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Decarbonization Challenges and Opportunities in India's Secondary Steel Sector:

A Stakeholder Perspective from West Bengal

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Executive Summary:

India's MSME steel sector, particularly re-rolling mills and induction furnace units, contributes significantly to national steel production—accounting for approximately 40% of crude steel output and employing over 400,000 people. The Durgapur steel cluster in West Bengal, with 136 registered units and around 60,000 workers, exemplifies the sector's economic and industrial importance. However, this sub-sector remains highly **energy-intensive,** relying heavily on outdated technologies and fossil fuels, resulting in substantial greenhouse gas (GHG) emissions. With emissions projected to rise sharply under a business-as-usual scenario, urgent decarbonization is essential to meet India's climate targets and remain globally competitive, especially under emerging carbon regulations like the EU's Carbon Border Adjustment Mechanism (CBAM).

This report explores the decarbonization challenges and opportunities in Durgapur's MSME steel cluster through stakeholder consultations and field observations. Key challenges identified include **technological obsolescence, high energy costs, financial and skill constraints, limited access to quality raw materials,** and **gaps in policy support.** These systemic issues make it difficult for MSMEs to adopt low-carbon technologies, access affordable finance, and comply with emerging market and regulatory demands. Despite these barriers, five clear pathways for low-carbon transition emerged -

1. Renewable Energy Integration :	Solar rooftop systems, cluster-level open access models, and partnerships with ESCOs offer immediate savings and reduced grid dependency.
2. Technological Upgrades :	Adopting best available technologies (BATs), such as energy-efficient furnaces and process automation, can significantly reduce emissions and improve productivity.
3. Efficient Scrap-Based Production:	Strengthening scrap sourcing, quality, and processing through shared infrastructure and circular-economy partnerships can cut material emissions and enhance furnace efficiency.
4. Government Schemes & Financial Incentives:	Schemes like PAT, SIDBI's green finance lines, and BEE initiatives, if made more MSME-accessible, can unlock investments in clean technologies.
5. Collaborations & Partnerships:	Engaging with large firms, finance institutions, and local authorities can create shared infrastructure, lower investment risk, and attract climate-aligned capital.

The report emphasizes the need for structured energy audits as a first step, alongside better awareness, financing access, and enabling policies. Targeted interventions—such as **simplified compliance processes,** and **carbon market participation**—can further strengthen the decarbonization roadmap.

In conclusion, while the Durgapur MSME steel cluster faces deep-rooted challenges, it also holds significant potential to lead India's low-carbon industrial transition. With coordinated policy support, practical financial tools, and collaborative frameworks, this sector can not only reduce its carbon footprint but also enhance its competitiveness in an evolving global market.

Introduction:

India's MSME steel sector, particularly **steel re-rolling mills** (SRRMs) and induction furnace units, is a vital pillar of the nation's steel industry, contributing ~40% of crude steel output (48 million tonnes of 120.23 million tonnes in FY 2022-23). Producing long products like TMT bars and angles, it supports construction, infrastructure, and accounts for 80% of India's bar exports, while employing ~400,000 people. The Durgapur cluster in West Bengal, with 136 iron and steel units supporting 60,000 jobs, exemplifies this economic role. However, its energy-intensive processes, reliance on outdated technologies, and fossil fuel use (coal, natural gas, pet coke) drive significant GHG emissions, projected to reach 563 MTCO2e by 2030 under a business-as-usual scenario. Decarbonization is critical to meet India's 2030 Paris Agreement targets and 2070 net-zero commitment, mitigating climate change impacts while addressing regulatory pressures like the EU's Carbon Border Adjustment Mechanism (CBAM), which threatens export competitiveness. This report explores **decarbonization pathways** for the MSME steel sector, focusing on Durgapur, to achieve sustainable, low-carbon production.

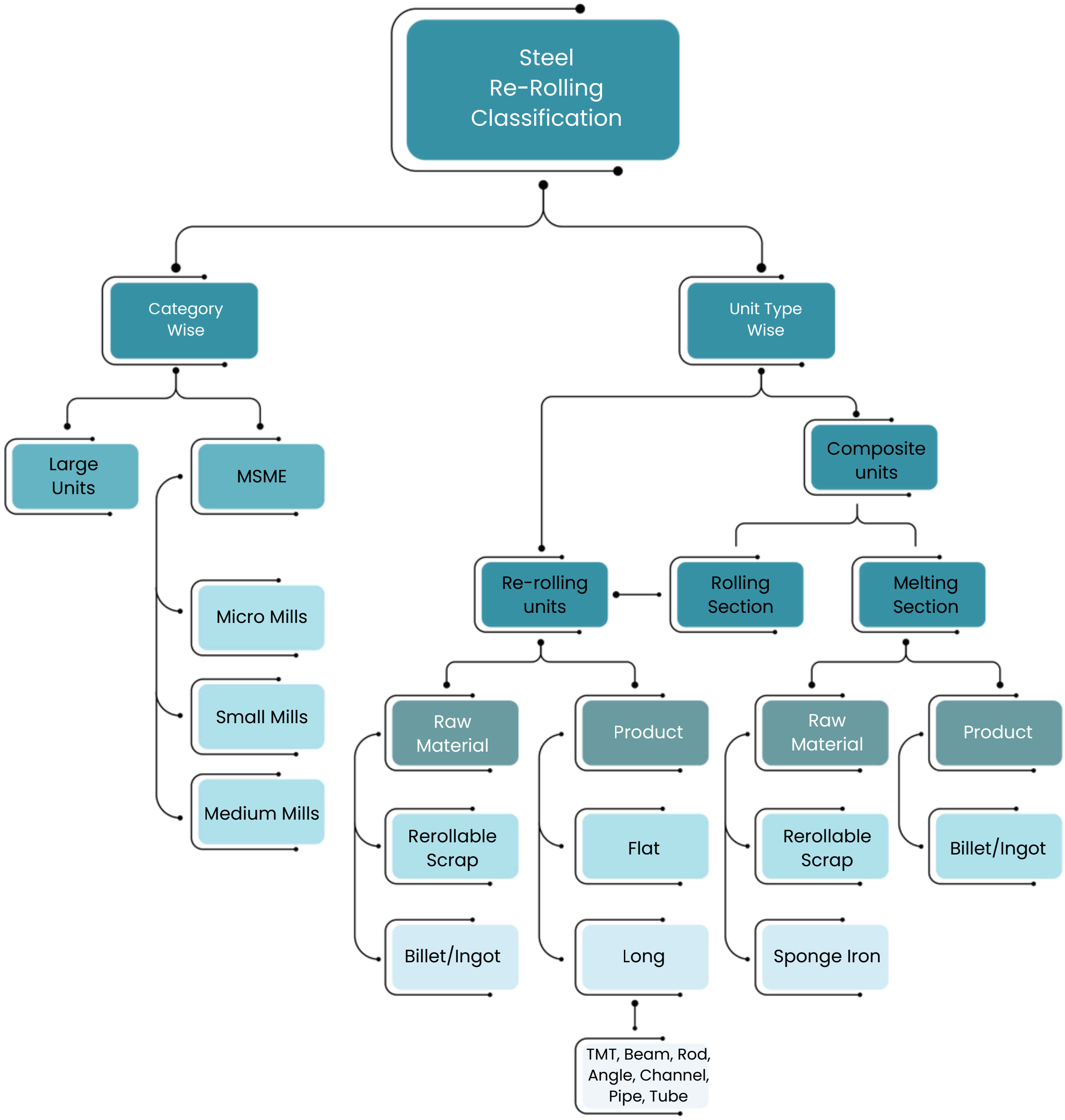
Present Scenario of MSME Steel Sector:

This MSME sub-sector is energy-intensive in their operations and generally uses a mix of both modern as well as conventional technologies for their day-to-day functioning, but at the same time, it holds immense potential for energy efficiency measures and up-gradation of technologies in routine processes.

Secondary steel sector or steel re-rolling (Global Steel Context: **World Steel Association**) is the process of transforming raw/unprocessed steel into finished steel products by rolling and re-rolling it into desired forms including bars, TMT (thermo-mechanically treated) rods, sectional products, and wires while it is still hot.

The steel re-rolling mill (SRRM) sector is one of the most important segments of the steel industry in India and is a key link in the supply chain of iron and steel production in the country. The sector produces majorly long products mills with the facility of the re-heating furnace and rolling mills. Few units have completed backward integration by installing induction furnaces to melt scrap and DRI cast by ingot or continuous casting.

The Steel rerolling units can be classified in 3 ways viz. based on the category (Small, Medium, Large), based on the raw material, and based on the products. The classification of the steel rerolling units is depicted below:



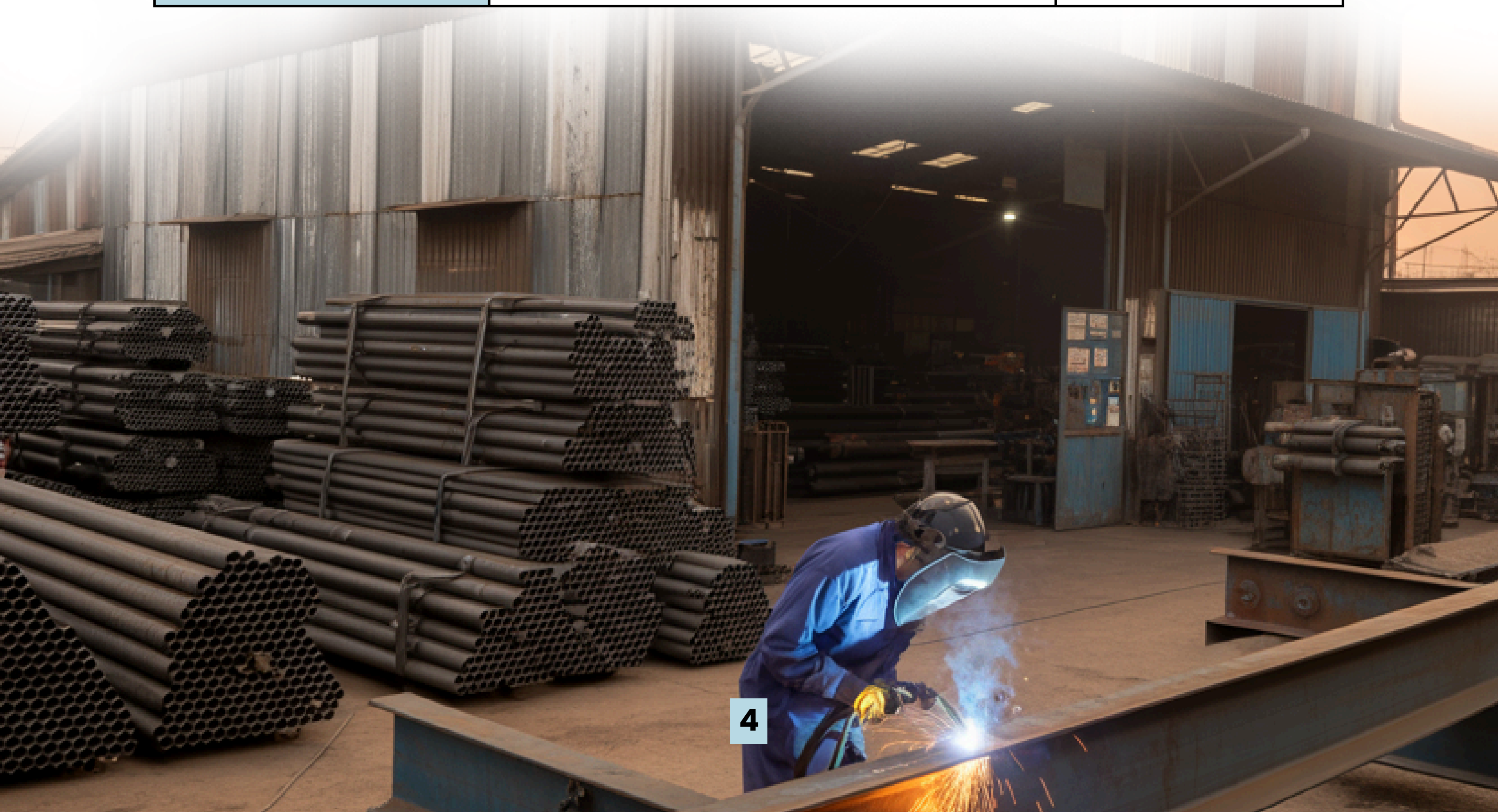
Mostly the Steel Rerolling units belong to the "Small" category which is estimated to be varying between 40 percent to 60 percent of the total number of units in the cluster. About 10 to 20 percent of the units belong to the Micro category.

According to TERI and GIZ (2022), India had **approx. 1,313 steel re-rolling mills**, comprising standalone and integrated units at the MSME scale. According to the Ministry of Steel Annual report, FY 2022-23, the steel production was 120.23 million tons (MT). As per TERI & GIZ, the entire secondary steel sector—which includes **333 DRI plants, 55 EAFs, 1103 IFs, and 1313 re-rolling mills—**contributes about **40% of total crude steel output** (TERI & GIZ. (2022). Indian Secondary Steel Sector Cluster Mapping and Resource Consumption Study.)

It is also reported that 80% of India's total exports of bars are sourced from the secondary steel sector. It is estimated that the sector employs, directly and indirectly, about 400,000 people (Energy and Resource Mapping of MSMEs In India (Steel Re-Rolling Sector Report, 2022). These employees are a mix of skilled engineers/operators, semi-skilled foremen and technicians, and unskilled shop-floor workers

The raw materials used in the re-rolling steel mills have a wide variety of materials from semi-finished steel (Billet/Blooms/Ingot) and the re-rollable scrap to pig iron, coal etc. These materials are mixed with the need and necessity of the production. As per ISO 6929 Steel products are classified into flat and non-flat products or long products. Mostly the large units produce flat products mainly sheets, about 73% of their total production and the units in the MSME category produces long products mainly Thermo Mechanically Treated Bars (TMT), angles, channels, beam, pipe, tubes and others, about 82% of the production (Joint Plant committee Survey of Indian Re-Rolling Industry).

End-User Industry	Product Type	Share of Demands
Construction	Commodity items - TMT, Hi beam, sheet pile and coated sheet	62%
Capital Goods	Steel Plates, sheets, pipes, bars and specifically and highly functional sheets	15%
Automobiles	Surface treated sheets, steel plates, sheets Pipes and bars	9%
Intermediate Products	Gear boxes, bearings, pipes, drums and barrels	6%
Consumer durables	Sheets, strips, plates and stainless steels	5%
Railway	Sheet metals and special steels	3%



Durgapur MSME Steel Cluster:
(Situational analysis of Secondary Steel Cluster)

Durgapur is located in Paschim Bardhaman district in the state of West Bengal, in eastern India. A major industrial hub, Durgapur, is adjacent to the Damodar River. The city developed post the establishment of the Durgapur steel plant in 1959. Some of the industrial areas, like Angadpur, Andal, Barjora, Bamunara, Jamuria, and Raniganj, are located nearby. Durgapur has some of the very big steel and energy plants, such as Durgapur Steel Plant (DSP), Durgapur Steel Thermal Power Station (DSTPS), and Damodar Valley Corporation (DVC). Durgapur also has one of the largest concentrations of micro, small, and medium enterprises (MSMEs) in West Bengal. The major secondary steel industry segments in Durgapur include direct reduced iron (DRI)/sponge iron, ferro alloys, steel melting, steel re-rolling mills (SRRMs), wire industries (WI), and foundry (cite). The industrial base of the region is primarily supported by the iron and steel industries. There are at least 136 registered iron and steel industries in the cluster.

Industry	Number
DRI	23
Ferro Alloy	7
steel Melting	43
SRRM	31
Wire industries	12
Foundary	20
Total	136

Some of the products manufactured by the secondary steel industries in the cluster include TMT bars, alloys, ingots, billets, angles, channels, wires, coils, sheets, and pipes. The products manufactured by the industries in the cluster are used in a wide range of end-use sectors, including building and construction, infrastructure, engineering, and so on. The products are transported by road and rail to different parts of the country. Some products are shipped to Haldia port in West Bengal for export.

The Durgapur cluster plays a vital role in integrating backward and downstream processes of the secondary steel sector. About 60,000 people are directly or indirectly employed by the steel industry. There is a substantial potential to reduce the energy consumption, with consequent reduction in greenhouse gas (GHG) emissions, among the steel industries in the cluster. Thus, the cluster is poised to play a pivotal role in the decarbonization of the steel sector in India.

Challenges:

Most of the steel rerolling units fall under MSME, and they cannot use advanced technological equipment or automation due to high capital costs. In the Durgapur MSME steel cluster, the key stakeholders' perspective is very important to understand the present challenges being faced by the different types of stakeholders - ranging from mill owners and plant managers to equipment suppliers and local regulators. The market is dominated by large players, which sometimes inhibit the growth of MSME enterprises. Besides this, the sector faces various challenges related to energy pricing, financial, and workforce skill-related challenges.

Challenge	Description	Impact
Technological Obsolescence	Many MSMEs use outdated and conventional technologies like coal-based EAFs and induction furnaces, which are energy-intensive and difficult to retrofit with modern, low-carbon alternatives.	Increases energy consumption, cost and emissions, making compliance with national standards challenging.
Financial Constraints	Limited access to capital due to low credit ratings. It restricts MSMEs' ability to invest in cleaner technologies. Only 16% of MSMEs receive timely finance, forcing reliance on internal resources.	Hinders adoption of energy-efficient and low-carbon technologies, limiting competitiveness.
Poor Raw Material Quality	Use of high-ash coal, high-alumina iron ore and poor quality of scrap increases energy consumption and emissions during steel production. Some semi-finished steel (i.e. Ingot/Billet/Blooms) produced are further processed in outdated technologies which makes it more inefficient	Raises production costs and environmental impact, complicating decarbonization efforts.
Workforce & Skill set Barriers	Plants and factories very often use energy efficient technologies and offer training in energy-efficient steelmaking, so plants lack both in-house and local talent versed in process controls, instrumentation, or preventive maintenance.	High energy cost, raises production cost and maintenance
High Energy Costs	Energy constitutes a significant portion of manufacturing costs, with MSMEs vulnerable to rising fuel prices, limiting funds for energy-efficient upgrades.	Restricts investment in decarbonization technologies, perpetuating reliance on fossil fuels.
Limited Market Access	Buyers' increasing demand for carbon accountability and high competition risks are excluding MSMEs unable to meet stringent emission standards, particularly in export markets.	Reduces competitiveness and market share
Lack of R&D Support	Limited access to research and development for innovative low-carbon technologies tailored to MSMEs' scale and needs.	Slows technological advancement and adoption of sustainable practices.
Low Awareness and Tech. adoption	There is widespread uncertainty about the ROI, maintenance demands, and operational complexity of advanced furnaces, digital monitoring systems, and green-energy integrations—leading many to stick with the traditional technologies.	High energy and production cost, loss of heat and energy.
Regulatory & Policy Gap	MSME tailored schemes are not that much accessible for easy finance, R&D and adoption of energy efficient technologies	Less adoption of Energy efficient technologies

The collective insights underscore that decarbonization in Durgapur's MSME steel sector hinges not only on technology upgrades but equally on improving processes, strengthening energy-management routines, streamlining finance access, bridging policy gaps, and building local technical capacity. Addressing these interconnected barriers will lay the groundwork for a credible, stakeholder-driven transition to lower-carbon steel production.

Opportunities:

Despite the challenges, Durgapur's MSME steel cluster has clear paths to speed up its shift to low-carbon production. Stakeholders pointed to five key areas: integrating renewable energy, upgrading technology, using scrap more efficiently, tapping government schemes and incentives, and building partnerships. At the heart of every pathway is energy efficiency, and most agreed that the best place to start is with a thorough energy audit. By looking at everything from furnace heat balance and motor performance to compressed-air leaks and lighting, mills can see exactly where they lose energy and pick the improvements that deliver the biggest impact. From there, they can boost efficiency by fine-tuning their production equipment and adding on-site renewables to cut grid reliance. Layering in better scrap management through a circular-economy approach and taking advantage of tailored policy support and finance options completes the picture, offering a practical roadmap for the cluster's decarbonization journey.

These pathways are : Renewable Energy Integration, Technological Upgrades, Efficient Scrap-Based Production, Government Schemes & Incentives, and Collaborations & Partnerships

- ### Renewable Energy Integration:

Most induction and electric-arc furnace units in Durgapur run independently and draw the majority of their energy from fossil-fuel–powered electricity. Adding renewables can therefore sharply reduce their carbon footprint and stabilize energy costs. Solar panels—whether installed on mill rooftops or in a shared cluster park—can supply a large slice of their power needs and shield operators from expensive grid tariffs. Some owners have already embraced rooftop solar, but confusing net-metering and net-billing regulations, scarce low-interest financing, and limited supplier information have slowed broader rollout. To bridge these gaps, mills could partner with an energy-service company (ESCO) to handle installation and maintenance or tap West Bengal's open-access rules to access green power. With clearer policies and streamlined funding, renewable integration can become both simple and cost-effective—delivering immediate savings and jump-starting the cluster's shift to low-carbon steelmaking.

- ### Technological Upgrade:

Beyond renewables, integrating the best available technologies into the existing production system can increase efficiency. Further incorporating advanced monitoring systems can lead to reduced energy loss, increased production, lower costs, and lower emissions. Integrating **Best Available Technologies** (BATs) into India's secondary steel sector can unlock substantial energy savings and emissions reductions across all major process routes. First, recovering and reusing process heat—whether from DRI kilns, arc furnaces, or reheating stations—can substantially lower overall energy demand and kickstart a culture of continuous improvement. Second, modest equipment upgrades (like modern burners, automated controls, and variable-speed drives) were seen as "no-regret" steps that unlock immediate efficiency gains without overhauling entire plants.

- ## Efficient Scrap based production:

Raising the quality and share of scrap through a shared sorting facility or circular-economy partnerships emerged as a win-win for cost savings and emission reductions. Strengthening **scrap procurement** and embedding **circular-economy practices** offers a high-leverage route to decarbonization. By creating shared sorting and preprocessing hubs, mills can access more uniform, contaminant-free scrap that not only boosts furnace efficiency but also cuts reliance on virgin inputs. Partnering with local municipalities, metal-recovery enterprises, and logistics providers was highlighted as a way to close the loop—turning urban and industrial by-products into reliable feedstock. This collective approach to scrap management not only drives down costs and emissions but also fosters a **collaborative ecosystem** where waste becomes a resource and every stakeholder shares in the value generated.

The government introduced the **Steel Scrap Recycling Policy (2019),** which mandates a hub-and-spoke model with 300 scrapping & dismantling centers funneling materials to ~70 processing units, aiming to increase scrap use in steel production from 15% today to 25% by FY27, and 50% by 2047. Complementing that, the **Vehicle Scrappage Policy (2021)** targets **end-of-life vehicle (ELV)** recycling by phasing out older vehicles and promoting authorized scrapping infrastructure. This unlocks a high-quality scrap stream that could boost domestic supply significantly.

- ## Government scheme and financial incentives:

Stakeholders were clear that unlocking decarbonization hinges on tailored government support and accessible financing. They called for a dedicated "secondary steel" window within national efficiency programs—complete with simplified application procedures and cluster-specific benchmarks—so that small mills aren't squeezed out by complex compliance requirements. Equally important is the expansion of concessional loan lines and credit guarantees through institutions like SIDBI and state industrial banks, coupled with streamlined access to central and state solar or energy-efficiency subsidies.

Many participants saw great promise in cluster-level ESCO arrangements supported by performance-linked grants or energy-savings certificates, which would allow groups of mills to pool financial resources, share risk, and attract green-bond or impact-investment funding. In their view, blending these policy and financing tools—rather than relying on one single scheme—will be key to driving rapid, scalable investments in low-carbon technologies across the Durgapur MSME steel cluster.

National and state programs—such as the Perform-Achieve-Trade (PAT) scheme, BEE's cluster initiatives, and SIDBI's SRIJAN/4E/STAR lines—offer both technical assistance and soft financing for efficiency upgrades and renewables. Projects under UNDP–MoS–AusAID have already achieved 20–30 percent energy savings and prevented hundreds of thousands of tonnes of CO_2 annually in mini-steel mills, demonstrating the scale of impact when these schemes are well-targeted.

- **Collaborations & Partnerships:**

Formal alliances—with larger steel companies, technology providers, financial institutions, and local governments—can unlock access to **advanced tools, shared infrastructure**, and **green-bond** or **impact-investment capital.** Scope-3 emission requirements from corporate offtakers can further incentivize MSMEs to bundle projects under cluster-level ESCO models, pooling resources and lowering the per-unit cost of decarbonization.

By weaving together targeted policy support, modular technology upgrades, renewable energy deployment, circular-economy practices, and collaborative financing, the Durgapur cluster can pursue both quick wins and longer-term pathways—transforming its secondary steel operations into a model of cost-effective, low-carbon production

Conclusion:

The MSME steel sector, a vital cog in India's industrial framework, faces a pivotal moment as it grapples with its carbon-intensive legacy and the pressing need for decarbonization. Producing 33 million tonnes annually via coal-based DRI and induction furnace routes, the sector's reliance on outdated technologies and fossil fuels has positioned it as a hard-to-abate industry, with emissions set to soar unless transformative action is taken. The Durgapur cluster reflects these challenges acutely—technological obsolescence, financial constraints, poor raw material quality, and high energy costs hinder progress, while regulatory pressures like CBAM threaten to erode its 46% share of India's steel exports. Yet, amidst these hurdles lie significant opportunities for change.

Pathways to decarbonization are clear and actionable: integrating renewable energy like solar power, adopting best available technologies (BATs) for energy efficiency, enhancing scrap-based production through circular economy practices, leveraging government schemes such as the Perform Achieve and Trade (PAT) initiative, and fostering collaborations with stakeholders ranging from technology providers to policymakers.

Energy efficiency, starting with comprehensive audits, offers immediate gains, while renewable energy adoption and improved scrap management can reduce both costs and emissions over time. Government support—through tailored financing, incentives, and cluster-specific programs—alongside partnerships with larger firms and research institutions, can bridge the resource gap for MSMEs. For Durgapur, these strategies promise not only environmental benefits but also enhanced competitiveness in a carbon-conscious global market. By embracing this multi-pronged approach, the MSME steel sector can transition from a high-emission outlier to a model of sustainable industrial growth, securing its economic relevance while aligning with India's net-zero ambitions.

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