verified technology adoption, while the GIFT scheme provides concessional institutional finance for broader clean technology deployment across energy, transport, buildings, and waste management, with risk-sharing mechanisms. Complementary to these efforts, the SPICE scheme targets circular economy integration in select sectors through credit-linked support.

The Green Transition Roadmap draws from several ongoing government initiatives targeted at the MSME sector. It adopts a holistic and sector-agnostic approach, emphasising demand aggregation and targeted interventions. Further, adopting a sectoral approach offers several advantages, as it enables targeting similar units engaged in facilitating the scaling-up of implementation measures. This allows for a more focused and coordinated approach from implementation agencies.

Earlier schemes by the Government of India have effectively used the cluster approach. The roadmap recommends demand aggregation, which combines several demands of a service/product in a specific region to drive the outreach of the initiative thereby addressing systemic barriers at scale. When combined with demand aggregation, this approach strengthens the implementation across 3 levers. The Green Transition Roadmap has addressed a wide range of issues, which will lead to holistic green transition. It includes specific provisions to promote the adoption of green electricity and alternate fuels, ensuring a comprehensive pathway toward sustainable industrial development in the MSME sector.

3. Institutional Mechanism

The successful implementation of this roadmap relies heavily on effective resource management, mobilising finances, and division of responsibilities. Under the primary approaches highlighted under the energy efficiency and green electricity levers, and the alternate fuels lever highlighted in the upcoming sections, the implementation will be undertaken by the Ministry of MSME which will institute a National Project Management Agency (NPMA) to ensure its implementation.

Implementation of secondary approaches highlighted under the energy efficiency and green electricity levers in the upcoming sections have been explained in the same sections, respectively. The NPMA can be in the form of independent consultants or a consortium, depending on the suitability, and can be monitored through an inter-ministerial committee. The monitoring committee can include members from the Ministry of MSME, Central Electricity Authority (CEA), DPIIT, NITI Aayog, MoEFCC, Ministry of Power, MNRE, MHI, MoPNG, and state-level Ministry of MSME agencies, EESL, BEE/State Designated Agencies of BEE. This committee will appraise Detailed Project Reports (DPRs), set baselines, and establish target Key Performance Indicators (KPIs) to be achieved.

Dedicated state-level committes can also be constituted for coordination of state-specific activities. The state-level committee will work closely with MSME clusters and associations, financial institutions, private organisations, OEMs, DISCOMs, State Electricity Regulatory Authorities, and other stakeholders to look after the green transition implementation across MSME clusters. The state committee may also appoint agencies like MIDC, SIPCOT, SIDCUL, etc., as state Programme leads that support the demand aggregation work. Cabinet approval will be taken for the establishment of NPMA and allocation of funds under different levers identified under the programme. The flowchart demarcating the roles and responsibilities of the NPMA and the blueprint of the Green Transition Roadmap is provided in Figure 7.

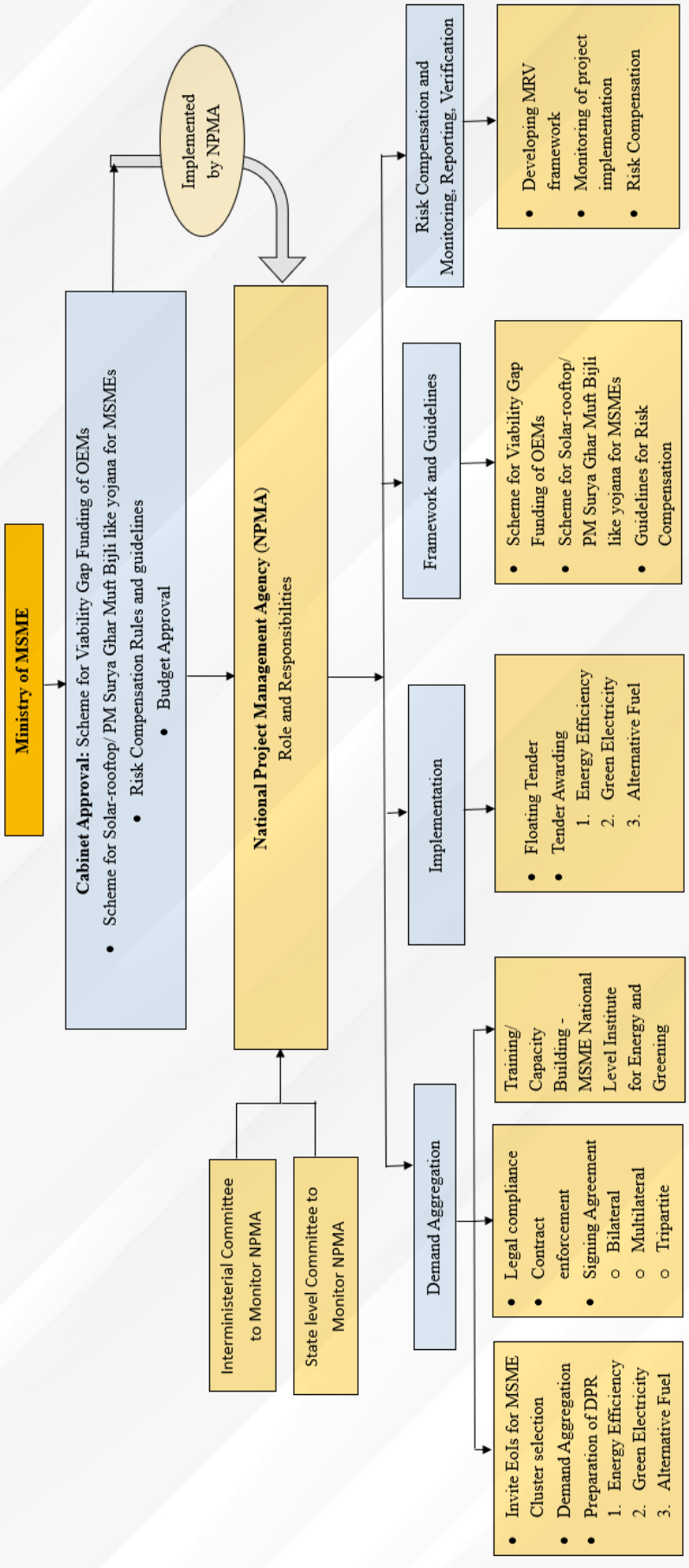


Figure 7: Roles and responsibilities of NPMA

3.1 The Different Roles and Responsibilities of NPMA are Elaborated as:

3.1.1 **Administrative Support:**

(i) **Expression of Interest:**

- NPMA will be responsible for inviting Expression of Interest (EoI) from MSME clusters to participate in the national programme. This EoI will largely determine the eligibility and criteria through which MSME clusters, through SPVs, can adopt a green transition. The EoI should ideally mention why a particular MSME cluster through its SPV should be a part of the programme and the likely impact on energy usage, emissions, job creation, profitability, etc. EoI will help NPMA assess the intention and capability of the MSME clusters, compare it with other MSME clusters and make a well-informed decision for programme implementation. A detailed draft format for the EoI will be shared at a later stage of implementation. EoI will likely accommodate the following details:
  - » Information about the nature and type of the MSME cluster including geographical spread, type of industries (micro, small, medium), total number of MSME units, total employment generation, etc.
  - » Cluster information including export orientation, final goods produced, electricity and energy requirements (if available), turnover, any technical or financial requirements and other qualification metrics that potential clusters must meet to be considered for national programme implementation. EoI help sellers assess the buyer's intention and capability, compare it with other purchase offers and make a well-informed selling decision.

Box 3: Special Purpose Vehicles (SPV) for MSME Clusters

SPVs are corporate vehicles private companies established for a variety of purposes. SPVs can be established as subsidiaries, project or joint venture vehicles to ensure that only those assets linked to a related transaction are exposed to the liabilities associated with that transaction. SPV will be a company registered under Section 8 of the Company Act and will have at least 10 small and/or medium enterprises (SMEs) having Udyam Registration as members.

The creation of SPV for MSME clusters can follow the SPV creation under MSE-CDP:

It is necessary to form an SPV before setting up and running the proposed CFC. An SPV is a clear legal entity (Cooperative Society, Registered Society, Trust or a Company) with evidence of prior experience of positive collaboration among its members. The SPV should have a character of inclusiveness, wherein provision for enrolling new members to enable prospective entrepreneurs in the cluster to utilise the facility should be provided. In addition to the contributing members of the SPV, the organizers should obtain written commitments from 'users' of the proposed facilities so that their benefits can be further enlarged. The SPV should ideally have one State Government official as members of the SPV. There should be a minimum of 20 MSE cluster units serving as members of the SPV. There is no ceiling on the maximum number of members. In special cases, where considerations of investments, technology or small size of the cluster warrant a lesser number of units, a minimum of 10 MSE units may be considered for the SPV.

(ii) **Demand Aggregation:**

- Once the clusters have been selected based on the EoI received, demand aggregation will be conducted by the NPMA under one or all levers identified under the national programme. Demand aggregation is a key enabler of the green transition in the MSME sector. While it is possible to drastically reduce emissions in MSMEs, scaling these low-emission equipment alternatives comes with a high initial cost and a large upfront investment (Kajol 2020). All these high initial costs can be reduced if demand aggregation is effectively undertaken in the cluster. Demand aggregation involves bundling the demands of single or multiple energy-efficient equipment or technologies across multiple MSME units into a single demand for procurement. This will lead to sending a strong demand signal for low-emission products and subsequently help OEMs and ESCOs/RESCOs accelerate new investments. Aggregating demand can speed up the process, even though MSMEs can and will independently source demand from interested parties bilaterally.

  Building more consensus around voluntary standards and other market infrastructure that MSMEs need to purchase and evaluate the environmental impact confidently is another important benefit of demand aggregation. Aggregation can help MSMEs and implementing agencies align on high-quality standards and product definitions, guidelines, and tools by using their combined purchasing power. This will harmonise and streamline processes within these sectors. Demand aggregation platforms can effectively assist in directing purchasing power towards technologies with higher emission reduction potentials and faster payback periods that can lead to a prosperous MSME segment.

(iii) **Training and Capacity Building:**

- Supporting green transitioning investments in the MSME sector requires more than just financial and technological inputs – it demands dedicated capacity building and project development assistance. These projects are often complex and typically implemented by actors with limited administrative capacity. Long-term, ongoing, and intricate process of capacity building depends on the involvement and ongoing communication for all parties involved (national and local governments, non-governmental organizations, academic institutions, etc.).

- There is no one-size-fits-all solution to capacity building. Instead, capacity building strategies must be adaptive and iterative, incorporating regular assessments, corrective actions, and adjustments based on evolving needs. Capacity building strategies and approaches should be flexible given the diverse and dynamic demands across nations, regions, and sectors.

- When viewed holistically, capacity building should address the following dimensions:
- Institutional and legal framework development: Creating enabling environments that allow organizations, institutions, and agencies at all levels to strengthen their capabilities.
- Organizational development: Developing management structures, processes, and procedures within and across sectors - public, private, and community.
- Human resource development: Equipping individuals with knowledge, training and access to information, required for effective performance.

The NPMA will also be required to drive capacity building efforts on the benefits of green technologies particularly in terms of cost savings, adherence to international and national regulations, energy savings, impacts on emissions, and greening of the products, by closely working with the MSME National Level Institute for Energy and Greening stated to be created under the RAMP-S Programme by Ministry of MSME.

Once capacity building and demand aggregation activities are conducted in the selected MSME cluster, a bilateral agreement must be signed between the Ministry of MSME and cluster SPV for the preparation of DPR under one or all levers identified. A bilateral agreement will be a legally binding agreement wherein the Ministry of MSME and cluster SPV exchange mutual obligations to perform specific actions in programme implementation. The agreement will necessarily include:

- Specifics on rights, obligations, and expectations of the parties involved.
- Inclusion of remedies for any breach.
- Addressal for violation of any rights, dispute, or wrongdoings.
- Penalties for non-adherence to specifications and implementations.
- Usage of precise terms to avoid misunderstandings.

(iv) **Other administrative responsibilities** of the NPMA will also include:

- Provide technical consulting services to MSMEs and state authorities on decarbonisation solutions e.g., highlighting of pilot installations of new technologies.
- Anchoring decarbonisation pilot projects focused on MSMEs for multilaterals and donor organizations such as UNIDO, GEF, JICA, etc.
- Setting up framework for model documents, e.g., prequalification, contract document, bidding process, concession agreement, tripartite

agreement, PPA, monitoring & evaluation model document, etc.

- Tracking and monitoring subsidy disbursement for risk mitigation under the programme.
- Provide advisory services to state governments on establishing new MSME clusters with low-carbon pathways in built in their design, e.g., build cogeneration facilities, with a scalable service model (e.g., steam-as-a-service).
- Support MSME clusters in enhancing resource efficiency and integrating circular economy principles into their production processes. These will also contribute to non KPI targets, that will make MSMEs more resilient and efficient.
- Create a bridge between the RAMP-S and National Programme. The RAMP-Sustainable (RAMP-S) programme will enable MSMEs to accelerate their energy transition with a specific focus on the adoption of green energy through an aggregation model. It will also facilitate access to clean technologies at the individual and cluster levels and supports EPR compliance. The National Programme and the RAMP-S programs share complementary objectives that collectively support the green transition of MSMEs. By fostering collaboration and learning between the two programmes, a more cohesive and enabling ecosystem can be created – one that empowers MSMEs to adopt green energies, enhance resource efficiency and become sustainable.

3.1.2 **Implementation:**

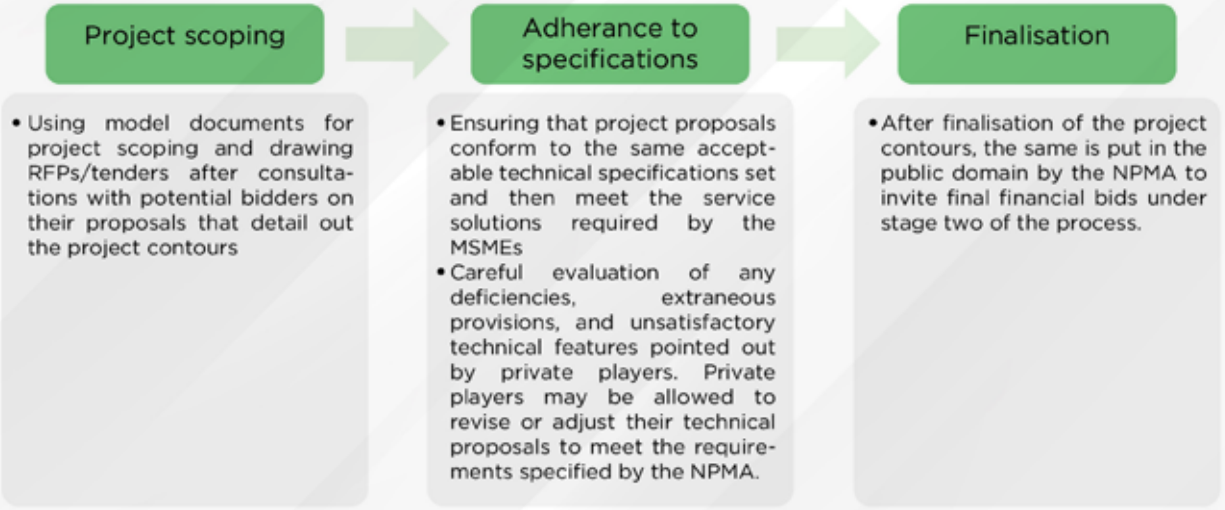
(i) NPMA will prepare Detailed Project Reports (DPR) that allow for the floating of a tender under one or all levers identified in the Programme. The DPR can ideally be prepared by NPMA in its own capacity or through empanelling an expert agency; however, this can also be done on the lines of Swiss Challenge Methodology (SCM).

Box 4: Swiss challenge methodology (SCM)

SCM is a type of public procurement where an interested party submits an unsolicited bid to the deciding authority. The project preparation cost is included in the unsolicited bid that has been submitted to the authority. After accepting an offer, the deciding authority reviews the bids for counteroffers and selects the best one. This could be better than the original submission. Most of the time, the right of first refusal is granted to the original submitter. The original submitter is awarded the bid if their offer matches the challenging proposal; if not, the challenging bidder is awarded. If the project proponent i.e., the original bidder, is not awarded the bid, the costs involved in the preparation of project documents including DPR are compensated. This regime is preferred as the most competitive bid of all the ones received will be selected for the final implementation. Any fee encountered for the preparation of DPR will be compensated by the NPMA to the successful bidder if the DPR is prepared by a private agency.

For each project, the NPMA can assist in onboarding the implementing agencies through a two-stage tendering mechanism in line with the SCM to implement green transition projects as explained:

- **Prequalification:** The NPMA can create a list of pre-qualified implementing agencies that match the requisite criteria, including a good services track record, number of projects implemented successfully, years of operations, past empanelment by relevant agencies, prior experience in executing projects of similar value, etc., and finalise the scope after consultations with potential bidders on their proposals. This practice will include:



- **Financial bid parameter:** This comes after giving bidders sufficient time to prepare the final project scope. The NPMA will evaluate this based on specified timelines. The L1 bid with the lowest quantum of the subsidy required from the NPMA will be selected. The maximum subsidy as a risk compensation amount can be either:
  - » An amount that is lower than the defined absolute amount in the bidding document.

    OR
  - » A fixed percentage of expected sales (X years for typical implementing agency payback) by assessing the risk profile of MSMEs in the particular cluster based on past loan delinquency rate (national delinquency of approximately 3 %).

A detailed bidding and tendering process is described as follows:

Box 5: Proposed Bidding Methodology

Step 1: Preparation of the project report and undertaking demand aggregation

a) The Participating Entity (PE), in this case the NPMA, can undertake the preparation of the DPR. The PE shall bear the entire cost.

Or

b) The PE may hold talks with a potential bidder to request them to submit an unsolicited DPR. Upon submission, the DPR will be vetted by the technical experts, and the cost of preparing the DPR will be released to the consultant once the DPR is technically accepted by PE.

Step 2: Request for technical proposal (RTP) stage

The PE is to evaluate the eligibility and technical capabilities of bidders, and only technically qualified bidders can participate in the next stage of bidding:

(i) Issuance of RTP Document:

The PE issues an RTP, inviting bidders to submit their technical proposals, which will include the following information:

- Background and objectives of the consultancy services.
- Scope of work and deliverables.
- Eligibility criteria for bidders.
- Evaluation criteria i.e., technical qualification criteria.

(ii) Submission of RTP responses:

Bidders submit their technical proposals, which are evaluated based on technical criteria such as experience, turnover, qualifications, and methodology.

(iii) Opportunity to the consultant: prepared DPR

The bidder who prepared the DPR will also be allowed to participate in the bidding process, and shall not be given any preference over other bidders.

(iv) Evaluation of RTP responses:

Technical Evaluation: The PE evaluates the technical proposals and shortlists only technically qualified bidders to the second stage of bidding (RFP).

Step 3: Request for proposal (RFP) stage:

(i) Issuance of RFP document:

Only technically qualified bidders from the second stage (RTP) are invited to submit their financial proposals

(ii) Financial evaluation:

The PE evaluates the financial proposals based on pre-specified financial criteria. The bidder with the lowest evaluated financial bid will be recommended for award.

RTP timeline:

30 days for document submission, 30 days for technical evaluation.

RFP timeline:

Within 15 days from the completion of technical evaluation, 30 days for bid submission, 30 days (max) for financial evaluation, 30 days negotiation and contract signing.

The bidding process can essentially follow the bus tendering process under FAME II scheme by the Ministry of Heavy Industries (MHI):

Box 6: Electric bus procurement under FAME-II

MHI mandated the opex procurement model under FAME-II, which resulted in all bus agencies adopting the Gross Cost Contract (GCC) procurement model for e-buses. The tendering process for bus procurement under GCC involved cities issuing an RFP, accompanied by a Model Concessions Agreement (MCA), that outlined the terms of procurement. Interested service providers could submit their bids, out of which the least cost (L1) bidder is selected and contracted. All the cities were mandated to adopt, draft MCA was issued by NITI Aayog, Government of India, after incorporating any necessary changes according to their local needs. The following factors determined the selection of the bidders:

- Eligibility criteria for service providers: Annual turnover, manufacturing capacity, operating experience, adherence to timelines, etc., were considered.
- Contractual obligations: Performance bank guarantee amount and duration, subsidy bank guarantee amount and duration, payment in the case of contract termination, taxes, third-party insurance, and asset ownership at the end of the contract influenced the cost of FAME-II bids.
- Functional and technical specifications: Charging strategy, battery capacity requirements, and bus specifications in determining the cost-of-service provisions.
- Payment terms and penalties – The terms of payment and penalties are at the heart of the payback period for the service providers who invested in the GCC operations. Assured kilometres of payments, periodicity, charges for late payments, and payments for additional and underutilized kilometres of operation were key payment terms that varied between cities and hence could have impacted their costs significantly.

3.1.3 **Framework and Guidelines:**

(i) The overall framework for green transition that revolves around the 3 levers of energy efficiency, green electricity and alternate fuels is described in detail in the forthcoming sections of the report.

3.1.4 **Project Monitoring and Risk Aversion:**

(i) Once the projects are in the pipeline and implemented as per the stipulated terms, the NPMA would be responsible for performing the monitoring, reporting, and verification (MRV) functions to determine the efficacy of the overall objective, which has been described in the following sections.

(ii) Since the implementation of several of the levers identified under the National Programme does not involve any upfront payments to selected implementing agencies and contains service-based payments, there is a possibility of MSME units defaulting on scheduled payments. To mitigate the perceived risk of MSMEs defaulting on payments to implementing agencies – arising from the implementation of one or all the levers identified under the National Programme – financial security and risk mitigation measures will be extended to the NPMA as outlined below:

- **Financial support**: The NPMA will closely monitor all implemented projects and work toward releasing funds to implementing agencies if there have been any payment defaults by MSMEs. A risk-sharing mechanism is proposed to mitigate any financial losses in the project implementation and monitoring phase, considering the poor credit ratings usually found in MSMEs that lead to a risky investment status for the implementing agencies. Two strategies can mitigate the risks associated with these payments, as elaborated:
  - » Payment guarantees: If the applicant (MSME) does not pay for the goods or services rendered, a payment guarantee gives the beneficiary (implementing agencies) financial security. This form of guarantee is particularly critical in international trade and high-value contracts where the credibility and reliability of parties can be difficult to ascertain. Sometimes, a payment guarantee helps protect the seller by acting as collateral to ensure they'll get paid later. These guarantees often cover the beneficiary up until the last day of the payment schedule and include a grace period to allow for any follow-ups if needed.

    This regime has been deployed in all solar and wind projects that are financed and tendered by SECI for DISCOMs. It is perceived that in a scenario where an MSME defaults, an independent M&V agency can be deployed to assess the situation and provide recommendations to disburse pending payments to the implementing agencies involved. Payment guarantees may not be favorable for the Programme as it can reduce the collection efficiency of implementing agencies and increase the overhead cost for the authority.
  - » Concessional agreement: A concession agreement is a contract between a government and an implementing agency (also known as the concessionaire) that grants the company the right to operate a business within the government's jurisdiction or on another firm's property, subject to specific terms. These agreements often include performance payouts, which are financial incentives tied to the achievement of specific performance targets.

    Key elements of concession agreements with performance payouts include the scope and duration, performance metrics, roles and responsibilities of all the parties involved, termination clauses, and incentives and penalties for failing to meet performance targets. This agreement has several benefits that lead to a surge in efficiency and accountability and further promote innovation. These types of agreements have been drafted by the NHAI for several projects across India. Herein, the exchequer may prefer to pay upfront, and annuity grants as a concession based on the perceived risk of MSME payment defaults that may vary from one cluster to another.

It is recommended that a tripartite concessional agreement with performance payouts be employed for the Programme implementation. This agreement will be signed between the Ministry of MSME, the implementing agency and MSME cluster SPV before executing any project under the levers identified in the roadmap. The concessional agreement will incentivise implementing agencies to improve collection efficiency, as annuity payouts will be linked to targets such as units of energy saved, emissions reduced, or revenue collected.

3.1.5 There are 2 ways in which these funds can be provided to implementing agencies:

(i) **Achievement linked periodic payments**: These payments are provided upon achievement of target KPIs, for example, Scope 1 GHG emissions intensity reduction from baseline, wherein the targets are set in line with global Science Based Targets (SBTi) standards. Once these targets are met by an MSME unit where an implementing agency is engaged, and the MSME unit defaults on payments, the NPMA can roll out the agreed-upon subsidy to the implementing agency.

(ii) **A hybrid model:** This involves part upfront and part annual payout linked to delivery targets (as described above) as set by the NPMA.

The funds required to remove the risk of payment defaults by MSMEs will be provided through the Credit-Guarantee Fund (8-9 %) under the MSME Credit Guarantee Scheme. 8-9 % of the fund value to be allocated specifically for the National Programme.

Box 7: MSME Credit Guarantee Scheme

The MSME credit guarantee scheme, approved on January 29, 2025, helps MSMEs secure term loans for machinery and equipment without collateral. It offers 60% guarantee coverage to Member Lending Institutions (MLIs) for loans up to Rs. 100 crore, through the National Credit Guarantee Trustee Company Limited (NCGTC). The scheme creates a self-financing guarantee fund combining MSME credit risks, with guarantees for loans over Rs. 100 crore. The term loan and guarantee cover under the MSME credit guarantee scheme will play a vital role in modernising the MSME manufacturing sectors by enabling MSMEs to invest in advanced infrastructure and technologies. This scheme will also help MSMEs grow and compete globally. As per the Budget 2024 speech, all MSMEs in the manufacturing sector requiring term loans to purchase equipment and machinery are eligible for the credit guarantee scheme. The government has yet to release the detailed guidelines for this scheme.

The MRV platform and online tool, as described in the MRV subsection of the report will be utilized to track the status of all projects that have been implemented or currently under implementation within the roadmap. The online platform will also contain the risk mitigation module, which will follow the guidelines of the Credit Guarantee Fund Trust for Micro and Small Enterprises (CGTMSE) to manage and facilitate any payment defaults.

Upon ratifying a trilateral agreement, a comprehensive database will be established on the Cluster SPV, its constituent MSME members, and the selected implementing agency. All the agreements that are mutually agreed upon will be adhered to including payments by the MSMEs to implementing agencies on achievement of specific KPIs. However, in an event that the MSME does not release the payment even when the specific KPI is achieved, the following redressal mechanism aligned with CGTMSE protocols will be activated:

- Implementing agencies are required to report the date on which the account for a particular MSME Cluster SPV was classified as Non-Performing Assets (NPA) within a calendar quarter. This information must be submitted through the designated option in the online system by the subsequent quarter.
- The cluster SPV database will include all member MSME units. In case of payment defaults, the classification of NPAs will be attributed to the specific units, which have defaulted on scheduled payments to the implementing agencies.
- The online platform will include a dedicated access for logging in and registering NPA details structured as follows: Member Login Area >> Guarantee Maintenance >> Periodic Information >> NPA Details).
- The lending institution may invoke the guarantee for a credit facility within a maximum period of 3 years from the date of the NPA classification or lock-in period, whichever is later.
- Specific guidelines for classification of any asset as an NPA will be issued at a later stage of the program's implementation.
- Accounts classified by the implementing agency as fraudulent/willful defaulters/non-co-operative borrowers shall not be considered eligible for claim settlement.
- Accounts that slip into NPA status within 90 days from the material date shall not be considered eligible for claim settlement.
- Claims submitted by the implementing agency will be settled to the extent of 2 times the fee including recovery remitted during the previous financial year. Any claim exceeding this threshold including recovery remitted should be suspended until the payout is brought within the cap limit.
- Upon submission of an eligible and complete claim by the implementing agency, the trust shall release 75% of the guaranteed amount within 30 days, provided the claim is found in order and complete in all respects. In case of delays beyond 30 days, the Trust shall pay interest on the eligible claim amount at the prevailing bank rate for the delayed period. The claim for the remaining 25% of the guaranteed amount can be claimed after the completion of 3 years from the settlement of initial claim. Once a claim is paid, the Trust shall be deemed to have fulfilled its obligations under guarantee for the respective borrower. However, implementing agencies require refunding any amount received from the borrower after the full guaranteed amount has been paid by CGTMSE.

- In the event of default, the implementing agency shall exercise its rights, if applicable, to take possession of the assets. Any amount recovered through the sale of such assets, or any other means shall first be credited in full by the implementing agency to the trust. Only thereafter may the implementing agency submit a claim for the remaining 25% of the guaranteed amount.
- The implementing agency shall be liable to refund the claim released by the Trust along with penal interest at the rate of 4% above the prevailing bank rate, if such a recall is initiated by the trust.
- Implementing agencies will have option to opt for a single instalment claim settlement with reduced guaranteed coverage of 15% in cases where legal action has been waived. For example, if the original guaranteed coverage was 75%, the reduced coverage would be 60%; for 80% it would be 65% and so on.

A more detailed mechanism of the risk mitigation will be outlined with the model documents that will be prepared by the NPMA at later stages of National Programme's implementation. It is recommended that stakeholders adhere to web application user guide created for the National Credit Guarantee Trustee Company (NCGTC).

Figure 8 provides the workflow of the National Programme from inception and selection of MSME cluster to Monitoring Reporting and Verification (MRV) mechanism:

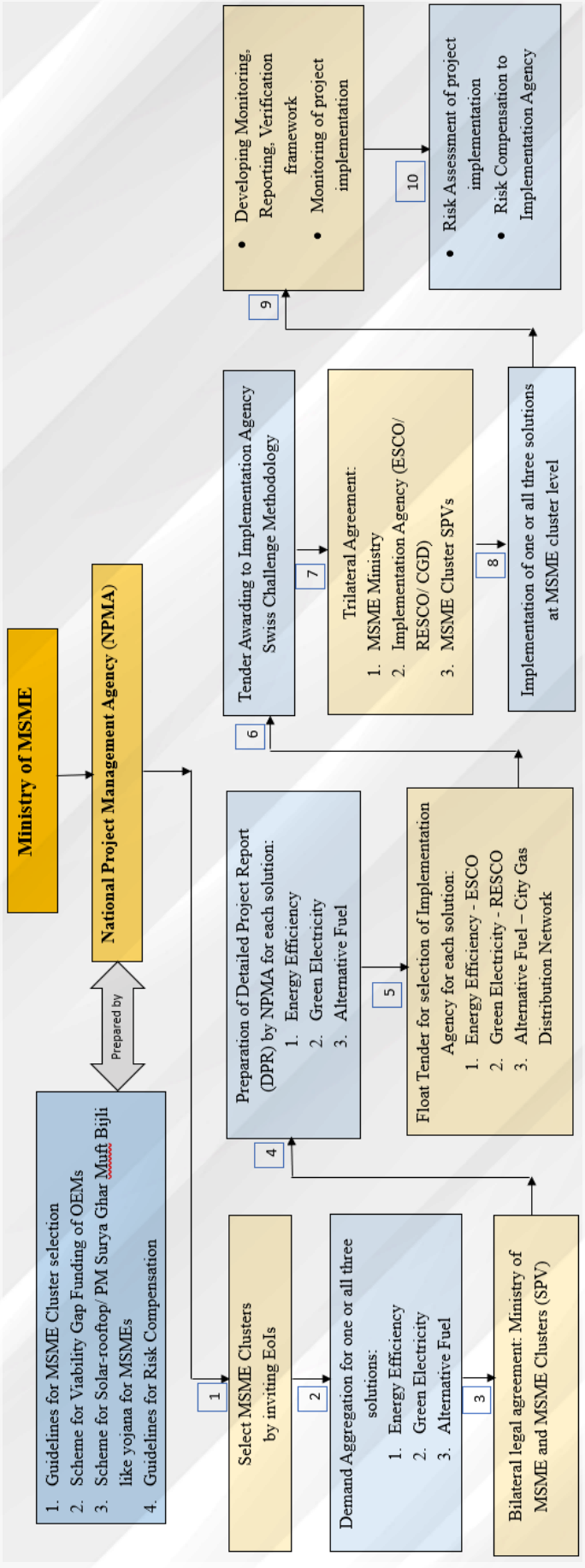


Figure 8: Proposed flow for the implementation of green transition across MSME clusters

For an effective uptake and robust mechanism, NPMA may look at the following specific tasks under different pillars of the Green Transition Roadmap (Figure 9):

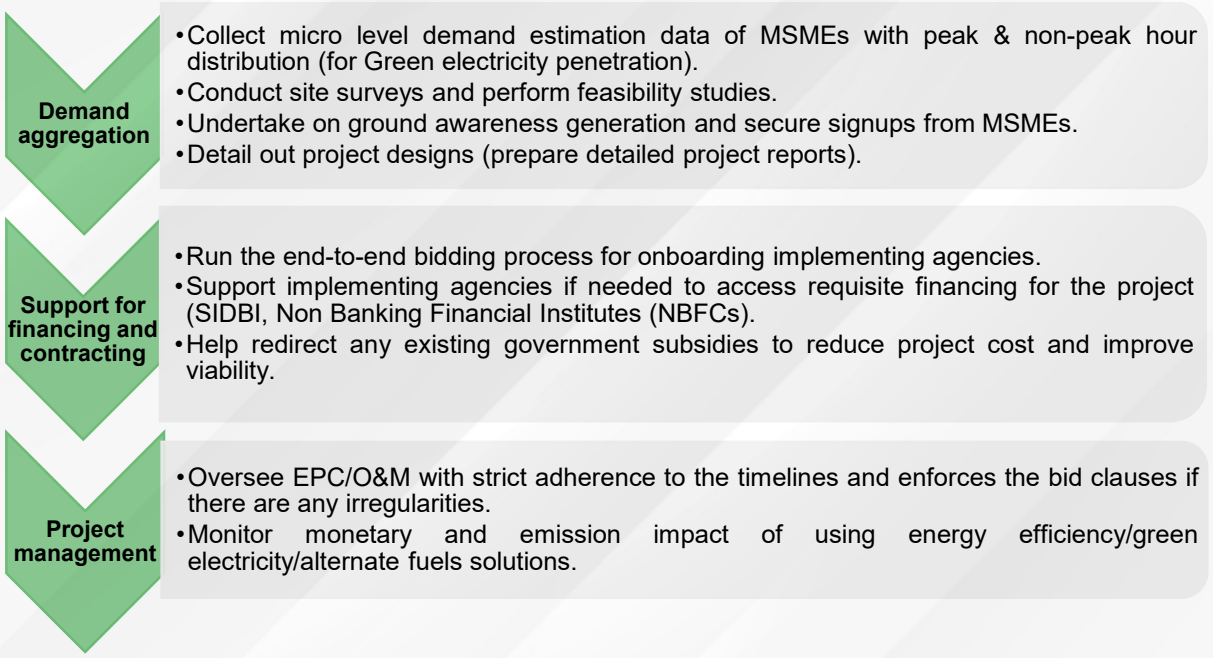


Figure 9: Specific tasks for NPMA to enhance the efficiency and outreach of the National Programme

Roadmap for Implementation of the Programme:

Table 4: Roadmap for implementation of the Programme

Phase	Phase 1	Phase 2	Phase 3
Timeline	2025-2030	Only upon successful implementation of Phase 1; 2030-2032	Only upon successful implementation of Phase 2; 2032-2035
Responsible agency	NPMA	NPMA	NPMA
Agencies to be consulted	MSME cluster associations MSME DFOs in states to be galvanized for demand aggregation and capacity building exercises. Interministerial Committee, State Committee.		
Key activities by Ministry of MSME	• Target shortlisted clusters for energy efficiency and green electricity for implementation • Galvanize cluster associations/ MSME DFOs/ DICs to get more MSME participation from the cluster through focused awareness programs. • Empanel NPMA to drive the green transition effort • Disburse concessions based on achievement of target KPIs (MtOe saved through energy efficiency measure, units of green electricity produced) for payment defaults through Credit Guarantee Scheme		

- **Phase I will focus on MSME clusters identified** for implementation in the later sections of the report. These clusters have been selected based on findings from reports on 'Energy and Resource Mapping of Bricks, Foundry, Pharma, Textile, Leather, Chemical, Glass, and Paper Subsectors' sectoral roadmaps for MSMEs from the years 2021-2023. These selections are based on key criteria including energy consumption, employment generation, export orientation, and potential for green transitioning.
- **Phase II will expand the focus on the remaining 170 high-energy intensive clusters** as defined by BEE. These clusters contribute significantly to India's manufacturing GDP and will be targeted after the successful implementation of green transition in the 20 odd clusters identified under Phase I. This phase will also include other moderately energy-intensive MSME sub-sectors including glass, food processing, glass, leather, chemical and fertilisers, pharmaceuticals and the other lower emission intensive clusters for textiles, paper, forging, foundry and steel re-rolling.
- **Phase III will include smaller MSME clusters** that may contribute less to national manufacturing output but hold substantial regional significance. Inclusion of these sectors is essential to ensure holistic decarbonisation of the MSME sector.

4. Recommendations

4.1 Recommendations for Enhancement of Energy Efficiency

When it comes to quick and affordable ways to mitigate carbon emissions, reduce energy costs, and improve energy security, energy efficiency is referred to as the "first fuel" in clean energy transitions. It has been estimated that in the next 10 years, while the Programme is in force, the overall GHG emissions reduction potential through the application of energy efficiency lever is around 36 $MtCO_2e$ of carbon emissions, and a potential to impact around 17 million MSME units. Five key subsectors, namely **textiles, paper, steel re-rolling, foundry and forging**, can contribute significantly towards this reduction potential and have been identified for immediate action. 10 MSME clusters from these subsectors have been identified (Table 5) to reduce around 12 $MtCO_2e$ (around 33% of the total reduction potential identified). These clusters have been shortlisted based on high emissions reduction potential, high export orientation, strong cluster association presence and influence, and homogenous nature of the clusters to increase scale. More details are provided in Annexure 5.

Table 5: Emission reduction and investment potential in 10 MSME sectors across India due to enhancement of energy efficiency

S. No.	Cluster/ Locations	Sectors	Energy consumption (in MtOe)	Current emissions (Mt)	Reduction potential (Mt)	Investments (in Cr.)
1	Surat	Textile	2.95	11.15	6.35	7,837
2	Bhiwandi	Textile	0.40	3.79	2.16	2,664
3	Vapi	Paper	0.32	1.16	0.13	370
4	Tirupur	Textile	1.30	0.98	0.56	692
5	Jalna	Steel Rerolling	0.25	2.2	0.48	644
6	Ludhiana	Textile	0.34	0.52	0.30	365
7	Morbi	Paper	2.95	2.41	0.28	433
8	Mandi-Gobindgarh	Steel Rerolling	0.25	1.3	0.29	400
9	Raipur	Steel Rerolling	0.18	1.13	0.24	331
10	Coimbatore	Forging	0.06	0.46	0.12	209
Total			**8.99**	**~25.1**	**~12.0**	**14,639**

4.1.1 Primary Approach:

The **Energy Service Companies (ESCOs) provide a robust ecosystem** for MSMEs to adopt energy efficiency. ESCOs offer zero-investment, risk-free models that are tailored for cash-strapped MSMEs to implement energy efficiency solutions on a Pay-As-You-Save (PAYS) payment model. The existing business models in the ESCO markets have been provided in Annexure 6.

The PAYS model, which has been largely employed by ESCOs, is elaborated in Figure 10:

(i) ESCOs initiate by conducting energy audits at the MSME unit(s). These are detailed surveys conducted by a certified energy auditor to determine the amount of energy a building uses and identify ways to reduce energy consumption.

(ii) Once the audit recommendations are made, the ESCO purchases energy-efficient equipment from OEMs and sells it directly to MSMEs who agree to implement the recommendations.

(iii) MSMEs who purchase the energy-efficient equipment do not have to pay any upfront capital cost for the technology being offered. The ESCOs charge the MSMEs based on shared savings models, wherein a monthly instalment is released for services rendered by ESCOs in terms of savings obtained in monthly electricity and energy bills, and have a usual payback of 2-4 years.

(iv) The ESCO provides additional after-sales services and warranties on the product that are directly obtained from the Original Equipment Manufacturers (OEMs).

(v) The regulatory authorities rate the products and services of the OEMs to instil a sense of trust in the whole ecosystem and provide policy measures to the MSMEs to encourage uptake of energy efficiency technologies.

(vi) ESCOs also drive awareness creation, project design, and implementation of energy efficiency technologies.

(vii) Financial institutions are the other part of the regime that provides finances to the ESCOs to meet their business requirements.

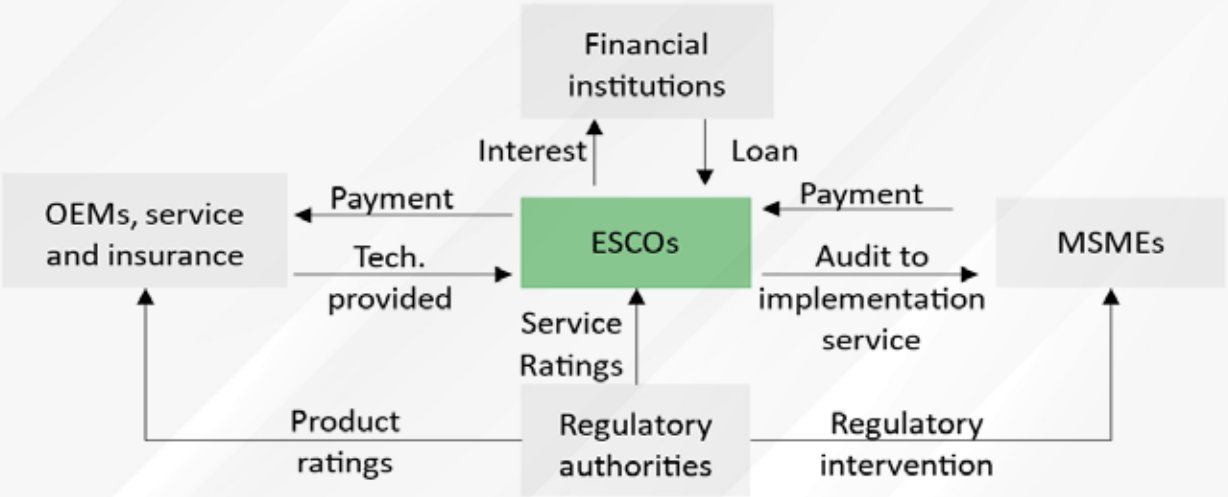


Figure 10: ESCO-MSME business model

However, the model has not seen the growth it was supposed to deliver due to several reasons, both on the supply as well as demand side of the technology. The 'no upfront investment' models are attractive for MSMEs

to adopt; however, risk perceptions about MSMEs' ability to generate reliable cash flows often mean that these haven't taken off as expected. The ESCOs and OEMs tend to avoid working with MSMEs due to their lower-than-expected credit ratings. A brief of the issues is outlined in Figure 11:

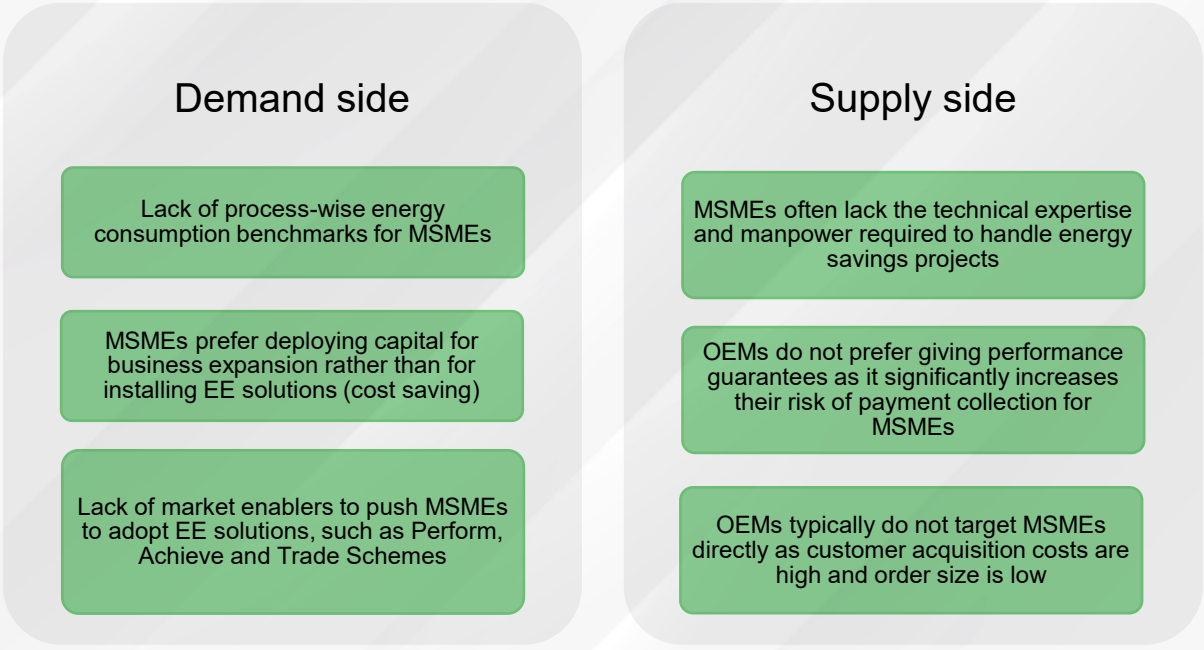


Figure 11: Problems in implementation of MSME-ESCO business model (Source: Expert Interviews)

To enhance energy efficiency in MSME clusters, the application of this lever will be done in 2 ways:

A. **Demand side**

To maximise the enhancement of energy efficiency in MSMEs on the demand side, it is pro\posed that NPMA facilitates the implementation. The procedure for its implementation will be as the description provided in the institutional mechanism chapter. The step-by-step procedure and details on a few specifications for an effective enhancement of energy efficiency on the demand side will include-

(i) NPMA identifies MSME clusters with EE potential through Expression of Interest (EoI) and subsequent demand aggregation, capacity building, bilateral agreement, and Detailed Project Report (DPR) creation, with elaborated steps mentioned in the institutional mechanism chapter under the administrative support subsection.

(ii) ESCOs are selected based on the two-stage bidding regime as specified in the institutional mechanism chapter under the implementation subsection.

(iii) ESCOs will employ the PAYS model under the National Programme.

(iv) Once the bidder has been selected, a service agreement must be signed between the MSME cluster SPV and ESCO on mutually agreed terms and specifics, including equipment to be supplied, retrofitting schedule, expected savings, etc. A tripartite concession agreement, is also signed thereafter between the Ministry of MSME, cluster SPV, and selected ESCO, and will follow the guidelines for risk mitigation and disbursement of specific funds as mentioned in the institutional mechanism chapter under the project monitoring and risk aversion subsection.

Considering that demand aggregation may not be carried forward in a cluster due to several reasons, individual MSME units can also adopt energy efficiency and avail subsidies from the Central Government under the RAMP-Sustainable (RAMP-S) programme. The Programme envisions providing a capital subsidy to individual MSMEs to encourage the adoption of energy-efficient technologies. These technologies will be made available at affordable rates within industrial clusters and include community boilers, centralized air conditioning or refrigeration systems, greywater recycling units, material recovery facilities (MRFs), and desalination or demineralisation plants. Upto 15% capital subsidy on the system cost will be offered to support the deployment of such technologies for both individual and community-level facilities. This will assist in resource efficiency through cost sharing by leveraging the success of schemes like GIFT, SPICE, and CLCS.

B. **Supply side**

Several emerging as well as new energy efficiency technologies currently operating at lower Technology Readiness Levels (TRL) or haven't seen much uptake in the country due to high capital costs. To acquire these technologies, customers must pay an additional amount (including marketing charges, duties, etc.). These extra expenses usually make low-emission alternatives more expensive than their conventional counterparts, particularly in the early stages of the market. Technologies that have a high potential for energy savings and equivalent emission reduction need rapid adoption among the five high-energy and emission-intensive MSME subsectors to magnify the green transition journey. The Programme recommends a Viability Gap Funding (VGF) mechanism directly credited to the Original Equipment Manufacturers (OEMs) for significant uptake of these technologies. Bureau of Energy Efficiency (BEE), in close consultation with the Ministry of MSME, will shortlist 5-7 emerging technologies that can provide enhanced energy savings (more than 20% from the current equipment) if applied across the five energy-intensive MSME subsectors. The VGF scheme aims to support this manufacturing project which is economically justified but falls marginally short of financial viability. Support under this scheme is available only for OEMS selected through a competitive bidding. The total VGF under the scheme does not exceed 15 percent of the total project cost. The details for the VFG scheme will align with the VGF scheme under Invest India.

Box 8: VGF Scheme

Process for Availing VGF:

- Proposal submission: The government or statutory entity must submit a project proposal containing all requisite information.
- Model document preference: Projects based-on model documents would be preferred over standalone documents.
- Eligibility criteria: Empowered Institutions (EI) may seek required details for satisfying eligibility criteria.
- Eligibility notification: The EI will inform the sponsoring government/statutory entity whether the project qualifies for financial assistance within 30 to 60 days.
- Referral to Empowered Committee: The EI may refer the case to an Empowered Committee (EC) for further clarity on eligibility.
- Approval and implementation: Approved projects will be implemented in accordance with procedures notified from time to time.

Eligibility Criteria:

- Sponsoring authorities: PPP projects may be proposed by central ministries, state governments or statutory authorities (like municipal corporations and councils) that own the assets.
- Private sector implementation: Eligible projects must be developed, financed, constructed, maintained and operated by a private sector selected by the government or a statutory entity through a transparent and open competitive bidding process.
- Bidding criterion: The primary criterion for selection should be the amount of VGF required by the private company assuming all parameters are comparable.
- User charge requirement: The project must deliver a service against payment of pre-determined tariff or user charge.
- Private sector mandate: This scheme applies only if the contract/concession is awarded to a private sector company.
- Approval and disbursement: Projects approvals must take place prior to invitation of bids, while actual disbursement takes place after the private entity has contributed to the equity share.
- Final VGF amount: The final VGF support is determined through a bidding process.

Through the VGF scheme, the Programme envisions developing a robust manufacturing capacity of innovative energy efficient technologies in the country with specific incentivisation for domestic manufacturing and technology sourcing. Considering how battery energy technologies and Electric Vehicles (EVs) have exponentially penetrated the Indian markets after the introduction of FAME and PLI-ACC schemes, the roadmap envisions similar provisions for the rapid indigenisation of innovative energy-efficient technologies that are currently sourced from international markets. The roadmap recommends a government outlay of Rs. 6,000 crore (Annexure 6) that facilitates the sourcing of innovative energy efficient technologies and scaled across the MSME clusters by leveraging the demand side

of energy efficiency enhancement. Approximately 19,283 units from top 5 energy-intensive MSME subsectors are being targeted under Phase I for the deployment of emerging energy efficiency solutions. The following are the recommendations for an effective uptake of emerging and innovative energy efficient technologies:

(i) BEE to regularly publish a list of decarbonisation technologies that have the potential to scale and define the subsidies that may be given to OEMs developing the technologies.

(ii) OEMs to get their products tested with designated testing agencies as onboarded by BEE and to provide proof of sale and service to NPMA to avail the subsidies under VGF.

(iii) The NPMA must verify the proof of sale to Udyam-registered MSME units before disbursing suggested subsidies.

(iv) It must be noted that the proposed subsidy and funds do not aim to support emission reductions covered under the Carbon Credit Trading Scheme, as those technologies are already proven, commercially viable, and can be mandated. These are hereafter called Best Available Technology (BAT). The present fund focuses on facilitating and manufacturing technologies that go beyond BAT, which can help India accelerate towards its net-zero goal.

Recommendations for the effective uptake of EE in MSME clusters:

(i) Establish a consortium consisting of members from BEE, Niti Aayog and Ministry of MSMEs to classify proven and emerging technologies.

(ii) Certify OEMs and associated energy efficiency equipment.

(iii) Extending energy audits, DPR creations, MRV etc. support under the ADEETIE Scheme to the National Programme. It must be noted that the MSME units cannot claim dual benefits under any overlapping provisions of the ADEETIE Scheme and the National Programme. By closely working with Ministry of Power and BEE, NPMA will monitor the beneficiary MSME units under both the schemes to avoid any duplicity in availing the benefits.

4.1.2 Secondary Approach:

While the primary approach outlines specific activities across 10 initial export-oriented clusters identified and top 5 energy intensive subsectors in the MSME space, there are many MSMEs outside of these spaces that are also looking at energy transition and require additional hand holding support for a green transition. Specifically, small and medium enterprises (SMEs) are well positioned to initiate a green transition in their facilities. These SMEs are highly energy intensive when compared with their micro counterparts, and are also looking at alternative and efficient forms of technologies to ramp up their businesses for ease of compliance, sustainability and progress. Through this approach, all Udhyam registered SMEs will be targeted for reduction in specific energy consumption by at least 20% from the baseline by using high energy efficient equipment (boilers, heat pumps, motors, waste heat recovery systems, energy monitoring systems, heat exchangers, rolling, milling, cooling devices etc.). This approach will be governed by the Ministry of MSME. The implementation of this approach will be carried out as follows:

(i) **Technologies to be covered:** The identification and selection of energy efficient equipment or technology to be covered under this approach will be carried out by BEE and Ministry of MSME. While technologies could differ from one SME to another, and one subsector to another, the overall aim would be to reduce the energy consumption by a factor of atleast 20%. The SMEs must aim and identify technologies that will result in the stipulated reduction to avail the benefits of the scheme. The technology could be a standalone technology or a group of technologies that result in the achievement of the target. A detailed list of the technologies covered, and their Original Equipment Manufacturers (OEMs) will be published during the National Programme implementation.

(ii) **Disbursal of Subsidies:** The subsidies to be provided under this approach will either be available directly for the SMEs employing these technologies or to the OEMs supplying the technology. It will be available to the SMEs in form of financial incentive or a capital subsidy, or as Production Linked Incentive (PLI) to the OEM. The PLI will result in reduction of manufacturing costs for the OEMs, and this benefit will directly be passed on to the SMEs buying it.

(iii) **Qualification:** SMEs registered on the Udyam portal can only apply for benefits under the said approach. Preference will be given to the highest energy intensive and polluting SMEs present in any region. The selection of SMEs under the approach will be governed through a qualifying criteria basis, for which details and guidelines will be shared by the Ministry of MSMEs at later stages of implementation.

(iv) **Energy Audit-** The implementation of this approach for SMEs necessitates both pre-audit (baseline) and post-audit (verification) assessments. These audits will serve as critical mechanisms to ensure that investments in energy efficiency technologies and process improvements yield measurable and verifiable energy savings. The pre audit will establish a baseline for current energy consumption patterns within the SME, identify energy inefficiencies, overconsumption areas, and losses. It will also quantify technical and economic feasibility of proposed energy-saving measures. The post audit will not only validate and verify energy savings after implementation, but also assess the technology effectiveness to determine performance versus planned energy savings and identify corrective measures if savings fall short.

(v) **Budgeting:** A sum of INR 6000 crore has been allocated for the implementation of this approach. Any SME who installs a listed energy efficient equipment under this approach will be eligible for a maximum capital subsidy of upto 15% on the total cost of the requisite plant and machinery for a period of maximum 5 years. The approach will be implemented for a period of 5 years and will be considered for an extension only on an effective turnaround and high interest show from the SMEs during the initial 5 years.

4.1.3 Impact of proposed recommendations

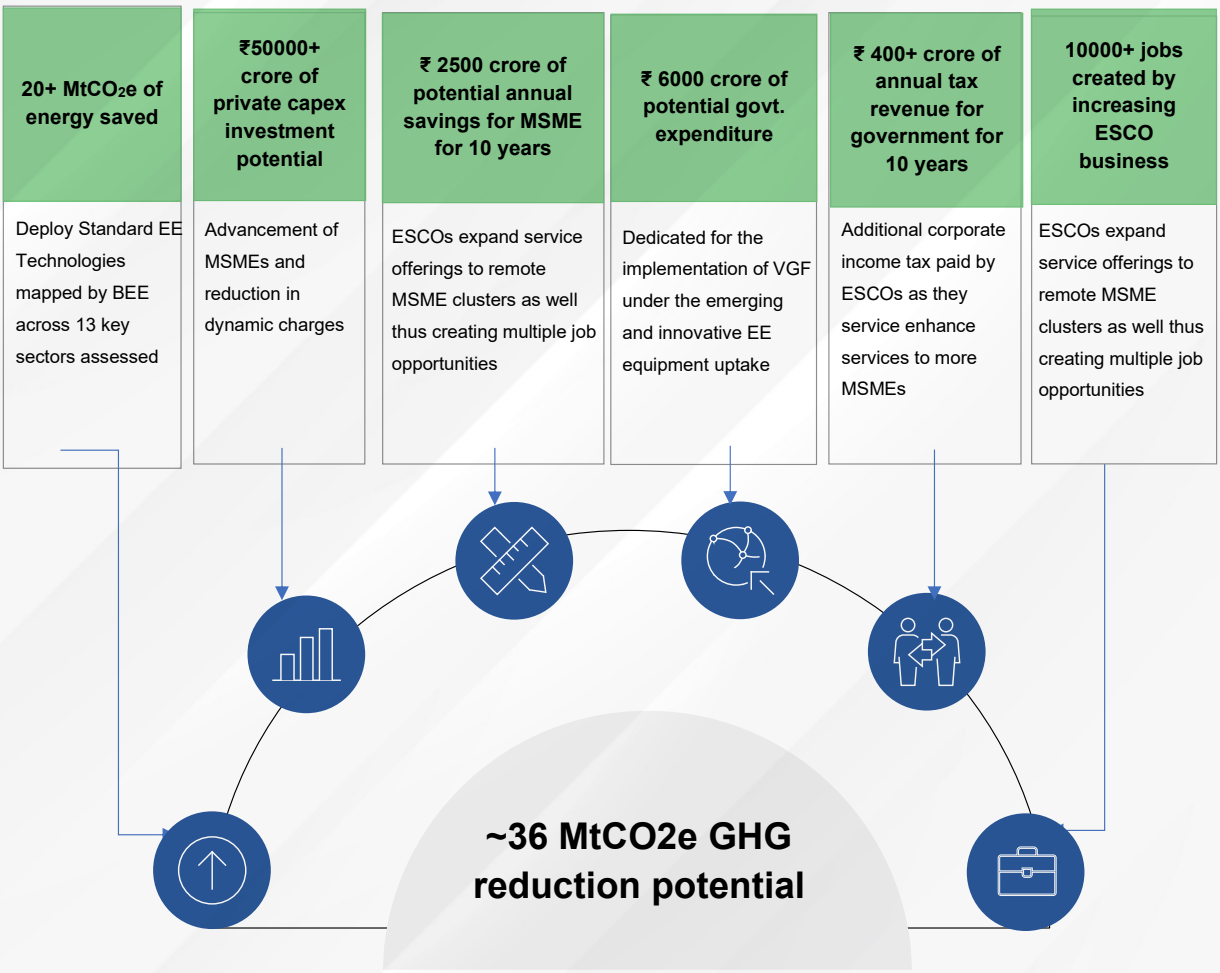


Figure 12: Impacts of proposed recommendations

4.2 Recommendations for Uptake of Green Electricity

Green energy technologies, including solar, wind, geothermal, biomass, and hydroelectric power, are common sources of green electricity. MSMEs can adopt electricity generated from these green sources, that will lead to their green transition. There are several ways in which MSMEs can adopt green electricity, which have been described in the following sections. It has been estimated that during the Programme, the overall emissions reduction potential as MSMEs adopt green electricity will be 27-36 Mt over the next 10 years, with a potential to impact around 16 million MSME units across the country. The top 10 electricity-intensive clusters have been identified for immediate action in the first phase of implementation, which have a GHG emission reduction potential of around 12.9 $MtCO_2e$ (around 37% of emissions reduction potential under green electricity lever). Annexure 7 provides insights on the calculations performed in Table 6.

Table 6: Emissions reduction and investment potential in 10 MSME sectors across India due to green electricity adoption

S. No.	Clusters /Locations	Sub-sector	States	Current electricity consumption (mtOe)	Solar capacity required in MW (approximate)	Emission reduction potential, (million tonnes)
1	Bhiwandi	Textile	Maharashtra	0.4	1764	3.8
2	Jalna	Steel rerolling	Maharashtra	0.21	922	2
3	Jagadhri	Foundry	Haryana	0.2	882	1.9
4	Surat	Textile	Gujarat	0.14	631	1.3
5	Muzaffarnagar	Paper	Uttar Pradesh	0.12	545	1.2
6	Rajkot	Forging	Gujarat	0.1	451	1
7	Tirupur	Textile	Tamil Nadu	0.07	288	0.6
8	Ludhiana	Foundry	Punjab	0.06	243	0.5
9	Jamnagar	Steel rerolling	Gujarat	0.04	154	0.3
10	Coimbatore	Textile	Tamil Nadu	0.03	150	0.3
Total				**1.37**	**6031**	**12.9**

4.2.1 **Primary Approach:**

MSMEs have several avenues in India by which they can access green electricity. NPMA, in its sole discretion, can choose the most convenient and effective way through which an MSME cluster can adopt green electricity. The various ways of adopting green electricity have been elaborated as follows:

(A) **The Behind the Meter (BTM) RESCO model and/or Green Open Access:** This model for adoption of green electricity allows the MSME customers to obtain:

- A part of the electricity requirements through locally installed renewable energy plants, particularly rooftop or ground-mounted solar plants, while sourcing the balance electricity from the grid.

OR

- Sourcing all electrical needs through renewable energy plants present anywhere in the country via the Green Open Access (GOA) rules, 2022.

(i) **Behind the Meter (BTM) model-**

The BTM model provides an avenue for MSMEs to source part of their electricity through locally installed renewable energy plants in the form of rooftop or ground-mounted solar installations. Two financing models for BTM solar adoption are provided in Figure 13:

Aggregated Asset Finance (Capex)	Build, Operate, Transfer (Opex)
• MSMEs finance the setting up of RE plants in their vicinity. • Captive RTS has been the most go to technologies; and projects generate around 20% Internal Rate of Return (IRR) on average on a BTM setup. • Micro and Small units may require credit enhancement to access loans for capex requirements for asset installation. • While around 90% of MSMEs fall under <100 kW load category and hence miss out on the advantages of demand aggregation by not negotiating on better pricing.	• MSMEs adopt RE (specifically solar) through RESCOs. • The potential landed RTS tariff has been found between Rs. 3.8-6.5 per unit while DISCOM tariff ranges between Rs. 5.6 to 9.9 per unit depending on location, thus being an attractive proposition for the MSMEs. • RESCOs have been found to be reluctant in working with MSMEs due to perceived risk of default and may require risk mitigation mechanism to incentivise them.

Figure 13: Comparison between capex and opex models of BTM adoption

While both models give considerable savings (capex model giving Rs. 3-4 per kWh vs 2-3.5 per kWh for opex model) (Deloitte 2019), opex model will be the preferred mode for driving the Programme under this lever. Operations under the capex model can be adopted on a case-by-case basis and have been provided in the forthcoming subsection.

To increase BTM plant penetration in MSMEs under the opex financing model through Renewable Energy Service Companies (RESCO), the Programme proposes a mechanism similar to that suggested for the demand-side energy efficiency application lever:

- NPMA identifies MSME clusters with green electricity potential through Expression of Interest (EoI) and subsequent demand aggregation, capacity building, bilateral agreement, and Detailed Project Report (DPR) creation, with elaborated steps mentioned in the institutional mechanism chapter under the administrative support subsection.
- RESCOs are selected based on the two-stage bidding regime as specified in the institutional mechanism chapter under the implementation subsection.

- RESCOs will employ the Rent-A-Roof model under the National Programme.
- Once the implementing agency is selected and DPR is prepared, State Electricity Regulatory Commissions (SERCs) can be approached by NPMA/RESCOs to set the Power Purchase Agreement (PPA) prices at which MSMEs will purchase electricity from RESCOs to protect all stakeholders involved (DISCOMs/RESCOs/MSMEs). The same can be finalised by the respective SERC before the finalization of tripartite concessions agreement between the MSME cluster SPV, the Ministry of MSME and RESCO (implementing participant). Alternatively, Rs. 3.50 per unit discovered in RAMP-S transition to green electricity projects (aggregation model) can also be opted for based on mutual agreements between the SERC, NPMA, selected RESCO, and the Ministry of MSME.
- Once the bidder (RESCO) has been selected, a service agreement must be signed between the MSME cluster SPV and RESCO on mutually agreed terms. This agreement will also include specifics of equipment to be supplied, schedule of retrofitting, expected savings, etc. A tripartite concession agreement is also signed thereafter between the Ministry of MSME, cluster SPV and selected RESCO, and will follow the guidelines for risk mitigation and disbursement of specific funds as specified in the institutional mechanism chapter under the project monitoring and risk aversion subsection.
- Figure 14 elaborates on the opex BTM Model for green electricity adoption in MSMEs:

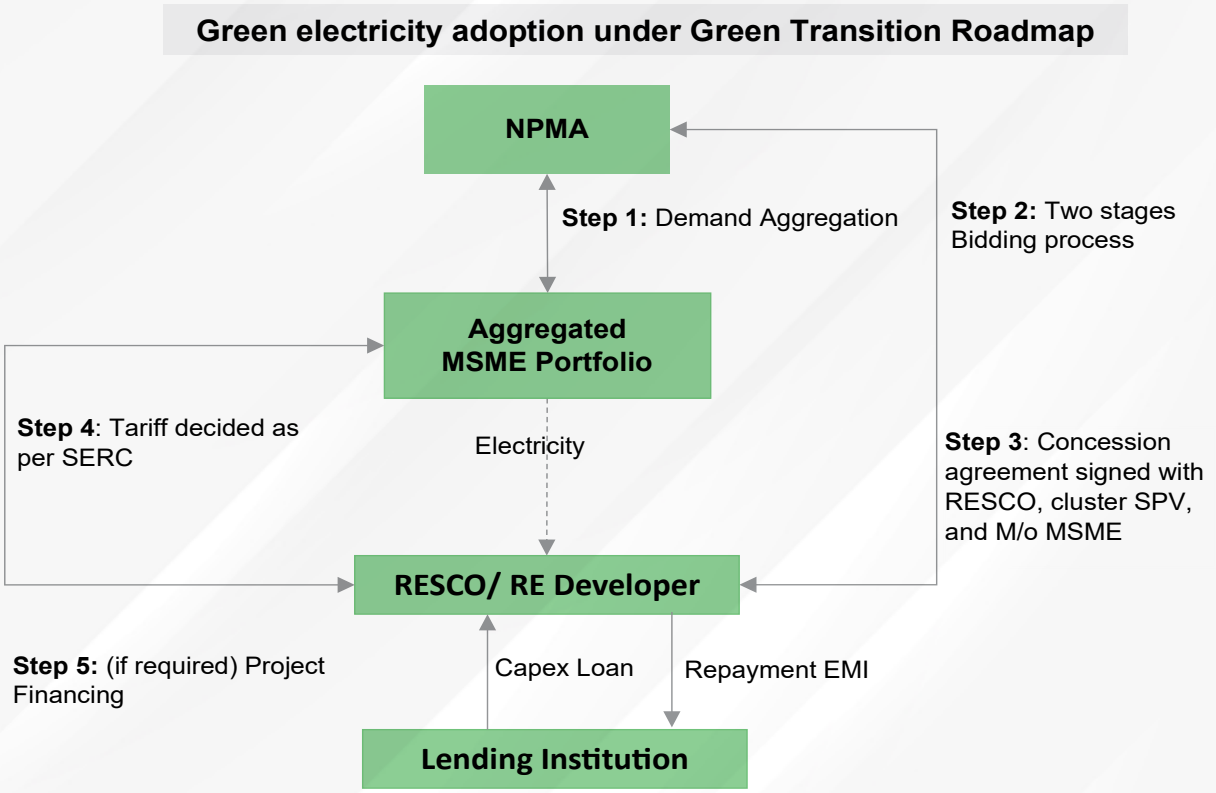


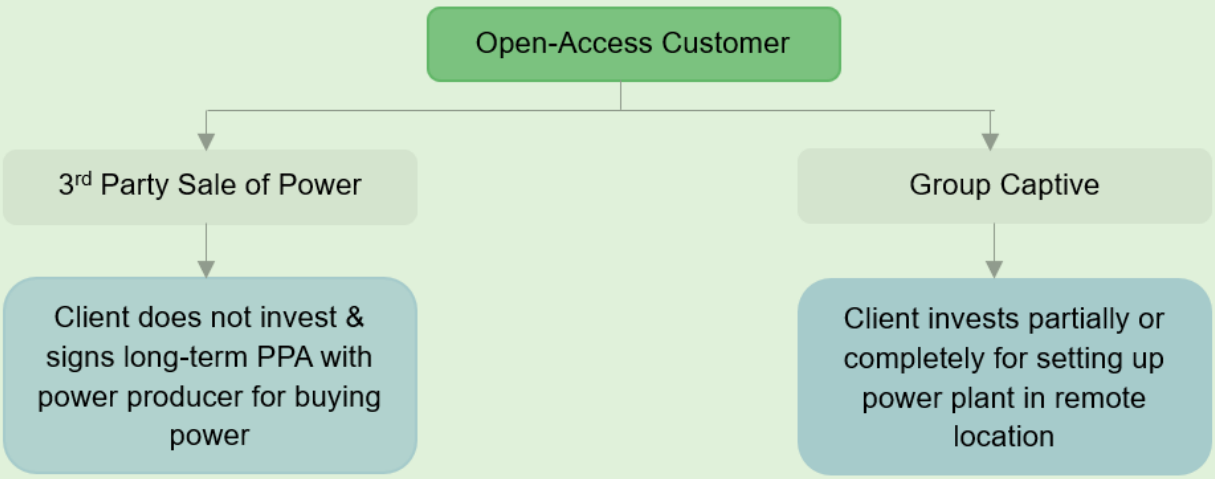
Figure 14: Opex BTM model for green electricity adoption in MSMEs

(ii) **Green Open Access**

The Green Open Access Rules (GOA), 2022 were notified in June 2022 to promote generation, purchase, and consumption of green electricity, through open access. GOA registry is a transparent platform through which long-term, medium-term and short-term open access transactions will be managed and performed on both interstate and intrastate transmission systems. This platform is accessible to all the stakeholders present in the Indian power market. MSMEs can opt for green electricity under the said rules if their connected load (or the total of all loads across several MSMEs) is equal to or greater than 100 kW.

Box 9: Development of open access regime in India

Open access to power was first incorporated in the 2003 Electricity Act to encourage competition and raise the standard and dependability of the power supply. To accelerate the expansion of India's renewable energy (RE) projects, the Ministry of Power notified the Electricity (Promoting RE through green electricity open access) Rules, 2022 on 6 June 2022. These regulations permit consumers with connected loads greater than 100 kW to participate in open access to RE through a variety of means, such as installing their own RE plant or signing a Power Purchase Agreement (PPA) with an RE developer, or establishing a captive power plant. As the GOA regulations evolve, industrial and commercial consumers can benefit significantly from increased opportunities to adopt green energy. Notably, a key amendment allows consumers with an aggregate demand of at least 100 kW, spread across multiple connections at different locations within a defined operating area, to pool their demand and become eligible for open access to green energy sources. Green Open Access can be of two types. (MERCOM 2023)



The Group Captive model is highly capex-intensive and may involve leasing/ purchasing land for setting up the renewable energy plants, and thus can be unattractive for MSMEs given their tight financial situations. While third-party open access offers a promising route for MSMEs to adopt green electricity, the model has

not seen much adoption from these consumers since they do not come forward and seek GOA on aggregated demand due to a lack of awareness. NPMA will facilitate the application of GOA for selected MSME clusters under the said lever, based on requirement and interest.

(B) **PM Suryaghar like initiative for MSMEs:**

(i) The Programme recommends the creation of PM Surya Ghar Muft Bijli Yojna (PMSGY) (PIB 2025b) like scheme for the MSMEs. Currently, PMSGY is the world's largest domestic rooftop solar initiative, and is transforming India's energy landscape with a bold vision to supply solar power to one crore households by March 2027. It aims to provide free electricity for households, reduce electricity costs for the government by promoting the widespread use of solar power, increase the use of renewable energy, and reduce carbon emissions. MSMEs, specifically the micro and few small units, need additional support for adopting solar rooftop installations on their available rooftops and a provision of subsidy is envisioned to maximise uptake among these users. The subsidy provided for installation will follow the domestic consumer pattern for every increase in kW up to a maximum of 3 kW, and the intervention aims to benefit approximately one-fourth of all the MSMEs registered in the country. The outline for the recommendations is as follows:

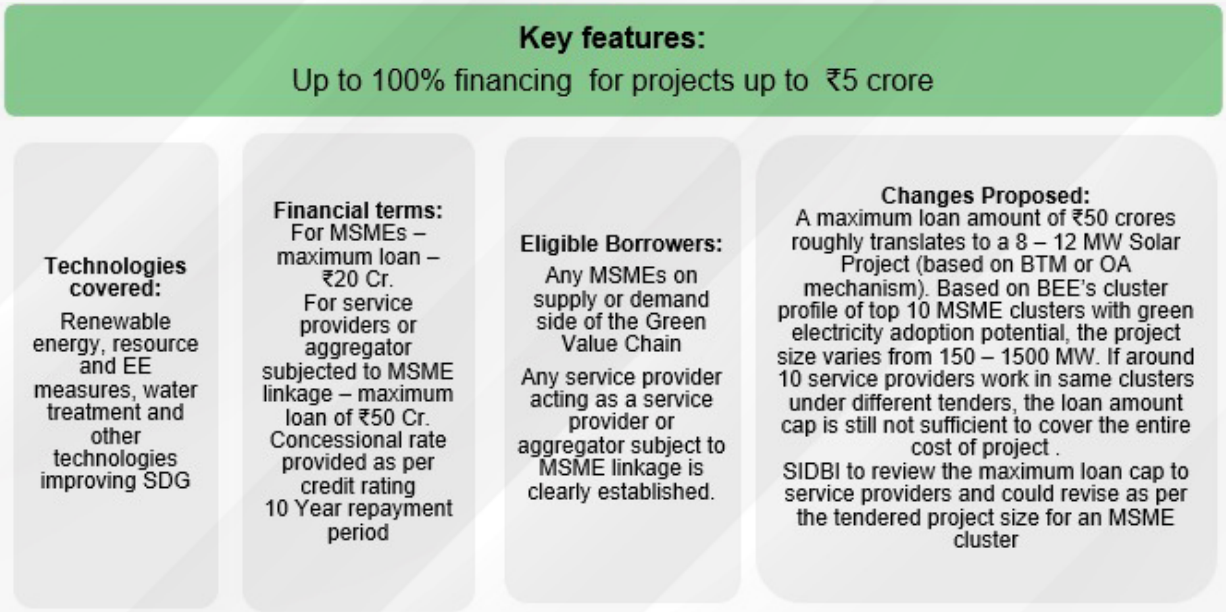
(ii) It is assumed that MSMEs lack the necessary funds to implement such projects. Therefore, it is proposed that subsidies are directly disbursed to MSME units, particularly in cases where RESCO-led demand aggregation under the BTM model, Green Open Access or green tariff mechanisms have encountered implementation challenges.

(iii) The subsidy mechanism should only be implemented where earlier solutions provided under the green electricity interventions have failed to achieve the desired impact.

(iv) The scheme will require financial support from the government in terms of capital subsidy for each solar rooftop installation. The total expected outlay is estimated at Rs. 28,672 crore over a 20-year period, based on the projected capex of INR 21,109 crore. In phase I, over the next 5 years, Rs. 7,000 crore have been allocated to support MSMEs with solar rooftop adoptions. Detailed calculations and assumptions considered supporting this estimate have been provided in Annexure 8.

(v) Subsidy levels are structured as follows: a 1 kW system will receive Rs. 16,040; systems up to 2 kW will get Rs. 48,120, and systems up to 3 kW will receive Rs. 80,200.

To drive the adoption of PMSGY like scheme for MSMEs, which adopts the capex financing model, the Programme proposes a similar model of implementation as suggested for BTM solution under the RESCO model. The demand aggregator i.e. the NPMA can follow transparent bidding process to identify vendors that provide the aggregated demand of a RTS at the lowest prices. Further, to ease the access to finance for the MSMEs for financing these projects, the following changes are also proposed to SIDBI's Green Loan scheme (SIDBI 24b):



- The subsidy offered to MSMEs under initiatives like the PMSGY, is intended to cover micro and small units that have limited rooftop space, and were unable to adopt any of the previously recommended green solutions due to unforeseen circumstances. To prevent misuse of the subsidy, a cap on the maximum connected load for the MSMEs could be introduced.
- The subsidy will be provided only when the demand is aggregated under the capex model. Individual units applying for the subsidy outside of aggregation will be evaluated on a case-by-case basis.
- Specific guidelines and detailed procedural measures for initiatives like the PMSGY under the roadmap, will be issued at the later stages of implementation.

4.2.2 Secondary Approach:

A sizeable number of micro units exist in the country. These units are very important considering the entire product value chain and provides for crucial parts and operations without which the operations of the larger small, medium and large industries cannot be sustained. Considering the importance of these units, the specific approach calls for the extension pf PM Suryaghar yojana to the micro units, or a new scheme that subsidies the adoption of RTS plants by micro units. This will provide inclusive access to renewable energy since these units lack the financial or roof space resources to adopt large solar installations and extension of subsidy to these units ensures equitable access to clean energy solutions. It will also promote decentralization of energy generation, enhance energy security and reduce transmission losses in urban clusters and remote or under-served areas. This will also provide support for low-cost, scalable installations to micro units, who are oftenly neglected while planning for energy transition. The approach will be implemented by the Ministry of New and Renewable Energy. The details of the scheme are provided as follows:

(i) **Reach:** The subsidy amount will only be available to the Udyam registered micro units. The subsidy will only be available upto 3kW of RTS systems that are installed on these units. Micro units usually have connected loads between 1-30 kW and RTS can effectively reduce their electricity requirements. The subsidy will act as an additional mauver that increases interest of micro units towards adoption of RTS systems.

(ii) **Empanelment of Vendors and Development of user-friendly interface:** The RTS adoption in micro units through subsidization will follow the residential model currently being implemented under the PM Suryaghar Yojna. A dedicated portal will be created in line with the current PM Suryaghar model to track the RTS installations. The vendors will be empanelled to certify only credible and reliable vendors be available for installation of RTS systems in the micro units.

(iii) **Allocation:** INR 7000 crore will be allocated under the said approach for the solarisation of micro units for a period of 5 years. A total number of 1-1.5 million MSMEs are initially targeted to be solarised under this approach.

(iv) **'Rent-A-Roof' RESCO model:** The approach will also look at the RESCO model applicability among the micro units. Interested RESCOs will be contacted for RTS installation in micro units and preference will be given the aggregating demands of several micro units in a geographical area for RESCO model implementation. The process will initiate the assessment where RESCO evaluates the rooftop space, shading, and micro unit energy demand, followed by contracting, where the micro unit signs a rooftop lease agreement and a PPA with the RESCO. This will be followed by the installation, operation and maintenance, and monitoring of the system. Finally, the micro units pays only for electricity consumed, usually at rates below traditional grid tariffs, while earning indirect financial and sustainability benefits.

4.2.3 Impacts of Proposed Recommendations

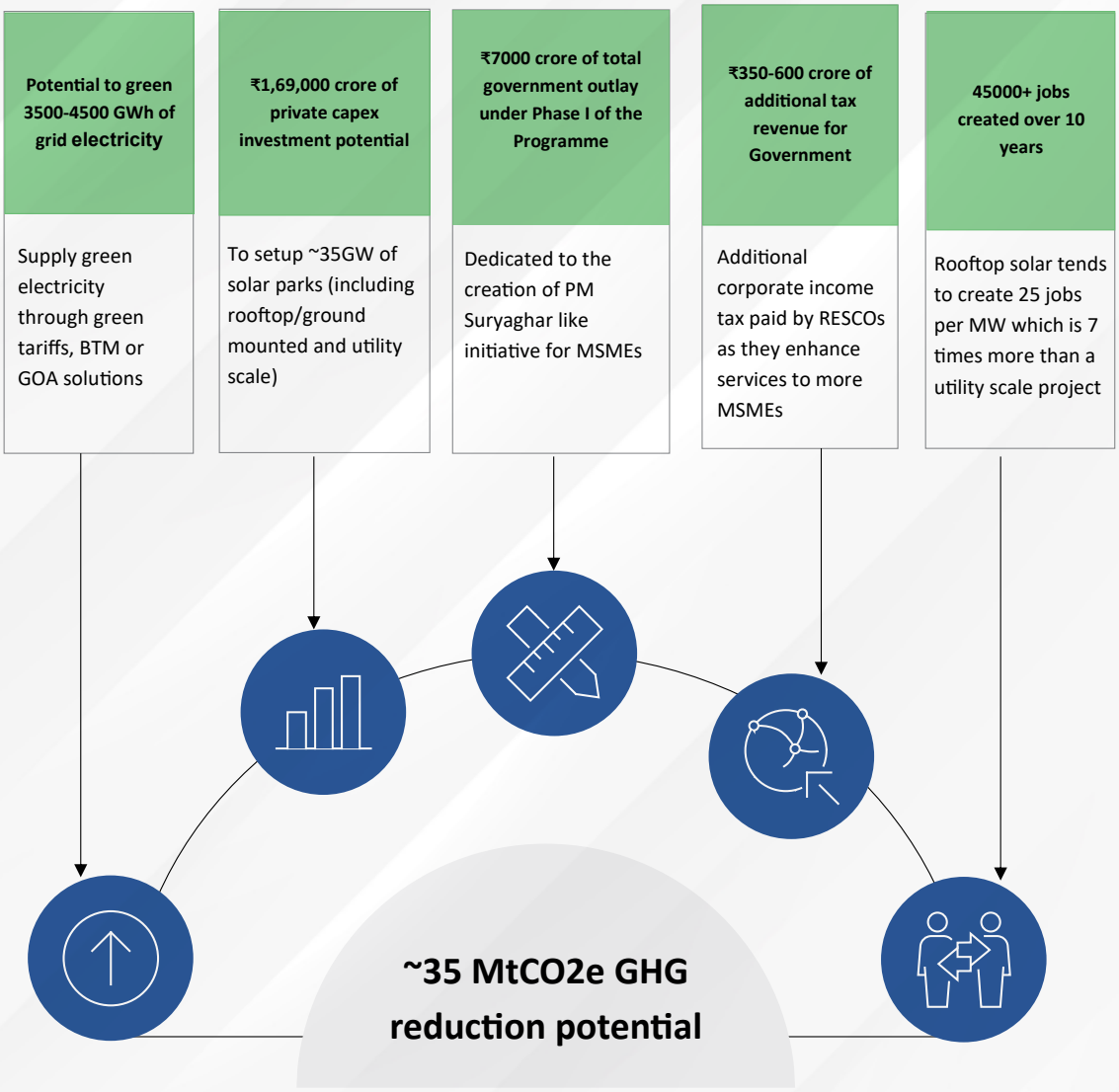


Figure 15: Impacts of proposed recommendations

4.3 Recommendations for Alternative Fuels

4.3.1 **Background**

Alternate fuels represent the third lever that can enable deep decarbonisation of the MSME sector. Coal, which is used for in-process thermal energy, and grid electricity are the two primary sources of energy used in the top five energy intensive MSME subsectors accounting for approximately 54% of the total energy demand. In contrast, zero-emission interim fuel sources such as agricultural residue, firewood, and biomass cumulatively account for around 35% of the total energy needs. To understand the usage of different emission-intensive fuels in the five MSME subsectors, the respective emission shares have been provided in Figure 16 for the year 2022. Coal, with its high emission intensity, is heavily employed in the sector and is followed by other high-emission fuels like pet coke and furnace oil. Pumped Natural Gas (PNG) and Liquified Natural Gas (LNG), which are low-emission fuels, are primarily used in metalworks industries such as steel re-rolling, foundry, and forging. Their applications in other industries remain limited.

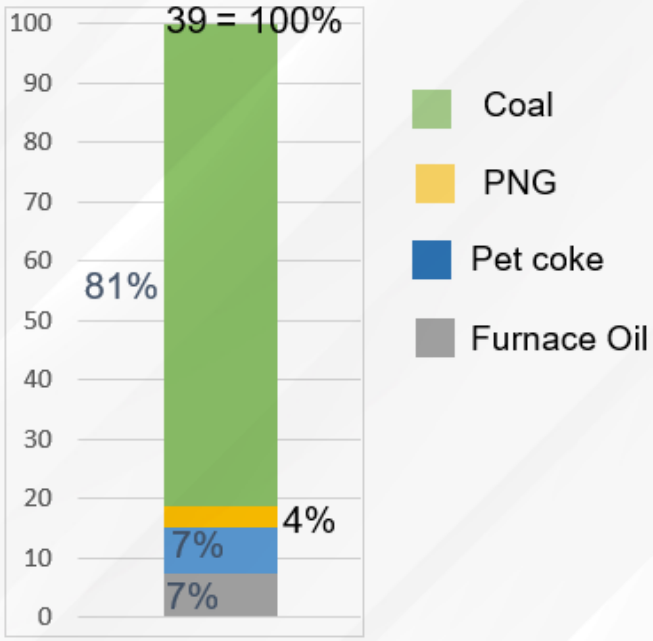


Figure 16: Share of Scope 1 emissions by fuel type in top 5 MSME subsectors in the year 2022

Considering the scenario provided above, a techno-commercial survey of the current availability of alternate fuels was conducted to understand the economic viability of each of these fuels if adopted by MSMEs, which has been provided in Figure 17:

Biomass	Natural gas (NG)	Compressed biogas (CBG)	Green electricity
• Biomass is the most cost competitive alternative to coal as a fuel. • However, the annual subsidy for biomass procurement required to accelerate its adoption is around Rs. 1.2 per kg of biomass (or) Rs. 5 lakh per boiler. • Availability of biomass with consistent composition is challenging due to varying crop harvest seasons. • An increase of around Rs. 186 is estimated to produce one tonne of water to steam using biomass with respect to G2 grade of coal.	• 50% of India's natural gas requirement is imported with the price ranging from $11-12 per Million Metric British Thermal Units (MMBTU); but CGD prices are available to MSMEs at ~$10 per MMBTU as regulated by the Petroleum and Natural Gas Regulatory Board (PNGRB). • Natural gas adoption by MSME clusters such as Tirupur, Morbi, Surat, Ludhiana, etc. is still not adequate. • An increase of around Rs. 724 is estimated to produce one tonne of water-to-steam using natural gas with respect to G2 grade of coal.	• Compressed biogas (CBG) is a derivative of biomass having an Oil Marketing Companies (OMC) retail outlet tariff of Rs. 46 per kg (~15% more expensive than landed tariff of imported natural gas). • Pipeline for CBG and natural gas could be made common, but natural gas connectivity to MSMEs is limited. • An increase of around Rs. 1740 is estimated to produce one tonne of water-to-steam using compressed biogas gas with respect to G2 grade of coal.	• Around 700 units of electricity is required to convert one tonne of water-to-steam at low pressure. • Although the capex cost of electric boilers is 0.5 times a coal-based boiler, the operational costs is 7-8 times than a conventional coal-based boilers. • The availability of Round The Clock (RTC) supply of green electricity is still a challenge with peak availability attained so far is around 90% with solar + wind (55-60% CUF and battery + pump hydro giving additional 25-30%. • An increase of around Rs. 3880 is estimated to produce one tonne of water-to-steam using green electricity with respect to G2 grade of coal.

Figure 17: A comparison of different alternative fuels

4.3.2 Challenges for Uptake of Alternate Fuels:

There is a huge potential for alternate fuels to be scaled up in the MSME sector, however, several problems limit this growth. By taking into account all the considerations for each of the alternate fuels listed above, the current challenges for the use of alternate fuels are:

(i) At the national scale, most alternate fuel sources, e.g., biomass and derivatives such as compressed biogas (CBG), biofuels, etc., natural gas and green electrification of existing equipment's are around Rs. 200-4,000 more expensive per calorific value of each of the fuels.

(ii) Resources for using biomass, biofuels and CBG for MSMEs currently clash with national agenda for blended fuels (ethanol blending for petrol/diesel, CBG blending for natural gas and biomass for power generation).

(iii) Uptake for biomass-based boilers are still in nascent stages due to the seasonal availability of crops and technical limitations in delivering consistent steam/heat.

Given these challenges, natural gas is potentially a viable solution for delivering low-emission fuels to MSMEs. Whereas alternate fuels are currently not economically viable for widespread adoption across all MSMEs, existing market mechanisms such as City Gas Distribution (CGD) networks, can enable MSMEs to adopt preferred alternate fuels based on cluster demand with natural gas acting as an initial enabler.

It is recommended that the NPMA act as facilitator, mobilizing CGD licensees and MSMEs within respective geographical areas to consider the uptake of natural gas as a transition step towards the broader uptake of alternate fuels. Under Phase I, the PNGRB should be consulted to help build an enabling ecosystem for natural gas adoption among MSME clusters. This support may include:

- Extension of the interest subvention scheme for natural gas projects and onboarding project financing partners to drive down interest costs for capital infrastructure.
- Provision of a risk mitigation mechanism for CGD networks to cover potential payment defaults by MSMEs adopting natural gas.
- Allocation of budgetary, financial, and decision-making powers to PNGRB for the disbursement of subsidies or government funds.

Further, the following key interventions are required to enhance the adoption of natural gas among MSMEs:

- Standardising Right of Way (RoW) charges across states: This can be achieved by implementing a uniform RoW pricing framework that reduces cost disparities (currently hovering between Rs. 100/km to Rs. 100,000/km from one geographic location to another) and enable faster, more cost-effective infrastructure development.
- Introducing targeted financial incentives for natural gas projects: Direct capital subsidies and green financing options (e.g., green loans), like those available for solar and renewable energy projects, can be provided to stimulate private sector investment.
- Making low-cost alternatives such as Administered Pricing Mechanism (APM) and High Pressure, High Temperature (HPHT) gas available for MSMEs.
- Transitioning natural gas from the VAT regime to GST (at 5-%, like LPG) to eliminate inter-state pricing inefficiencies and ensure a robust mechanism to compensate state governments for potential revenue losses.

- Introducing a cess on polluting fuels (coal, pet coke, etc.), which may aid in fast-tracking the switchover to natural gas.

In the next 10 years, the overall potential GHG emission reduction through the alternate fuel lever is approximately 9-16 million $tCO2_e$ largely driven by shifts in using natural gas/biogas and biomass instead of fossil fuel-based fuel sources. Key sectors that contribute mostly to exports and has high emission intensity such as textiles, steel, forging and foundry may be considered for immediate action in the first phase of implementation.

Considering the proposal calls for amendments to several acts and changes in rules and regulations across the power and regulatory sector at the centre and in states, following actions are proposed for the overall implementation of the alternate fuels lever (Table 7):

Table 7: Takeaways for action and implementation from the alternate fuels lever adoption in MSMEs

Actions	Responsible Entity
Evaluate the feasibility of providing connections to MSME clusters through CGDs based on technical parameters such as pressure requirements, demand balancing, etc.	Ministry of Petroleum and Natural Gas (MoPNG)/ PNGRB
Create national guidelines to enable CGDs in their allocated geographical areas to aggregate and assess demand in MSME clusters that require NG solutions.	MoPNG/PNGRB
Develop a list of MSME clusters (export-oriented clusters to begin with) to prioritise during the first phase of implementation.	Ministry of MSME

Considering the subsidisation of natural gas supply to MSME clusters, a few guardrails are recommended to protect against pilferage of any of these provisions:

- Subsidised price should not be above domestic supply rate: Subsidized price of the natural gas shall not be less than the price at which it is offered to the domestic/ household sector as this will deter pilferage to the domestic sector.
- Incentivising MSMEs to ensure there is no pilferage: MSMEs should receive subsidies periodically. The disbursement of subsidies should be linked to units of consumption. NPMA, in consultation with state committee, should carry out audits to ensure that there is no pilferage. If any pilferage is found, then MSMEs and CGDs should both be penalised, and penalty amounts should be deducted from the subsidy payouts.
- The PNGRB should monitor energy consumption levels: PNGRB should devise industry-specific energy requirement index by tracking historical energy consumption and production levels using proxies like GST returns, etc. The actual consumption of natural gas should

be tracked against the industry-specific consumption benchmarks computed.

- Mandating MSMEs to forego a share of conventional energy sources: PNGRB, while sanctioning the subsidy request for MSMEs, can take an undertaking from MSMEs to forego other conventional energy sources to the extent of subsidised natural gas supply by CGDs in a phased manner.
- The NPMA can track emissions reduction: The NPMA should monitor reduction of emissions in clusters where natural gas is supplied at subsidised rates. If a given cluster does not deliver the expected reduction in emissions, the domain ministry should review the supply of subsidised natural gas connections in that cluster.

4.4 Recommendations for Monitoring, Reporting, and Validation

4.4.1 Background

Developing and maintaining standardised MRV frameworks is critical to driving the progress of decarbonisation initiatives. With increased global pressure on account of climate mitigation, there is a need for India to develop robust MRV frameworks, which can enable businesses to retain their economic competitiveness and thereby safeguard themselves against changing regulatory norms that can adversely impact their operations, while delivering on net-zero commitments and Nationally Determined Contributions (NDCs). Non-tariff barriers such as CBAM will also place additional pressure on export-led MSMEs, as they will now have to disclose their emissions prior to trade. Considering this, MSMEs that form a part of supply chains need to develop their capability to report GHG emissions, particularly their Scope 1 and Scope 2 emissions, on account of CBAM and in response to the demands of investors.

Hence, through this section, we are proposing recommendations to standardise MRV mechanisms, which can thereby enable targeted decarbonisation interventions and extend support to enterprises, that might struggle with changing regulatory norms. Globally, MRV mechanisms are gaining traction as they allow continuous tracking of emissions in key sectors, encourage businesses to align emission reductions with their country's NDCs, and provide a foundation for future market-based mechanisms. The GHG Protocol, initiated in 1998 and jointly developed by the WRI and the WBCSD, is the most widely used international accounting tool for governments and businesses to understand, quantify, and manage GHG emissions and many countries, including India, are now developing GHG-emission reporting standards based on the GHG Protocol.

Box 11: GHG Protocol Corporate Standard

Global warming and climate change have come to the fore as key sustainable development issues. Many governments are taking steps to reduce GHG emissions through national policies that include the introduction of emissions trading programs, voluntary programs, carbon or energy taxes, and regulations and standards on energy efficiency and emissions. As a result, companies must be able to understand and manage their GHG risks if they are to ensure long-term success in a competitive business environment, and to be prepared for future national or regional climate policies. GHG Protocol Corporate Standard provides standards and guidance for companies and other types of organisations preparing a GHG emissions inventory. It covers the accounting and reporting of the six greenhouse gases covered by the Kyoto Protocol – carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride. The standard and guidance were designed with the following objectives in mind:

- To help companies prepare a GHG inventory that represents a true and fair account of their emissions, using standardised approaches and principles.
- To simplify and reduce the costs of compiling a GHG inventory.
- To provide business with information that can be used to build an effective strategy to manage and reduce GHG emissions.
- To provide information that facilitates participation in voluntary and mandatory GHG programs.
- To increase consistency and transparency in GHG accounting and reporting among various companies and GHG programs.

Both business and other stakeholders benefit from converging on a common standard. For businesses, it reduces costs if their GHG inventory is capable of meeting different internal and external information requirements. For others, it improves the consistency, transparency, and understandability of reported information, making it easier to track and compare progress over time.

4.4.2 Components of MRV:

(i) Monitoring and measuring the amount of GHG emissions reduced by a specific mitigation activity, undertaken by companies, in a reliable manner.

(ii) Reporting these findings in a robust, transparent and consistent manner encompassing key factors standardised to ensure consistency in the way MSMEs measure and report progress against targets. This can also include types of information that MSMEs should disclose to support investors, lenders, and insurance underwriters in appropriately assessing risks.

(iii) Verifying the report by third parties so that the results can be certified for accuracy and reliability, and disbursements in the form of subsidies or carbon credits can be issued. This will also enable entities to make credible decarbonisation claims across different activities and emission sources. Assurance and verification must be provided to ensure the reliability of data for stakeholders – government, investors, financial institutions, etc.

Based on this, MSMEs require MRV standards, which can be developed based on the following framework specified in Figure 18:

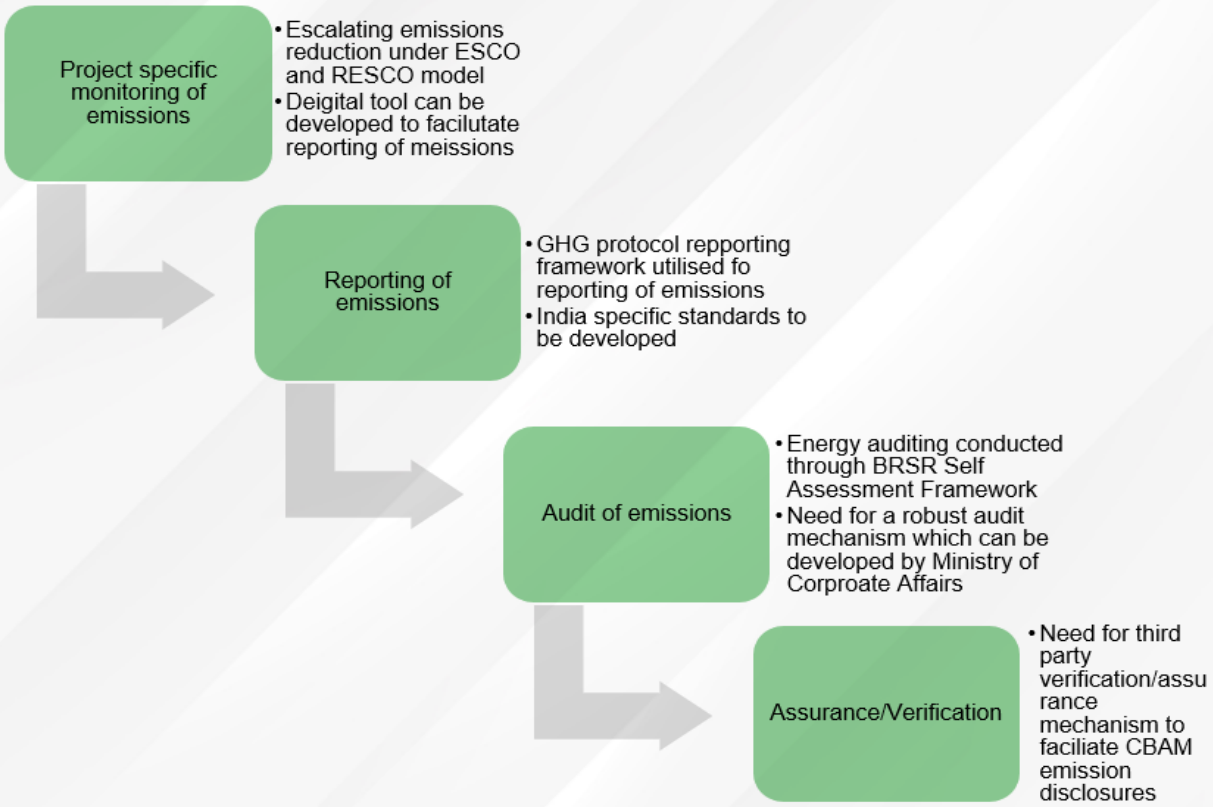


Figure 18: MSME MRV framework to track GHG emissions

As MSMEs adopt the measures provided in the earlier chapters, their emissions will be reduced. The MRV mechanism will ensure that these emissions are effectively monitored, reductions are reported, and best practices are applied. This will also act as a trust-enabling factor for the disbursement of risk related financials to implementing agencies at different parts of the projects.

4.4.3 Challenges for MRV implementation in MSMEs:

(i) Lack of awareness- Awareness of sustainability measures and reporting mechanisms is low amongst MSMEs. Around 70% of MSMEs are only partially aware of the opportunities from implementing sustainability measures and relevant sustainability factors for their business, sector, and geography.

(ii) Complexity of current reporting methodologies- MSMEs struggle to adapt the current available reporting frameworks due to high complexity and numerous indicators often exceeding the capacity of their in-house resources. According to a recent survey, only 4 % track emissions (scope 1-3), and 5% measure renewable energy use (Financial Express 2024).

(iii) Lack of standards/frameworks in India- No framework for MRV in India has been notified for all companies. SEBI has recently introduced the Business Responsibility and Sustainability Reporting (BRSR) framework for Environmental, Social and Governance (ESG) reporting by listed entities along with an assurance framework;

however, a clear set of simplified standards, disclosure and assurance framework customized to MSMEs is needed.

(iv) Upfront investment for setup- Mechanisms to measure and report emissions involve significant upfront costs (e.g., hiring dedicated specialists for report preparation, certification by accepted bodies, purchasing and installing monitoring hardware and software etc.) which may be beyond the scope of MSMEs.

(v) Lack of incentives- There are currently no targeted incentives for adoption in India (e.g., tax benefits, lower cost of financing compliance requirements etc.) for MSMEs to produce emissions reports, beyond the direct requests for disclosures from limited global MNC suppliers.

(vi) Capability gap- There is a lack of internal talent with capability or access to talents that are trained in helping MSMEs measure and report emissions or trade in carbon markets. This is partially due to lack of dedicated training programs from governments or industry/cluster bodies.

(vii) Disclosure concerns- There is a perception amongst MSMEs that voluntary / regulated disclosure of certain metrics can expose MSMEs to legal and commercial risks (e.g., competitors might be able to access business information) and thus may act as an additional operational burden. This prohibits them for being part of the exercise.

4.4.4 Benefits of a robust MRV framework:

While MSMEs face these problems, several benefits can accrue to the MSMEs and the governments if a robust and scalable MRV framework is implemented. An MSME delivering a product produced sustainably can attract a 20 percent premium in India (Bain Global Consumer Lab 2023). At least 60% of consumers in India are willing to pay a premium for sustainability products, while 52% in urban India expect to increase spending on planet-friendly brands in the next three years (The Times of India 2022). For MSMEs, it has been reported that MSMEs saw increased sales growth or had access to low-cost financing when they declared ESG parameters on their products (Curry 2023). MSMEs could also use the database of process energy consumption and emissions to benchmark and improve their efficiency. As for the governments, the benefits include-

(i) Evidence-based policymaking- Maintaining a data repository during multiple climate-related policy changes, like revising emission norms on motor vehicles, Diesel Generating (DG) sets, etc., could help in making impact-driven policy changes using RIA tools.

(ii) Socio-economic benefits- MRV mechanism could improve uptake in energy efficiency technology and GE adoption mechanisms creating 50K+ jobs and an annual tax revenue of around Rs. 800 Cr from encouraging ESCO/RESCO services to MSMEs (as elaborated in earlier sections).

(iii) Access to funds for green financing- There is a potential to access funds from multilateral organizations such as Climate Investment Fund (CIF), GEF, Japan International Cooperation Agency (JICA),

United Nations Industrial Development Organisation (UNIDO), etc. to help the GE transition.

MRV mechanism remains the key for disbursement of risk aversion guarantees identified under the interventions of energy efficiency and green electricity. It is essential that it is implemented in a way that does not disturb the sensitive nature of the MSMEs. A few case studies of effective MRV implementation in GHG emission reduction and sustainability across India and the world is provided as follows:

Box 12: Business Carbon Calculator-SME Climate Hub

The SME Climate Hub has launched a dedicated landing page for India to empower MSMEs to take climate action. The SME Climate Hub is an initiative of the We Mean Business Coalition, the Exponential Roadmap Initiative, and the United Nations Race to Zero campaign, which simplifies and aids the decarbonisation process for MSMEs. This enables them to commit to and act upon climate targets aligned with limiting global temperature rise to 1.5°C.

Available virtually and free of charge, the SME Climate Hub helps MSMEs make a globally recognized climate commitment, and measure, report and reduce their emissions through a suite of tools and resources, including Business Carbon Calculator, which enables MSMEs to identify priority sources of emissions within their business operations; Climate Fit education course, which offers short, digestible modules as an introductory primer for MSME climate action. A reporting tool, through which signatories of the SME Climate Hub can report their emissions data on a yearly basis, to track progress on their climate commitment and communicate their action to key stakeholders such as consumers, buyers and investors. In collaboration with Normative and the Net Zero team at Oxford University, the SME Climate Hub provides tools and resources to enable small and medium-sized enterprises (SMEs) to make a climate commitment, act and measure their progress towards emissions reductions in line with the latest science. Over 6,500 businesses across 125 countries have already made the commitment.

Box 13: CII Climate Action Charter (CCAC)- MSME Toolkit

The MSME Toolkit by CII Climate Action Charter (CCAC), provides MSMEs with a platform for assessing their vulnerability to climate-related hazards, raising awareness, and developing short- and long-term resilience measures. The toolkit helps in GHG foot printing through an easy-to-use tool for calculating Scope 1 and Scope 2 emissions, allowing MSMEs to assess their carbon footprint and take appropriate mitigation measures across different scopes. The toolkit also addresses the climate-related risks that Indian MSMEs face by taking a comprehensive and collaborative approach.

The toolkit enables MSMEs to take ownership of their climate action transition by mapping climate change as a material risk across their value chains. It allows them to build resilience, develop sustainable practices and showcase best practices. The toolkit promotes a collective assessment of climate-related vulnerabilities, with a focus on collaboratively finding solutions for a just, equitable, and resilient transition.

Box 14: Clean Energy Emission Reduction (CLEER) Tool

The CLEER Tool provides simple, standardized methodologies for calculating emission reductions from clean energy activities. The tool enables users to estimate, track, and report GHG reductions from clean energy, which may help users identify high impact activities with cost effective GHG reductions, assess emissions reduction potential of planned activities or alternatives, and measure benefits from indirect clean energy activities. CLEER is also publicly available for general use by any organisation that wants to estimate GHG emission reductions or projections for their purposes. CLEER tool clean energy activities include renewable energy (e.g., solar photovoltaic, wind turbines, geothermal, hydroelectric), EE (e.g., building and appliance efficiency), biomass energy, fuel switching, as well as additional technology types. It also supports reporting on projected GHG emissions reduced or avoided through 2030 from adopted laws, policies, regulations, or technologies related to clean energy.

CLEER supports users that know basic information about their activities, such as the amount of energy generated or saved, or the amount of new technology built, adopted, or deployed. Users can input data and information, select responses from drop down menus, answer questions, and document assumptions related to the following: activity information (e.g., location, activity type and name), energy information (e.g., whether the activity replaces direct fuel consumption and electricity, amount of electricity generated by the system, installed capacity, and type and amount of fuel replaced. The Tool also contains default data embedded into the calculations (e.g., country electricity grid and fuel emission factors, renewable energy capacity factors, unit conversion), and users can provide alternate values to default data if more accurate data is available. This default data comes from internationally accepted sources, such as Intergovernmental Panel for Climate Change and the International Energy Agency. After inputting the necessary information, users are provided with an activity information summary, results on annual emissions reductions, and an energy consumption comparison.

4.4.1 **Recommendations for development of MRV framework under the Green Transition Roadmap:**

(i) Simplified reporting standards and target-setting framework for MSME linked to global standards**:** At the initial stages, fewer indicators and readily available data sources may be required to be reported by the MSMEs. The MSMEs can also be asked to voluntarily declare overall net-zero targets, interim milestones, and make disclosures on roadmap, etc. Compliance can be considered in a phased manner, for example, with the year 2030, the medium units start disclosing, with small and micro units to follow subsequently in Phase II and III of the Programme. The GHG emissions reporting being discussed can be framed in the following steps-

- An annual fuel, electricity, and process emission consumption reporting for MSMEs can be taken up in line with large, listed companies. This will be compatible with the existing sustainability reporting system for large companies and further lead to an enhancement in the ease of compliance for MSMEs.

- MSMEs usually have better control over internal process costs, such as fuel and electricity expenses (scope 1 and 2 emissions) and may lack access to resources needed to assimilate information on upstream and downstream players (scope 3 emissions). It is highly recommended that reporting focuses on two emission categories: scope 1 emissions, which include thermal fuel source emissions and process emissions, and scope 2 emissions, which consist of electricity consumption based on grid electricity usage.
- Voluntary reporting with phase-wise mandate may be issued to ensure adequate training and resources are provided to MSMEs to understand the mechanism.
- The development of simplified standards for annual scope 1 and 2 emissions reporting must be aligned with global protocols (such as IFRS standard for financial reporting by SMEs) to help MSMEs reduce complexity and costs (International Financial Reporting Standards 2024).
- The reporting requirements can be streamlined by omitting indicators that are not relevant to typical MSMEs, requiring fewer substantial disclosures than prevailing global frameworks and SEBI's BRSR standards, and enabling easy and simplified reporting methods.
- The reporting should simplify measurement, disclosure, and data use by embedding simplified measurement principles, focussing on disclosures that can be made using readily available data sources, and enabling easy-to-use digital platforms to make disclosures.
- The MRV should encompass development of a customized approach for voluntary commitments to reduce emissions towards achieving net zero by 2070. This can include designing a target-setting approach with achievable milestones/roadmap in line with India's net zero goals and global frameworks such as the Science Based Target initiatives (SBTi) (Science Based Targets initiative 2024), UN Race to zero (UNFCCC 2024) which are in line with India's NDCs (emission reduction by 45 % by 2030). For example, the targets are based on broad goals such as reducing 1/3rd of the emissions by 2030, halving your emissions by 2050 and achieving net zero by 2070.

(ii) Development of free user-friendly GHG accounting digital tool to ease MSME reporting: A free-of-cost digital tool should be created that can capture data, measure emissions, set targets, and report them in the new proposed format. Add-on services such as industry analytics and other related dynamics could be provided to the MSMEs on payment of fee; however, report generation could be retained free of cost to reduce cost of compliance. The tool could have the following features:

- Carbon calculator for MSMEs to calculate emissions accurately in an easy-to-use format. The emissions could be calculated by entering fuel sources, equipment names, energy consumption, etc. The inputs should be contextualized according to Indian conditions and across sectors.

- The tool could have a feature providing a personalized dashboard with a detailed breakdown of current emissions and targets to continue the carbon reduction journey based on the target-setting approach defined earlier.
- An automated setup of a "carbon account" for participation in Indian carbon market scheme could be enabled. Linkages to data from other markets for ease of comparison and assessing CBAM impacts could also be provided.
- An example to calculate GHG emissions from different types of fuels (KPMG 2024):

tCO_2e	=	Activity data	×	Emission factor	×	GWP
Tonnes of CO_2 equivalent		Estimated measure of activity related to a specific emissions source		Factor applied to make varied activities comparable		Multiplier that makes different GHGs comparable

- A sector-specific guidance on best practices and interventions can be undertaken for reduction from current levels, by taking into considerations from BEE could be included for building awareness.
- An additional and important feature that contains educational resources embedded to learn how to use the tool effectively.
- The digital tool could use a pre-specified list of fuel sources which is based on current fuel mix of MSMEs and its carbon content. It will be important to link the electricity bill generated with the tool through GST/Udyam registration.
- The tool could also provide an ability to download standardized reports that is accepted as valid format for international and domestic ecosystems.
- For data privacy, it is proposed that only analytical support, such as overall emission trend of sector/process, best practices in implementation etc. can be made public. This will be in line with existing sustainability reporting system for large companies and remove any apprehensions since companies may want their individual data protected.

(iii) Capacity building for higher take up in MSMEs: It is proposed that industry bodies such as the Federation of Indian Chambers of Commerce and Industry (FICCI), The Associated Chambers of Commerce and Industry of India (ASSOCHAM) and Confederation of Indian Industry (CII) could raise awareness regarding the digital tool among the MSME clusters. They could be included as investors in the digital platform – e.g., on the lines of SAMEEKSHA website for reporting energy consumption, investments in the National Skill Development Council (NSDC) supported skilling platform, etc. This could lead to maximizing the adoption of the MRV mechanism since building awareness through industrial

bodies, cluster associations could accelerate the adoption of the standards. This could include-

- Awareness programs**:** Educating MSMEs about sustainable practices and the importance of emission reporting and target setting through online or in-person awareness programs.
- Train the trainer programs: Providing specialized training to MSME employees and consultants on new emissions reporting, target setting framework, and digital tools.
- Partnerships: Partnering with educational institutions, think tanks, non-profits, and cluster associations can assist in developing an ecosystem that provides impetus for maximizing the adoption.

(iv) Incentivization to encourage widespread adoption: Carbon account setup and reporting could be done free of cost, and an incentive can be directed towards export-oriented users to drive adoption. Sustainability-linked loans and additional credit guarantee under schemes like the SIDBI green scheme could be provided for MSMEs. Besides, cross-ministerial initiatives could be taken to promote MSME decarbonisation. For example, the Ministry of Railways could offer preferential rates or waive demurrage charges for MSME goods for units that declare emissions.

(v) Assurance and validation- Assurance and verification of disclosures is a key step to ensure the accuracy and credibility of data. They aid all stakeholders make better decisions by maintaining transparency. However, assurance and external verification of climate disclosures are currently nascent. SEBI's BRSR standards for sustainability reporting require mandatory disclosure by listed entities only. Further, most ESG information collected globally is subject to a limited assurance, which means assurance of no negative observations. Also, the capacity and capability available for sustainability emissions assurance are limited. This is scheduled to reduce as the Institute of Chartered Accountants of India (ICAI) issued a globally adapted sustainability assurance standard to guide auditors. It is proposed that voluntary verification of emissions and adherence to targets be recommended in line with the verification mechanism proposed by the Indian Carbon Markets scheme.

The implementation of the MRV standards based on the details provided will be essential for the implementation of the three levers and reduction of GHG levels. The institution implementing the MRV mechanism must own and drive end-to-end implementation and coordinate with the responsible agencies. Support from ICAI is recommended for the development of an MRV accounting tool and creation of a dashboard. The key responsibility of the institution is to drive development, ensure compliance, and debottleneck constraints in the MRV implementation. The proposed timeline and agencies responsible for the development of MRV framework roadmap is as follows:

Table 8: Roadmap for implementation of MRV in the MSME sector

Task/Details	Simplified emissions reporting and target setting framework	Free user-friendly tool	Incentives to encourage adoption	Awareness and capacity building
Responsible agency	Ministry of Corporate Affairs Accounting, Standards Board (ASB)	Ministry of MSME/NPMA/ tool builder	Ministry of MSME/NPMA	Ministry of MSME through NPMA and MSME National Level Institute for Energy and Greening (under RAMP-S Programme)
Agencies to be consulted	Ministry of MSME, Bureau of India Standards (BIS), Quality Council of India (QCI). Bodies setting global frameworks and protocols: SBTi, ISSB, SASB, TCFD, TPT, GHG protocol	National Information Centre (NIC), BEE, Ministry of Electronics and Information Technology, Cluster associations, SME Climate Hub	Ministry of Finance, SIDBI, NABARD, CGTMSE, Line Ministries such as Ministry of Railways, Public Sector Undertakings (PSU) Sector Ministries (Textiles, Food Processing, Steel etc.)	Cluster Associations, MSME industry bodies CII, FICCI
Implementation timeline	6 months	3 months	3 months	Ongoing: After the launch of the reporting framework and tool, for 3-year period

5. Regulatory Impact Assessment (RIA)

Regulations have several intended and unintended consequences for a wide range of stakeholders. Despite their widespread impact, regulations may not always achieve their intended goals. Thus, it is critical to estimate the potential impacts of regulatory proposals and adopt the proposal that is most likely to achieve the objectives, which the RIA supports in doing. Several expert bodies in India have recommended RIA over the years. These include the Working Group on Business Regulatory Framework (Erstwhile Planning Commission, 2011), the Financial Sector Legislative Reforms Commission (Department of Economic Affairs, 2013), the Tax Administration and Reforms Commission (Department of Revenue, 2015), etc.

Government agencies use the RIA process to assess the potential effects of new or amended regulations. RIA is intended to weigh the costs and benefits of various regulatory options, as well as the potential consequences for businesses, individuals, and society. The goal of RIA is to ensure that government regulations are effective and efficient while minimising negative effects on the economy, public health, and the environment. Regulators such as the Telecom Regulatory Authority of India (TRAI) have established a reasonably robust public consultation process that includes soliciting and responding to public comments, providing essential data for RIA. It is therefore suggested that RIA be included in the proposed regulation-making process under this roadmap.

Box 15: Regulatory Impact Assessment

There can be several ways to about RIA, however the methods have standage adherence guidelines that can streamline the overall process of conducting RIA:

- The monetary method has several approaches to proceed including-
  - Financial analysis: This approach involves assessing the financial costs and revenues associated with alternative regulatory options. It focuses on analysing the potential financial implications for the decision-making body.
  - Cost-effectiveness analysis: This approach evaluates the costs of different regulatory options that can achieve the same objective. It aims to identify the most cost-effective approach among the alternatives. Cost-benefit analysis: This approach involves assessing both the costs and benefits of alternative regulatory options. It seeks to assign monetary values to the expected impacts of each option.
  - Cost-benefit analysis relies on well-developed economic theories of valuation to quantify the benefits in monetary terms. These approaches within the monetary method allow decision-makers to quantify the financial implications and potential benefits of regulatory options, aiding in informed decision-making processes.
- The non-monetary involves Multi Criteria Analysis (MCA). MCA establishes preferences between alternative options based on a predefined set of objectives identified by the decision-making body. MCA relies on the judgment of the decision-making team in defining objectives and criteria. MCA involves a performance matrix, where different policy or regulatory options are evaluated against the same criteria including direct analysis of the matrix, linear additive models, analytic hierarchy process etc.

RIA plays an important role in improving rulemaking quality and promoting good governance. International organisations such as the World Bank have strongly advocated for RIA because it allows governments to ensure that the laws and regulations they develop and implement are of high quality—efficient, transparent, and accountable. Observation of RIA practices is one of the OECD Council's official policy recommendations, and 32 of the 35 OECD countries now include RIA in their regulatory framework.

Any regulations made for the MSMEs can create long term effects on the effective functioning of MSMEs. MSMEs are naturally prone to economic distress, business metrics, and policy changes, which makes this segment more important for conducting RIA. MSMEs are the backbone of the economy and employ a larger number of citizens, and any significant changes in the business ecosystem can be catastrophic. Even lockdown measures introduced during the COVID-19 pandemic had considerable effects on MSMEs in the country.

Box 16: Impact of Covid-induced economic lockdown on MSMEs in India

The world witnessed Covid-19 form 2020-2022. The adverse impact of this pandemic is globally recognized, and it spread as a contagion affecting trade across nations undesirably. The lockdown, one of the means to contain the spread of this pandemic, was implemented in the country since March 2020. Though the lockdown was effective in containing the spread of pandemic, it enabled economic slowdown. Industries in manufacturing and services sectors faced several challenges, and a sizable number of enterprises suffered huge losses. The MSMEs sector has been one of the most vulnerable sectors during the pandemic because of its size, scale of business and availability of financial resources. Studies and surveys showed that approximately 95 percent firms were impacted negatively due to the national lockdown imposed in April 2020, and 70% of businesses remained disrupted till August 2020. Even after progressive unlocking, reports suggest that almost 40% businesses remained interrupted till the end of February 2021. Factors responsible for MSME vulnerability included capital crunch, high transaction costs, and risky perceptions by banks and financial institutions.

Regulatory changes that reduce emissions from MSMEs have significantly impacted these businesses in the past:

Box 17: Ban of Diesel Gensets in Delhi NCR

With air quality worsening in NCR, the Commission for Air Quality Management (CAQM) has barred the use of polluting gensets in processions, functions, exhibitions, and other such events in Haryana districts falling under the NCR. Since 2021, CAQM has been banning the production of pollution-causing, diesel gensets for use in industries and commercial areas, while directing them to be used only for back-up. To ensure compliance, the CAQM established a robust Enforcement Task Force (ETF) comprising 40 flying squads. These teams conducted over 10,000 surprise inspections across industrial and commercial units in NCR during 2022-23, issuing closure notices to hundreds of facilities for non-compliance with air pollution norms. To ensure compliance, the CAQM established a robust Enforcement Task Force (ETF) comprising 40 flying squads. These teams conducted over 10,000 surprise inspections across industrial and commercial units in NCR during 2022-23, issuing closure notices to hundreds of facilities for non-compliance with air pollution norms. But this has severely impacted businesses. It is estimated that more than 50000 large and MSME units were affected. Concerns about the economic impact and financial stability arise due to potential shutdowns. Furthermore, potential closure of MSME units and micro units could lead to job losses and impact the labour force.

Considering the above studies demonstrating how environmental and health guidelines severely impacted MSMEs, it is recommended that a committee of Secretary-level executives be established to address regulatory changes that adversely affect businesses or industries. This NPMA should lead this RIA process, with the inter-ministerial committee serving as the first point of contact to identify any adverse policy or regulatory impacts of the National Programme and approach the government with solutions. The core committee members could include Secretaries from the Ministry of MSME, MOEFCC, MoP, MSME, NITI Aayog, Ministry of Legal Affairs, DIPP, MHI, and other relevant departments to assess climate change impacts on industry. The main role of this committee would be to report the effects of regulations and policies on the industries while recommending policy or regulatory actions that mitigate these impacts. An effective RIA is essential for the successful implementation of green transitions in MSMEs.

6. Conclusion

The MSME sector is the backbone of the Indian economy. However, the world is entering an era where traditional business models are being challenged by a global shift toward sustainability. The Roadmap elaborates on the core themes of the green transition, exploring how MSMEs can transform from vulnerable entities into resilient, global competitors. The modern business environment is no longer static. Regulatory frameworks are tightening globally, with mechanisms like the Carbon Border Adjustment Mechanism (CBAM) penalize carbon-intensive exports. The green transition of India's MSMEs is not merely a moral or environmental obligation, it is a strategic imperative that aligns with the country's broader goals of sustainable development, climate resilience, and inclusive economic growth. Domestically, India is moving toward stricter environmental audits and product ratings that reflect a company's ecological footprint. For a small enterprise, keeping pace with these shifting dynamics requires more than just intent; it requires a structural overhaul of how they perceive value and risk.

To navigate these challenges, the Green Transition Roadmap focuses on three critical pillars: Technology Adoption, Financial Accessibility, and Capacity Building. By modernizing machinery and adopting clean energy solutions, MSMEs can lower operational costs. Improved competitiveness is a natural byproduct of these efficiencies. Furthermore, by adhering to general wellbeing standards, businesses ensure a safer, healthier environment for their workforce, which in turn reduces turnover and boosts productivity.

India has ambitious targets to reach Net Zero by 2070. Since MSMEs contribute nearly 30% of the country's GDP and a vast portion of industrial emissions, they are the ground zero for climate action. When a single MSME adopts a solar rooftop or a water-recycling plant, the impact is localised, however when clusters do that across geographies, it alters the national energy trajectory. This is inclusive growth in its truest form ensuring that the smallest players are not left behind in the race toward a modern, green economy. These initiatives are designed to make green transitioning both accessible and economically viable. By embracing sustainability, MSMEs not only contribute to India's climate commitments under India's Nationally Determined Contributions (NDC), the Paris Agreement and SDGs but also become more resilient, future-ready businesses that can thrive in a rapidly evolving global economy.

Transitioning to greener operations enables these enterprises to reduce their carbon footprint, conserve resources, and minimize waste, while enhancing productivity and cost-efficiency. In an increasingly sustainability-driven global market, MSMEs that align with international environmental standards and secure green certifications can gain a competitive advantage, access new business opportunities, and integrate more seamlessly into global value chains. The journey toward green transition is not just beneficial, it is essential for the long-term survival and success of India's MSME sector.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8. Annexures

8.1 Annexure

List of individuals from private organisations and ministries contacted for building the National Programme for green transition in MSME decarbonisation roadmap.

Name	Designation and Organisation
Anil Bharadwaj	Secretary General, Federation of Indian Micro and Small & Medium Enterprises (FISME)
Rakesh Chhabra	President, Rai Industries Association
Ajit Shah	Managing Director, Yantra Harvest (ESCO)
Praful Dadhich	Expert, Secure Meters
Sakhti Ganesh	Murugan Textiles, Tirupur
Jitendra P Vakharia	Surat Textile Association
Professor Ashwin Tai	Ahmedabad Textiles
Lalit Bohra	JS, MNRE
Suman Chandra	Director, MNRE
Sujata Sharma	JS, MoPNG
Ashok Kumar	Dy. Director General, BEE
S.C. Gupta	Director, PNGRB
Ateesh Kumar Singh	JS, MoMSME
P. Shyam Sunder	Director- BEE
Ajay Seth	Secretary (EA), Department of Economic Affairs, Mo Finance
M. Nagaraju	Secretary (FS), Department of Financial Services, Mo Finance
Challa Sreenivasulu Setty	Chairman, State Bank of India
Prem Prabhakar	MD & CEO, State Bank of India Ventures (cc)
Manoj Mittal	Chairman & Managing Director, Small Industries Development Bank of India
S.C.L. DAS	Secretary, Ministry of MSME
Shrikant Nagulpalli	Director General, BEE
Jaydeep Modi	President, Federation of Small Scale Industries (FSSI)
CA. Shashidhar Shetty	President, Karnataka Small Scale Industries Association (KASSIA)
Shri Biswanath Bhattacharya	President, Federation of Small & Medium Industries (FOSMI)
Dr. (CA) Harindra Kumar Garg	Chairman, SIDCUL Manufacturers Association of Uttarakhand (SMAU)
Baldevbhai Prajapatl	President, Laghu Udyog Bharti

Stakeholders	Remarks
NITI Aayog	Scheme is a timely intervention as it focuses on access to green energy, technology and circular economy which is aligned with MNRE's EPR scheme.
	Green Institute should be a permanent set up with adequate and qualified staff to function beyond the scheme period.
	Renewable energy integration for MSME clusters needs to be emphasized more.
	The subsidy is limited to the tariff proposals. The aggregated demand is handled under RPO regime, not directly subsidizing MSME energy procurement.
	15% green energy subsidy supply impact emissions per output unit need to be studied before finalising the Scheme.
	Efforts should be made to ensure that the proposed RAMP Sustainable program (RAMP-S) aligns with the NITI Aayog study findings.
	While Niti Aayog proposal consider OEMs, the same is not considered in RAMP – S proposal.
MNRE	The Ministry should consider a Grant for open access.
	Going forward, the Ministry should keep RCO / RPO pathways.
BEE	The Ministry of Power is implementing the Aditi Scheme in 60 clusters by providing an interest subsidy of 3-5%. MoMSME should ensure that the clusters covered under the Aditi Scheme do not overlap with the RAMP – S scheme.
	Brick Sector accounts for 250 billion bricks annually, matching cement sector emissions due to coal dependency. It was recommended to depict emissions from the brick sector separately.
World Bank	The proposed RAMP–S program aligns with the World Bank goals. It enables private capital mobilisation which is a priority area for the World Bank. It was informed that the World Bank would come out with actionable steps for the RAMP – S program in a few weeks.
SIDBI	The proposal of RAMP – S was appreciated and it was suggested that the institutional framework established for MSE GIFT and MSE SPICE initiatives be utilised for RAMP – S also.
IamSME of India Association	They highlighted EPR as an opportunity for MSMEs to build competitive advantage rather than a challenge. While Aditi Scheme focuses on a few specific trades, MoMSME's program is sector-focused and geographically comprehensive.
MCCIA Association	They appreciated the design of the RAMP – S programme which would allow the States/ UTs to develop their own greening agenda, as per their requirements and priorities.
KIIT	Supported the proposed RAMP – S Scheme.

MOEFCC	Concessional Audit Fees at 25% of Application fees to be considered
	Trading Platform charges: Registration, Transaction and Annual fees
	Reduced GST at 5% for recycled plastic (For MSME Recyclers)
	Technical/financial assistance for setting up recycling facilities
	Setting up of EPR Helpline
	CPCB may consider grant of Auto approval for MSME producers
DC MSME	The learnings from RAMP & UNIDO projects to be incorporated
	It should be ensured that the maximum flow of funds in the scheme may be directly utilised by the MSMEs to create maximum value out of the scheme.
	With respect to the EPR component, the actual requirement over & above what has been provisioned in the scheme must be checked up and the same may be suitably included.
	List of schemes of MNRE & MOP may be checked up for similar schemes/duplication.
	Justification for capital subsidy component may be built in the proposed scheme.

8.2 Annexure

Details of calculations for Figure 3: Sub sectoral emissions and Specific Energy Consumption (SECs) (derived from BEE energy and resource mapping of MSME clusters in India for different MSME sectors)

Sector	Overall Energy Consumption (MtOe)	% Fuel Wise Energy Consumption	Emission Factor of Different Fuels	Resulting Overall Emissions (Mt)	SEC (toe/ tonne)
Textile	8.7	Coal=37%, Agro Residue=24%, Firewood=19%, Pet coke=PNG=2%, Electricity (Grid)=12%, Electricity (RE)=4%	Lignite Coal=4.02, Imported Coal= 4.54, Agro Residue= Firewood= RE Electricity= Biomass=0, PNG=1.97, LPG= 2.54, Electricity Grid= 9.42, HSD= 2.90	24.7	1.1
Paper	6.6	Coal=80%, Electricity (Grid)=10%		30.3	0.2
Foundry	1.4	PNG=7%, Pet coke=34%, Furnace Oil=3%, Electricity (Grid)= 56%		9.7	0.2
Forging	1.6	PNG=21%, Furnace Oil=38%, Electricity (Grid)=41%		9.6	
Steel Rerolling	2.1	Coal=60%, PNG=1%, Pet coke=1%, Electricity (Grid)=35%, Electricity (RE)=3%		12.4	0.2
Food Processing	5.67	-		3.2	0.3
Chemical	4.93	-		1.8	0.2
Pharma	1.48	-		1.8	0.2
Leather	0.14	-		1.6	0.1
Glass	0.10	Coal=64%, Pet coke=35%, HSD=0.3%, Electricity (Grid)= 0.7%		0.7	1.1
Brick	-	-		0.7	0.9

8.3 Annexure

Fuel consumption in the top 5 MSME subsectors and resultant emissions-

- Total MSME energy consumption in year 2022- 65 (MtOe)
- Total MSME emissions in year 2022- 135 Mt
- Fuel wise consumption for 5 MSME subsectors provided in Annexure 2

Fuel Type	Energy Consumption Units (MtOe) (Derived from BEE Reports)	Energy Consumption (%)	Resultant Emissions (Mt)	Resultant Emissions (%)
Coal	9.6	48	43.6	50
Agro Residue	2.0	10	0	0
Firewood	1.7	8	0	0
PNG	0.6	3	1.6	2
Pet coke	0.7	3	2.7	3
Biomass	0.7	3	0	0
Furnace Oil	0.6	3	2.9	3
Electricity (Grid)	3.8	19	35.7	41
Electricity (RE)	0.3	2	0	0
Total	20		86.5	

8.4 Annexure

The reduction in MSMEs emissions is described as follows-

Total MSME emissions in year 2022= 135 Mt

Top 5 MSME sub sectoral emissions in 2022= 86.5 Mt

MSME Emissions due to Other Sectors expect the 5 listed= 48.5 Mt

MSME Subsector	Energy efficiency potential (%)-derived from EE initiatives mentioned in BEE reports)	Sectoral emissions (Before energy efficiency interventions) (Mt)	Sectoral emissions after application of energy efficiency (Mt)
Textile	60	24.7	9.9
Paper and Pulp	7	30.3	28.1
Foundry	21	9.7	8.6
Forging	22	9.6	7.5
Steel Rerolling	12	12.4	9.6
Total		86.5	63.6

Assuming similar levels of energy efficiency is expected across the segment, the emissions for other sectors would be=48.5*((86.5-63.6)/135) =12.9 Mt

Emissions after application of energy efficiency lever across other MSME subsectors besides the 5 =48.5-12.9=35.7 Mt

Total Reduction from energy efficiency lever= (86.5-63.6) +12.9≃36 Mt

Both Line of Sight (LoS) and Aggressive scenarios have been considered under two conditions- with Electrification and Without Electrification. A with-electrification scenario allows for replacing energy intensive process by buying equipment that requires electricity. This electricity may be sourced through the grid with the following assumptions-

- Both scenarios allow for zero/low emission intensive fuels like PNG, biomass gradually being adopted in replacement of high emission intensive fuels like coal, grid electricity (brown power), pet coke, furnace oil, diesel etc.
- The usage of other zero-emission intensive fuels like Agro residue and firewood biomass remains the same.
- In a scenario with electrification, following the LoS assumptions, the usage of energy-intensive fuels was reduced to 65%, usage of PNG increased by 15 percent, usage of biomass increased by 10%, and that of electricity by 1%from the baseline.
- In a scenario with electrification, following the Aggressive assumptions, the usage of energy-intensive fuels reduced to 45%, usage of PNG increased by 20 percent, usage of biomass increased by 20%, and increased usage of electricity by 15 percent from the baseline.
- In a scenario without electrification, following the LoS assumptions, usage of

energy-intensive-fuels reduced to 75 percent, usage of PNG increased by 15 percent and usage of biomass increased by 1%.

- In a scenario without electrification, following the Aggressive assumptions, usage of energy-intensive fuels reduced to 60%, usage of PNG increased by 20 percent and usage of biomass increased by 20%.

Subsectors	Emissions after energy efficiency (Mt)	Emissions Without electrification (Mt)		Emissions with electrification (Mt)	
		LoS	Aggressive	LoS	Aggressive
Textile	9.9	8.9	8.2	9.6	9.3
Paper and Pulp	28.1	24.5	21.8	26.9	25.4
Foundry	8.6	8.3	8.1	8.6	8.5
Forging	7.5	7.1	6.9	7.2	6.9
Steel Rerolling	9.6	8.9	8.3	9.3	9.1
Total	63.6	57.6	53.2	61.5	59.1

The maximum reduction in emissions is being obtained without electrification, which has been prioritised for calculations under the alternate fuel lever-

- Emissions reduced without electrification after application of alternate fuel lever in LoS scenario across the 5 MSME subsectors = 63.6-57.5=5.9 Mt
- Emission factor= 5.9/63.6 =0.09.
- Assuming similar levels of achievements across other MSME subsectors besides the 5, resultant emissions=35.7*0.09=3.3 Mt
- Total emissions=5.9+3.3 ≃9 Mt.
- Emissions reduced without electrification after application of alternate fuel lever in Aggressive scenario across the 5 MSME subsectors = 63.6-53.2=10.3 Mt
- Emission factor= 10.3/63.6 =0.16.
- Assuming similar levels of achievements across other MSME subsectors besides the 5, resultant emissions=35.7*0.16=5.8 Mt.

Total emissions=9+5.8 ≃16 Mt.

- The maximum reduction in emissions is being obtained with electrification under the alternate fuel Lever-
- Emissions reduced with electrification after application of alternate fuel lever in LoS scenario across the 5 MSME subsectors = 63.6-61.5≃2 Mt
- Emission factor= 2/63.6 =0.03.
- Assuming similar levels of achievements across other MSME subsectors besides the 5, resultant emissions=35.7*0.03=1.13 Mt
- Total emissions=2+1.13 ≃3.1 Mt.
- Emissions reduced with electrification after application of alternate fuel lever in Aggressive scenario across the 5 MSME subsectors = 63.6-59.1=4.5 Mt
- Emission factor= 4.5/63.6 =0.07.

- Assuming similar levels of achievements across other MSME subsectors besides the 5, resultant emissions=35.7*0.07=2.51 Mt

Total emissions=4.5+2.5≃7 Mt.

In the green electricity lever, the LoS scenario calls for electrical needs fulfilled by 45 percent RE, whereas aggressive scenario raises this to 60% of electrical needs provided by RE. Assuming RE electricity takes precedence over adoption of alternate fuels (due to market availability, lower calorific value, costs etc.), the following scenario is considered for further calculating emission reductions under green electricity lever.

The LoS and Aggressive scenarios for RE adoption are provided as-

Subsectors	**Emissions after alternate fuel adoption (Mt) (LoS Scenario)**	**Emissions after alternate fuel adoption (Mt) (Aggressive Scenario)**	**Emissions after green electricity Adoption (Mt)**	
			LoS	**Aggressive**
Textile	9.6	9.3	6.7	5.8
Paper and Pulp	26.9	25.4	19.6	17.7
Foundry	8.6	8.5	5.3	4.2
Forging	7.2	6.9	4.6	3.9
Steel Rerolling	9.3	9.1	6.1	5.1
Total	61.5	59.1	42.3	36.7

Emissions reduced after application of green electricity lever across 5 MSME subsectors in LoS scenario= 61.5-42.3= 19.2 Mt

Emission factor= 19.2/61.5 =0.31.

Emissions in other sectors besides the 5 after application of alternate fuel lever (with electrification) in LoS Scenario=35.7-1.13=34.5 Mt

Assuming similar levels of achievements across other MSME subsectors besides the 5, resultant emissions=34.5*0.31=10.8 Mt

Total emissions=19.2+10.8 ≃30 Mt.

Emissions reduced after application of green electricity lever across 5 MSME subsectors in Aggressive scenario= 61.5-36.7= 22.4 Mt

Emission factor= 22.4/59.1 =0.38.

Emissions in other sectors besides the 5 after application of alternate fuel lever (with electrification) in Aggressive Scenario=35.7-2.51=33.2 Mt

Assuming similar levels of achievements across other MSME subsectors besides the 5, resultant emissions=33.2*0.38=12.5 Mt

Total emissions=22.4+12.5≃35 Mt.

8.5 Annexure

Clusters identified for initial stages of energy efficiency implementation: The energy efficiency potential and cluster emissions across sectors have been formulated from BEE reports.

S. No.	Clusters/ Locations	Sector	Current Emissions (ton)	Reduction Potential (ton)	Investments (in Cr.)
1	Surat	Textile	1,11,47,947	63,54,330	7,837
2	Bhiwandi	Textile	37,88,978	21,59,717	2,664
3	Panipat	Textile	15,14,666	8,63,360	1,065
4	Tirupur	Textile	9,83,970	5,60,863	692
5	Jalna	Steel Re Rolling	21,95,600	4,83,032	644
6	Ludhiana	Textile	5,19,861	2,96,321	365
7	Morbi	Paper	24,07,000	2,88,840	433
8	Mandi-Gobindgarh	Steel Re Rolling	13,62,200	2,99,684	400
9	Raipur	Steel Re Rolling	11,28,800	2,48,336	331
10	Vapi	Paper	11,60,000	1,39,200	209
Total			**2,62,09,022**	**1,16,93,683**	**14,639**

8.6 Annexure

Calculation of outlay required by the government for enabling supply side of energy efficiency lever:

- The calculations have only considered the adoption of technologies in the 5 most energy-intensive/polluting MSME subsectors- Textile, Paper, Foundry, Forging, and Steel Re-Rolling with Technology Readiness Levels (TRL) greater than or equal to 7.
- The total fund requirement has been taken from the BEE-accredited list of Energy-Efficient technologies for 2023.
- Applicable cross-sectoral technologies have not been considered.
- It has been assumed that all technologies requiring an investment of more than ₹25 crore will not be taken up by MSMEs, considering their financial status and affinity. These technologies must be developed in India so that the overall costs can be reduced and the uptake can be increased.
- Further, technologies that provide enhanced potential savings (>20%) are selected as technologies to maximise MSME energy savings and emission reductions.
- It is further assumed that none of the technologies specified in the list have been adopted by MSMEs, and the subsidy is aimed at promoting the adoption of all these technologies in all the MSME units specified as per the reports by BEE for each subsector.
- These are recommendations, and modifications can be considered based on changes in assumptions and the underlying criteria defined for achieving the said numbers.

Sectors	**Textile**	**Forging**	**Foundry**	**Paper**	**Steel**	
Amount Required for energy efficiency measures implementation in each MSME unit (in Lakhs)	238	212	261	325	200	
Amount in crore	2.4	2.1	2.6	3.3	2	
Number of MSMEs- As per report	10509	1550	4500	324	1200	
Investment potential in energy efficiency						Total (In Cr)
Amount Required	25011	3286	11745	1053	2400	43495
Subsidy @15%						6524
Subsidy @20%						8699
Subsidy @30%						13049

8.7 Annexure

Clusters identified for the initial stages of green electricity implementation-

- It is assumed that 50% of electricity demand will be met by RE.
- Solar Rooftop CUF is assumed to be 21%.

S. No.	Clusters/ Locations	Current electricity consumption, in MtOe	Electricity Consumption (in kWh)	50% Electricity Demand (kWh)	Approximate Solar Capacity (MW)
1	Bhiwandi	0.4	4544000000	2272000000	1764
2	Jalna	0.21	2374240000	1187120000	922
3	Jagadhri	0.2	2272000000	1136000000	882
4	Surat	0.14	1625616000	812808000	631
5	Muzaffarnagar	0.12	1404096000	702048000	545
6	Rajkot	0.1	1160897292	580448646	451
7	Tirupur	0.07	742489600	371244800	288
8	Ludhiana	0.06	624800000	312400000	243
9	Jamnagar	0.04	397600000	198800000	154
10	Coimbatore	0.03	386240000	193120000	150
Total		**1.37**	**15531978892**	**7765989446**	**6031**

8.8 Annexure

PM Surya Ghar like initiative for MSMEs

The following assumptions are noted:

- Ratio of subsidy to actual loss computed for the domestic sector based on the state of Tamil Nadu.
- LOCE of solar for the domestic sector is assumed at Rs. 3 per unit.
- LCOE of domestic sector solar is assumed to be 0.21.
- Cost per unit of RE RTC taken from Techno economic analysis report (CEA 2024).
- Price escalation of RE and conventional power is assumed at 3% for the period of 20 years.
- Efficiency loss due to degradation of machinery for RE is assumed at 2% for the period of 20 years.
- RESCO profit margin for RE is assumed at 10%.
- Discounting rate of 8%is assumed to be provided by the RESCO for aggregated solar rooftop installations.
- CUF for RE Round The Clock (RTC) is 0.48 (CEA 2024).
- Power consumption of MSMEs taken from General Review report by Central Electricity Authority.
- Power consumed by MSMEs is 25% of total C&I consumption (Deloitte 2019).
- Ratio of Micro, Small, and medium enterprises is 90%,8%,2%for overall numbers of MSMEs in the country.
- Percentage of micro, small, medium enterprises opting/eligible for subsidy is 20 percent, 30% and 30% respectively.

Now, ratio of subsidy given to actual loss for domestic solar scheme (for the state of Tamil Nadu)-

- Assuming per annum power consumed by one house is 3000 units.
- Now, per unit cost of electricity in Tamil Nadu DISCOM is Rs. 1.17.
- Hence total cost of electricity is 3510.
- Now assuming 2000 units is generated from 1 kW solar (at LCOE of Rs. 3), then cost is Rs. 6000. Balance 1000 units from the grid which amounts to Rs. 1170.
- Calculating the Net present value by inferring loss incurred for the DISCOM (i.e. total subsidy required) at a discounting rate of 8% for a period of 20 years is Rs. 35934.
- If the subsidy provided for 1 kW solar is Rs. 30000, then the ratio of subsidy given is 30000/35934= 0.83.

Now, average cost of conventional electricity-

State	Cost per unit (INR)
Andhra Pradesh	7.10
Delhi	9.28
Gujarat	5.51
Karnataka	9.44
Maharashtra	10.63
Rajasthan	8.10
Tamil Nadu	10.32
Telangana	8.10
Uttar Pradesh	9.17
West Bengal	9.09
Average cost per unit	**8.67**

Considering the benchmark rates of green energy projects, which is I Rs. 4.23 crore/MW for solar, Rs. 6.50 crore/MW for wind and Rs. 5.60 crore/MW for biomass (from the concept paper on SBDS scheme).

Weighted average of 1 MW RE capacity = Rs. 5.41 crore per MW

Now the power consumption for MSMEs is tabulated as-

Total power consumed by MSMEs in India	Mn Units (Mn kWh)	1,33,730
MSME opting and eligible for subsidy scheme	%	21%
Total power consumed by MSMEs that opt and are eligible	Mn Units (Mn kWh)	28,083

Hence total capex required= (28083/1000/24*300) *5.41= ₹ 21109 crores

Model for power consumption and Net Present Value (NPV) for 1 MSME (With calculations for 20 years)

Year	**1**
Cost of conventional electricity	**8.67**
Net cost per unit of RE RTC	**6.80**
Cost per unit (taken from Case 2 of Techno Economic Analysis report)	4.97
Efficiency loss due to depreciation of machinery	-
Transmission loss (assumed at 1.5%)	0.07
Tariff	**5.04**
Banking charges (assumed flat ₹1.25 per unit)	**1.25**
10% profit margin of RESCO	**0.50**
Per unit Benefit/(loss) on account of switching to RE	1.87
Units consumed by MSMEs	2,110
Total cost of power consumption	3,956
NPV of benefit/(loss) on account of switching to RE	**(19,213)**
Ratio of subsidy to loss ratio for domestic solar	**0.83**
Subsidy required for 0.5 KW	**(16,040)**

Computation of subsidy required-

Capacity	**# MSME (Crs)**	**# of MSMEs opting for subsidy scheme (# Cr)**	**Subsidy per MSME unit (INR)**	**Total subsidy (INR Cr)**
Subsidy required for 0.50 KW (0-1 kW range)	5.70	1.14	19,918	36,603
Subsidy required for 1.5 KW (1-2 kW range)	0.51	0.15	48,120	7,321
Subsidy required for 2.5 KW (2-3 kW range)	0.13	0.04	80,200	3,050
Total subsidy required	**6.34**	**1.33**		**46,974**

NOTES

सत्यमेव जयते

NITI Aayog