Climate Change Report

Prepared by Promethium Carbon for:

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Executive Summary

This report by the South African Iron and Steel Institute (SAISI) evaluates the role and future of South Africa's iron and steel sector within the broader context of national and global climate action. Steel production remains a fundamental pillar of South Africa's economy, essential for industrial development, infrastructure growth, and employment. However, as a high-emitting sector, it faces considerable pressure to reduce emissions and align with international climate commitments and investor expectations.

Central to this assessment is the recognition of the steel industry's dual role. On the one hand, steel is a hard-to-abate sector, currently accounting for a significant share of South Africa's industrial greenhouse gas emissions. On the other hand, steel is an indispensable enabler of global decarbonisation. It is a foundational material in building the infrastructure required for the low-carbon transition: wind turbines, solar panel frames, electric vehicles, hydrogen electrolysers, transmission lines, rail systems, and climate-resilient urban infrastructure all depend heavily on steel. This intrinsic duality positions the steel industry not only as a challenge to decarbonise, but also as a catalyst for achieving global and national climate goals.

The global drive for decarbonisation, reinforced by the Paris Agreement and frameworks such as the EU Carbon Border Adjustment Mechanism (CBAM) and increasingly granular climate disclosures requirements, underscores the urgent need for South Africa's steel sector to strategically position itself as a leader in green industrialisation. Inaction or misalignment risks erosion of global market access, reduced investor confidence, and increasing trade exposure.

South Africa's evolving climate policy landscape, anchored by the Climate Change Act (2024), provides the framework for action. The Act introduces Sectoral Emission Targets (SETs), the Carbon Tax regime, and carbon offset regulations, which form a system designed to progressively reduce emissions intensity across industrial sectors. Complementing these national policies, the Steel Master Plan offers targeted strategic guidance and policy support, explicitly prioritising the industry's sustainable transformation, including the adoption of renewable energy, green hydrogen solutions, and circular economy practices. The Master Plan recognises the importance of decarbonisation not as a constraint, but as a pathway to competitiveness, reindustrialisation, and long-term sectoral growth.

Despite policy advancements, several critical barriers impede the sector's rapid decarbonisation. These include technological maturity and economic viability challenges, increasing cost burdens from carbon taxes, competition pressures from subsidised imports, and insufficient domestic incentives for investment in cleaner technologies. Addressing these barriers requires enhanced policy coherence, strategic investment, and collaborative efforts between industry, government, and financial institutions.

While the domestic steel industry faces structural and technological constraints, South Africa holds strategic potential to emerge as a niche producer of premium green steel[1], underpinned by high-grade iron ore, renewable energy resources, and growing international demand for low-carbon materials. Transition pathways are emerging, including near-term production of low-carbon steel through scrap-EAF powered by renewable PPAs and longer-term green DRI exports. Achieving scale will depend on resolving power and logistics bottlenecks, ensuring policy coherence, and unlocking blended finance.

In this context, SAISI holds an important role. As the central industry body, it can facilitate effective dialogue, provide strategic guidance to its members, advocate for coherent policy and regulatory alignment, and coordinate collective industry actions. SAISI's leadership is particularly important in guiding the industry through the complexities of international trade regulations such as the EU CBAM and investor-driven disclosure requirements, ensuring that the sector remains competitive, resilient, and aligned with international standards.

SAISI and its members rely on coordinated action across policy, technology, and finance to support South Africa's iron and steel sector in achieving meaningful decarbonisation while maintaining its critical economic role. The industry's successful transition is not merely a national imperative but a strategic opportunity to secure South Africa's long-term economic and environmental resilience in an increasingly climate-conscious global economy.

SAISI is committed to enabling this transition by facilitating structured dialogue between stakeholders, coordinating policy alignment, and supporting capacity-building across its membership.

[1] There is no standard definition for Green Steel – the carbon intensities vary across markets. See Table 1 in the following document: https://www.oxfordenergy.org/wpcms/wp-content/uploads/2025/06/CM12-50-Shades-of-Green-Steel.pdf

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ACRONYMS AND ABBREVIATIONS

AMSA	ArcelorMittal South Africa
BF	Blast Furnace
BOF	Basic Oxygen Furnace
CAPEX	Capital Expenditure
CBAM	Carbon Border Adjustment Mechanism
CCU	Carbon Capture and Use
CCUS	Carbon Capture, Utilisation and Storage
CEFIM	Clean Energy Finance and Investment Mobilisation
CISA	China Iron and Steel Association
COP28	28th Conference of the Parties (UNFCCC)
CSIR	Council for Scientific and Industrial Research
DFFE	Department of Forestry, Fisheries and the Environment
DRI	Direct Reduced Iron
DTIC	Department of Trade, Industry and Competition
EAF	Electric Arc Furnace
EU	European Union
EU ETS	European Union Emissions Trading System
EUROFER	The European Steel Association
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GMSA	Grinding Media South Africa
H_2-DRI	Hydrogen-based Direct Reduced Iron
IEA	International Energy Agency
IFRS S2	International Financial Reporting Standards - Climate-related Disclosures Standard

ISA	Indian Steel Association
LCOS	Levelised Cost of Steel
MIIT	Ministry of Industry and Information Technology (China)
MOE	Molten Oxide Electrolysis
MRV	Monitoring, Reporting and Verification
Mt	Million tonnes
NDC	Nationally Determined Contribution
OGCI	Oil and Gas Climate Initiative
REIPPPP	Renewable Energy Independent Power Producer Procurement Programme
SAISI	South African Iron and Steel Institute
SBTi	Science Based Targets initiative
SETs	Sector Emission Targets
TRL	Technology Readiness Level
UK	United Kingdom
WTO	World Trade Organization

1 Introduction

1.1 Purpose of the Report

The South African Iron and Steel Institute (SAISI) has commissioned this Climate Change Report to articulate a unified industry perspective on the challenges, opportunities, and strategic priorities facing the sector as South Africa's transition to a low-carbon economy. SAISI recognises the need for a clear, evidence-based strategy to support policy engagement, investment decisions and industrial resilience.

This report aims to position the South African steel and iron sector within national climate planning and international dialogue on decarbonisation. It aims to:

- Highlight the sector's strategic importance in enabling green infrastructure and energy transitions;
- Assess the emissions profile and decarbonisation potential of domestic steel production;
- Identify technology pathways and policy mechanisms that support a just, feasible and competitive transition;
- Provide a common reference point for stakeholders, including SAISI members, government, investors and international partners, to align around credible transition pathways.

SAISI intends for the report to support informed decision-making within the sector. It provides a foundation for SAISI members to engage with regulatory and market dynamics, prepare for carbon-related trade measures and explore opportunities for climate-aligned investment. This will help ensure that the domestic steel sector remains both resilient and competitive in a carbon-constrained global economy.

1.2 Framing the Role of Steel in a Low-Carbon Economy

The global transition towards a low-carbon economy hinges significantly on reducing emissions from heavy industries, particularly iron and steel, due to its critical role in both contributing to emissions and enabling the decarbonisation of other sectors.[2] Steel production globally accounts for around 8% of total energy-related carbon dioxide emissions, a considerable portion attributed to energy-intensive processes and reliance on fossil fuels.[3] Despite this emissions intensity, steel's essential role in infrastructure, renewable energy deployment, and technological advancements, positions it uniquely as a strategic enabler in global decarbonisation efforts.[4]

2 International Energy Agency (IEA). 2022. *Achieving Net Zero Heavy Industry Sectors in G7 Members*. Paris: IEA. Available here

3 World Steel Association (WSA). 2024. *World Steel in Figures 2024*. Available here

4 South African Iron and Steel Institute (SAISI). 2025. *The South African Iron and Steel's Position on Carbon Tax – February 2025*. Pretoria: SAISI. Available here

1.2.1 The dual role of steel (emissions invested vs emissions enabled)

Steel production represents a complex duality: it is both a significant source of greenhouse gas emissions ("emissions invested") and a critical component in enabling substantial emissions reductions across numerous sectors ("emissions enabled"). Most emissions arise from coal-based blast furnace methods, which remain dominant globally. Globally, steel production generates approximately 1.92 tonnes of CO_2 per tonne of steel produced.[5] South Africa's steel sector mirrors this global challenge, due to its reliance on coal-based electricity and production routes.

Despite its emissions-intensive nature, steel is indispensable in facilitating a global energy transition. Renewable energy technologies, critical for achieving global net-zero targets, heavily depend on steel. Each megawatt (MW) of newly installed solar power requires approximately 40 tonnes of steel, whereas each MW of wind power demands between 50 tonnes (onshore) and 200 tonnes (offshore) of steel[6]. The UAE Consensus goal of tripling renewable capacity by 2030 highlights the scale of steel demand for clean energy infrastructure.

Global forecast scenarios, such as those by the Network for Greening the Financial System (NGFS)'s Global Change Analysis Model (GCAM) imply growing steel related specifically to global infrastructure expansion and green technology deployment.

GCAM is an internationally recognised model that links energy, land, water, economy and climate systems to assess long-term global change. It projects energy supply and demand, technology shifts, emissions, and land-use changes up to 2100. GCAM is well suited for this assessment because it provides detailed, internally consistent projections of solar and wind electricity generation, installed capacity, and associated emissions under different climate scenarios, allowing the estimation of future steel demand linked to renewable energy growth.

- The Current Policies scenario reflects only climate policies and regulations in place as of March 2024. Fossil fuels remain dominant, carbon prices stay low, and global emissions continue to rise, leading to around 2.9 °C of warming by 2100.
- The Below 2 °C scenario assumes a gradual increase in climate ambition, with countries implementing stronger policies and some using carbon removal. Global carbon prices rise steadily, and warming is limited to around 1.7 °C by 2100.
- The Net Zero 2050 scenario represents a rapid and coordinated global shift. Major economies achieve net-zero CO_2 emissions by 2050, supported by high carbon prices, strong renewable energy growth, electrification, and carbon removal technologies. Warming is kept close to 1.5 °C.

Between 2025 and 2050, the world requires approximately 44.5 terawatts (TW) of solar and wind capacity in the Net Zero 2050 scenario, translating to 1.3 billion tonnes of steel needed to support these instalments – see Figure 1.

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5 World Steel Association (WSA). 2024. *Sustainability Indicators 2024 report.* Available here

6 ArcelorMittal. *Steel is the power behind renewable energy*. Available here

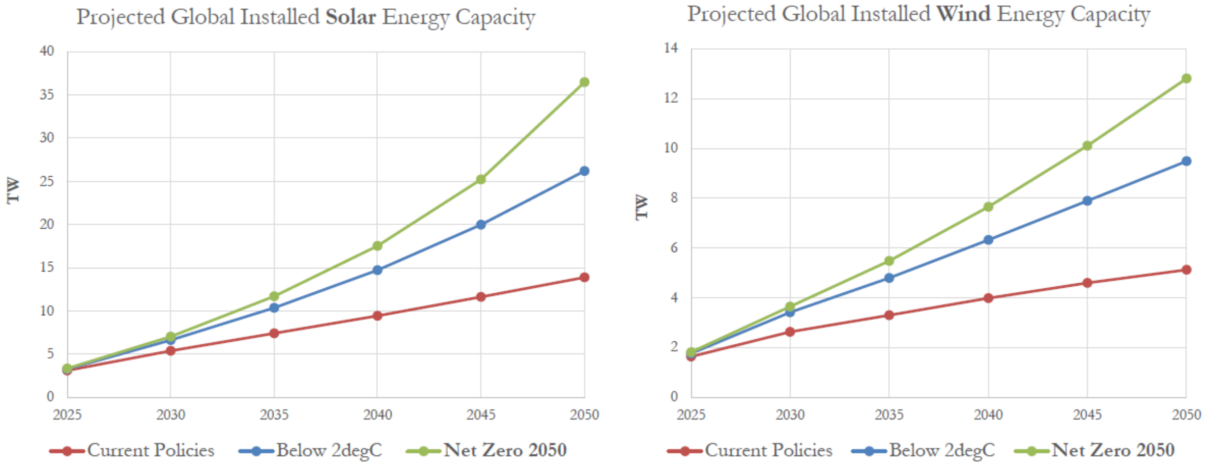

Figure 1: Solar and wind installation required from 2025 to 2050

This 44.5 TW solar and wind investment would save approximately 31.8 gigatonnes (Gt) of CO_2 over the same period, equating to 10 tonnes of CO_2 abated for every tonne of steel produced (delivering 10 times more emissions savings than it generates in production). This results in an average carbon "payback" period of roughly 4 - 7 weeks for steel used in renewable wind and solar systems respectively considering one year of operation.

Considering the increase of solar and wind energy and steel production projections by the NGFS, by 2050, roughly 75% of global steel production would be applied to solar and wind energy construction (Figure 2).

Figure 2: Global steel production vs. requirement for solar and wind projections

Steel's role extends beyond renewables, enabling numerous other decarbonisation technologies, including hydropower installations, carbon capture and storage infrastructure, green hydrogen electrolyser frames, electric vehicle chassis, battery storage, high-voltage transmission towers, high-speed rail networks, and efficient building heat-pumps (Figure 3).

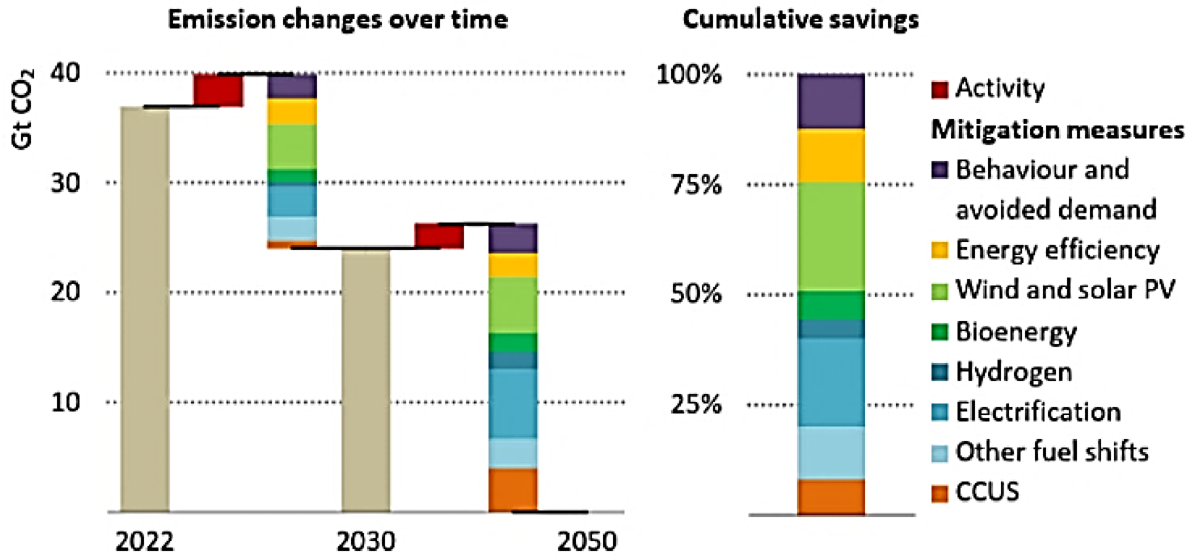

Figure 3: Mitigation measures and associated emissions savings enabled by steel

The emissions savings enabled by steel significantly surpass the emissions invested in its production, placing it strategically within the broader global climate *solution* category.

1.2.2 Steel as a strategic enabler of green industrialisation

The International Energy Agency's roadmap to net-zero by 2050 identify steel as a priority sector, highlighting the urgent need for transitioning to "near-zero emissions" production methodologies. These methodologies encompass advanced technologies such as hydrogen-based Direct Reduced Iron (H_2-DRI), electric arc furnaces (EAF) powered by renewable energy, and carbon capture utilisation and storage (CCUS). South Africa has made notable progress in positioning itself as a future green hydrogen producer, supported by the Hydrogen Society Roadmap and pilot projects such as the Boegoebaai Green Hydrogen Hub. These initiatives aim to develop export-oriented hydrogen supply chains and domestic applications in hard-to-abate sectors like steel. Implementing these technologies would align the iron and steel sector not only with climate objectives but also positions it competitively within an increasingly carbon-conscious global market.[7]

In South Africa, aligning industrial strategy with climate policy through initiatives such as the Steel Master Plan provides a pathway towards green industrialisation.[8] The Steel Master Plan explicitly identifies sustainable practices, renewable energy integration, circular economy approaches, and green hydrogen as pivotal elements for the industry's long-term competitiveness and

7 International Energy Agency (IEA). 2022. *Achieving Net Zero Heavy Industry Sectors in G7 Members*. Paris: IEA. Available here

8 Department of Trade, Industry and Competition (DTIC). 2022. *The South African Steel and Metal Fabrication Master Plan 1.0*. Available here

sustainability.[9] These priorities align the iron and steel sector with broader industrial policy objectives aimed at **stimulating innovation, economic diversification, and employment growth**, all within a sustainable and climate-responsive framework.

The ambition towards green steel production can further position South Africa within global supply chains. The EU Carbon Border Adjustment Mechanism (CBAM) and investor-driven climate disclosures are becoming increasingly stringent. Aligning steel production practices with these international standards are important. Early adoption of low-emission steel production processes provides competitive advantages, securing access to international markets and attracting green investment flows (Hector et al., 2025).

In South Africa, early initiatives such as green hydrogen demonstration projects[10], supported by national strategies including the JET-IP, demonstrate the practical pathways through which steel producers can align with global decarbonisation roadmaps. Such pilots not only prove the feasibility of emerging green technologies but also create investor confidence and industrial momentum towards scaling these approaches nationally (JET-IP, 2023).

This transition, while presenting many opportunities, poses significant greenhouse gas emissions reduction challenges to steel manufacturing - a hard-to-abate sector. Beyond high capital costs, early adoption of low-carbon steel technologies carries additional risks including market volatility in green product demand, technological immaturity, uncertainty over public and investor willingness to absorb green premiums, and critical skills shortages needed to operate and maintain advanced systems. The iron and steel sector's role in green industrialisation recognises South Africa's socio-economic landscape, where industrial growth, employment, and trade competitiveness are paramount, but often compete or contradict decarbonisation goals. **The South African iron and steel industry must therefore balance the imperatives of national and global decarbonisation goals with the imperative to sustain industrial growth and employment.**

Coordinated action and realistic, phased implementation across policy and technology investment is needed to ensure that the sector effectively contributes to South Africa's climate objectives. Coordinated action can provide a supportive environment for technology adoption, facilitate meaningful investment in cleaner production methods, and enhance the sector's resilience and global competitiveness. Coordination across the sector must also remain compliant with the Competition Act (1998), particularly in relation to information sharing, price coordination, and collaborative investment planning, which must avoid anti-competitive practices while enabling strategic alignment for decarbonisation. This approach however, if implemented with the relevant considerations, not only addresses immediate climate imperatives but also safeguards the long-term viability and growth potential of South Africa's iron and steel industry, underscoring its vital role in the broader national economic and environmental sustainability agenda.

[9] Department of Trade, Industry and Competition (DTIC). 2022. *The South African Steel and Metal Fabrication Master Plan 1.0*. Available here

[10] GIZ, 2025. African Green Hydrogen Report – Potential to Power, Advancing Green Hydrogen Across Africa. Available at: https://ptx-hub.org/wp-content/uploads/2025/06/African-Green-Hydrogen-Report-2025.pdf

As a strategic enabler of green industrialisation, the iron and steel sector holds the potential to drive economic resilience while acting in a climate-responsible manner, aligning itself with South Africa's broader climate and industrial policy landscape.

2 Drivers of Decarbonisation

2.1 International Climate Commitments and Expectations

The global climate agenda, framed largely by the Paris Agreement[11], has set clear international expectations for ambitious climate action, requiring countries to articulate their commitments through Nationally Determined Contributions (NDCs). Central to these commitments is the objective to limit global warming to well below 2°C, with efforts to keep temperature rise to 1.5°C above pre-industrial levels. The UAE Consensus, adopted at COP28, has further elevated international expectations by explicitly emphasizing the need for increased ambition, clear economy-wide targets covering all greenhouse gases and sectors, and explicit commitments to accelerate a just transition away from fossil fuels.

South Africa, as a signatory to the Paris Agreement, has responded by submitting its updated NDC in 2021, setting quantified emission reduction targets up to 2030, strengthening adaptation commitments, and outlining principles for a just transition. The country's next NDC update for the period 2030–2035 must significantly enhance ambition and comprehensiveness to align with these heightened international standards. Specifically, South Africa is expected to adopt clear targets for clean energy transition, energy efficiency benchmarks, and defined timelines for fossil fuel phase-down. These enhanced commitments are critical, not only for environmental and reputational reasons but also due to the mounting socio-economic imperative to protect development gains and economic stability from intensifying climate risks.

The International Energy Agency (IEA)[12] underscores the pivotal role of steel in constructing the infrastructure necessary for clean energy transitions, highlighting the need for massive market scaling for near-zero emissions steel. Such scaling requires coordinated policy measures, substantial investment, and international collaboration to overcome barriers related to high costs and technological risks. For the South African iron and steel sector, aligning with these international commitments and expectations is imperative to maintaining global competitiveness and accessing international markets increasingly sensitive to carbon footprints.

Global decarbonisation expectations for hard-to-abate sectors

The global steel industry is undergoing a fundamental transformation in response to climate change. According to the World Steel Association, steel production accounts for approximately 7–9% of global anthropogenic CO_2 emissions, with a global average of 1.92 tonnes of CO_2 emitted per tonne of steel produced. Yet, steel is also a critical enabler of climate mitigation - used in

11 UNFCCC Paris Agreement, November 2015. Available at: [Paris Agreement English (unfccc.int)]

12 https://www.iea.org/reports/world-energy-outlook-2022/an-updated-roadmap-to-net-zero-emissions-by-2050

renewable energy systems, electric transport, low-carbon buildings, and climate-resilient infrastructure.

The World Steel Association outlines a three-pillar strategy for decarbonisation:

- Improving efficiency through programs like Step Up[13];
- Maximising scrap use; and,
- Deploying breakthrough technologies such as hydrogen-based reduction, carbon capture and storage, and electrification via electrolysis.

The sector-wide roadmap developed by the International Energy Agency (IEA) sets a target of reducing emissions intensity of crude steel by 58% by 2050 under its Sustainable Development Scenario.

The World Steel Association stresses the importance of partnerships between governments, industry, and finance in enabling this transformation. SAISI, as South Africa's representative industry body, must play a proactive role in aligning domestic strategies with global pathways, facilitating knowledge exchange, advocating for enabling policies, and supporting its members in accessing international technologies, capital, and markets for low-carbon steel.

2.2 South African Climate Policy Context

South Africa's climate policy landscape is driven primarily by the Climate Change Act, 2024, supported by a broader policy framework that includes the Sectoral Emissions Targets (SETs), Carbon Tax regime, Carbon Offset Regulations, and planning instruments aimed at achieving net-zero emissions by mid-century, ensuring a just transition and enabling sustainable economic development. Understanding the implications of these are essential for enabling realistic and economically sustainable decarbonisation pathways within the iron and steel industry.

2.2.1 Climate Change Act

The Climate Change Act of 2024 forms the legislative backbone for South Africa's climate response, mandating an integrated, coordinated, and just transition towards a low-carbon and climate-resilient economy. Its key objectives include coordinating climate action across governance levels, enhancing resilience to climate impacts, contributing fairly to global emissions reduction efforts, and ensuring equity through a just transition. The Act also formalizes South Africa's international climate commitments, laying the groundwork for sector-specific targets and

[13] The "Step Up" programme, launched by the World Steel Association in 2019, is a four-stage efficiency initiative designed to help steel producers enhance operations by optimising raw material use, energy consumption, yield, and process reliability, enabling underperforming plants to reach the efficiency levels of the industry's best performers.

adaptation strategies that align national developmental objectives with climate goals.[14] The objectives of the Act are to:

1. Provide for a coordinated and integrated response by the economy and society to climate change and its impacts in accordance with the principles of cooperative governance;
2. Provide for the effective management of inevitable climate change impacts by enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change, with a view to building social, economic and environmental resilience;
3. Make a fair contribution to the global effort to stabilise greenhouse gas concentrations in the atmosphere at a level that avoids dangerous anthropogenic interference with the climate system;
4. Ensure a just transition towards a low carbon economy and society considering national circumstances;
5. Give effect to the South Africa's international commitments and obligations in relation to climate change; and
6. Protect and preserve the planet for the benefit of present and future generations of humankind.

2.2.2 Sector Emission Targets, Carbon Tax Act and Carbon Offset Regulations

The draft Sector Emission Targets (SETs) introduced alongside the Climate Change Act provide sector-specific pathways for emissions reduction. For the iron and steel sector, clear emissions reduction pathways are critical due to its significant contribution to national emissions. Achieving these targets will require substantial shifts in production methods, including the adoption of cleaner technologies and increased energy efficiency.

Complementing the SETs, the Carbon Tax Act[15] establishes a market-based mechanism to price carbon emissions, directly impacting heavy-emitting sectors like steel. Entities emitting greenhouse gases above prescribed thresholds are liable for this tax, with rates progressively increasing from R159 per tCO_2e in 2023 to R462 per tCO_2e by 2030.

The Carbon Offset Regulations permit companies to offset a portion of their tax liability through specific mitigation projects. Energy-efficiency upgrades in EAF operations (under Section 12L) currently receive a separate tax incentive and, under present rules, do not qualify as carbon tax offsets, though proposed phase-two reforms may transition certain projects into the offset regime post-2025. Renewable electricity procurement via REIPPPP solar PPAs does qualify as an offset, provided the PPA was signed after 9 May 2013 and the project receives no other overlapping support. Other limitations may further apply, for instance, geological carbon dioxide sequestration and certain renewable energy projects are excluded, affecting potential offset strategies available to the steel industry.

14 Climate Change Act 22 of 2024
15 Carbon Offset Regulations (No. 1556). [Carbon Tax Act: Regulations (www.gov.za)]

While the tax is designed to incentivise emissions reductions, it raises serious concerns regarding disproportionate financial impacts on the domestic steel industry. The local steel sector already faces several operational and market challenges, including high input costs (particularly electricity and raw materials), unreliable energy supply, and intense competition from cheaper, often state-subsidised imports. These imports, frequently produced in jurisdictions with less stringent climate policies, are not subject to equivalent carbon costs. This undermines the competitiveness of South African producers, particularly as there is currently no effective mechanism in place domestically to level the playing field.[16]

In the absence of such protective measures or meaningful support for decarbonisation investments, the escalating carbon tax imposes a significant cost burden that may result in loss of market share and further deindustrialisation. The limited availability and scope of eligible carbon offset projects restricts the industry's ability to mitigate this financial impact. For example, some renewable energy projects and geological carbon capture and storage - two important pathways for steel decarbonisation - are excluded from qualifying as carbon offset activities under the current regulations.

Given these pressures, SAISI advocates for a sector-sensitive approach to carbon pricing that acknowledges the steel industry's strategic role in enabling a just transition, and calls for alignment between climate, trade, and industrial policy objectives to avoid unintended socio-economic consequences.

2.2.3 Other Relevant Policies and Strategies

The Low Emissions Development Strategy (LEDS) outlines a vision for achieving net-zero emissions by 2050. For the steel sector, identified as one of the country's major emitters, the strategy emphasises phased decarbonisation, initially prioritising energy efficiency and increased adoption of Electric Arc Furnace (EAF) technology using scrap steel, followed by longer-term strategies including hydrogen-based Direct Reduced Iron (DRI) and targeted deployment of Carbon Capture, Utilisation, and Storage (CCUS). Energy policies, particularly the Integrated Resource Plan (IRP) and the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP), critically influence the steel sector's transition to sustainability. These policies steer the national energy mix toward renewable sources, offering the steel sector access to sustainable, cost-effective electricity, essential for reducing carbon intensity. Furthermore, direct energy procurement agreements under REIPPPP present opportunities for enhancing energy security and operational cost-efficiency in the steel sector.

Complementing the LEDS, the Just Transition Framework[17] addresses socio-economic equity in climate policies, aiming to safeguard employment, stimulate economic diversification, and support

[16] South African Iron and Steel Institute (SAISI). 2025. *The South African Iron and Steel's Position on Carbon Tax – February 2025*. Pretoria: SAISI. Available here

[17] A Framework for a Just Transition in South Africa, Presidential Climate Commission Report, 2022. Available at: 22_PAPER_Framework-for-a-Just-Transition_revised_242.pdf (imgix.net)

vulnerable regions dependent on coal and carbon-intensive industries. The Medium-Term Strategic Framework (MTSF), Just Energy Transition Investment Plan (JET-IP), and Just Transition Financing Mechanism (JTFM) further provide strategic and financial guidance essential for the steel sector's sustainable transformation.

The MTSF embeds industrial growth within the national development agenda, ensuring that climate-aligned infrastructure investments create new demand for local steel. For the steel sector, MTSF-aligned initiatives encourage the strengthening of domestic manufacturing capacity, particularly through public procurement of steel-intensive projects such as infrastructure, construction, and energy systems. This supports demand for locally produced steel while reinforcing economic stability during a green transition.

The JET-IP provides investment pathways and concessional financing specifically designed to de-risk the adoption of decarbonisation technologies, while prioritising renewable power and green hydrogen infrastructure essential to cleaner steel production. For iron and steel specifically, the JET-IP provides:

- Targeted support for low-carbon energy integration – funding mechanisms for renewable energy infrastructure and grid upgrades essential for powering electric arc furnaces (EAF), green hydrogen initiatives, and other decarbonisation technologies in steel production.
- Cross-cutting support for skills and municipal capacity development – key to enabling green transition in industrial regions, creating skilled jobs, and supporting infrastructure investment in steelmaking hubs.
- International pledges to the Just Energy Transition Partnership rose from USD 8.5 billion at COP26 in 2021 to USD 11.6 billion by 2023. Still, average annual climate finance tracked for 2019–2021 (R 131 billion) remains well below South Africa's needs of R 334 to R 535 billion per annum.

While the JET-IP and its expanded portfolios prioritise the energy, transport, and municipal sectors, targeted support for steel sector decarbonisation remains notably absent. Given the industry's critical role in enabling green infrastructure, future iterations of JET-IP should explicitly include hard-to-abate industrial sectors like steel to ensure a just and economy-wide transition.

The Just Transition Financing Mechanism (JTFM) complements JET-IP by channelling blended finance (grants, concessional loans, and public investment) into decarbonisation projects that support both industrial growth and social equity, unlocking pilot and scale-up opportunities in low-carbon steelmaking (including green hydrogen, CCUS pilots), energy access in industrial clusters (where steel manufacturers are often located), and just transition outcomes for workers and communities.

2.2.4 Steel and Metal Fabrication Master Plan

The Steel and Metal Fabrication Master Plan represents a sector plan developed through extensive engagement among industry stakeholders, labour unions, and government, aiming to stabilise and revitalise South Africa's steel industry through collaborative and adaptive strategies. Recognising the urgent need for transformation amid ongoing socio-economic and environmental challenges, the plan emphasizes the necessity of long-term thinking, particularly regarding sustainability and green industrialisation.[18]

A central strategic objective of the Master Plan is the transition towards "green steel" production, targeting carbon neutrality by 2050. This ambitious target aligns directly with South Africa's national climate goals and international climate commitments. The Plan explicitly acknowledges the importance of environmental considerations in investment planning, highlighting the need for integrating renewable energy sources, improved water efficiency and recycling, the transition to gas and hydrogen energy sources, and embracing circular economy principles within the steel value chain. The proposed adoption of hydrogen-based steel production technologies and renewable energy integration underscores a clear commitment to decarbonisation and aligns the steel industry's growth trajectory with the broader national strategy towards achieving a low-carbon economy. [19]

Furthermore, the Steel Master Plan recognises the critical role that infrastructure investment plays in creating demand for steel products. It supports localization by aligning infrastructure development plans with domestic steel production capabilities. Government-led initiatives, such as the Infrastructure Fund and the localisation drive through state-owned entities (e.g., Transnet and Infrastructure South Africa), are identified as significant opportunities for increasing demand for domestically produced steel. This alignment is essential not only for reducing import dependency but also for reinforcing the resilience and competitiveness of the steel industry amidst global trade pressures such as the EU Carbon Border Adjustment Mechanism (CBAM).

In addressing systemic challenges within the industry, the Steel Master Plan proposes a comprehensive approach to enhance competitiveness through improved infrastructure, reduction in administrative and regulatory burdens, and more predictable energy and raw material costs. These improvements are vital for creating a favourable investment environment. Additionally, the plan outlines the establishment of targeted financial mechanisms, including a Steel Industry Development Fund and the Industrial Development Corporation's (IDC) concessional financing, aimed at supporting critical industry projects and mitigating financial constraints on growth and technological innovation. [20]

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[18] Department of Trade, Industry and Competition (DTIC). 2022. *The South African Steel and Metal Fabrication Master Plan 1.0*. Available here

[19] Department of Trade, Industry and Competition (DTIC). 2022. *The South African Steel and Metal Fabrication Master Plan 1.0*. Available here

[20] Department of Trade, Industry and Competition (DTIC). 2022. *The South African Steel and Metal Fabrication Master Plan 1.0*. Available here

The Steel Master Plan recognises the socio-economic dimensions of the industry's transition, particularly regarding employment and industrial growth. The Just Transition Framework embedded within the Master Plan highlights the imperative of balancing climate objectives with job preservation, skill enhancement, and socio-economic equity. It also identifies specific measures such as industry consolidation guidelines under the Competition Act, export promotion strategies within the African Continental Free Trade Area (AfCFTA), and strengthened procurement practices to stimulate sustainable domestic demand.

2.2.5 Barriers to Sector Decarbonisation

The iron and steel sector's decarbonisation efforts face persistent technological and financial challenges, particularly concerning the affordability and maturity of decarbonisation technologies like hydrogen-based Direct Reduced Iron (DRI), electric arc furnaces (EAF), and carbon capture, utilisation, and storage (CCUS). These technologies are either not commercially viable at scale or require substantial capital investments that are currently unaffordable given the sector's strained financial state.

The financial strain is exacerbated by the increased carbon tax rates and reduced allowances in the second phase of South Africa’s carbon tax regime. From 2026 onwards, steel producers face significantly higher tax liabilities (both due to the escalating carbon tax rate and reduction in basic-free allowances), reducing available cash flow and limiting their capacity to invest in necessary decarbonisation projects. Moreover, the cost of carbon offsets, often exceeding the carbon tax rate itself, further diverts investment away from genuine decarbonisation efforts.

Market conditions also pose a critical barrier. The South African steel sector struggles with declining domestic demand, exacerbated by a continuous influx of low-cost imports, particularly from regions benefiting from significant governmental subsidies and protectionist policies. Such competitive disparities severely affect local producers' profitability and operational viability, significantly limiting the financial resources available for investment in decarbonisation initiatives.

Furthermore, systemic issues such as logistical inefficiencies, high energy costs, and inadequate infrastructure further constrain the industry's ability to transition effectively. The absence of sufficient governmental financial support and subsidies comparable to international peers further disadvantages South African steelmakers, creating an uneven playing field in the global market.

A further barrier arises from South Africa’s deteriorating freight and rail infrastructure, particularly the operational inefficiencies at Transnet. Frequent disruptions and capacity constraints on key rail corridors have led to increased reliance on more carbon-intensive road transport and have raised the delivered cost of bulk commodities, including iron ore and steel. These logistical challenges directly impact the competitiveness of domestic steel producers and increase the cost base for both conventional and low-carbon production pathways. For emerging green steel initiatives, such as those reliant on high-purity ore exports or regional hydrogen hubs, logistics reliability is essential to secure long-term offtake agreements and attract climate-aligned investment. Without urgent reforms to Transnet’s governance and performance, logistics bottlenecks will remain a structural barrier to scaling low-carbon solutions across the value chain.

Despite considerable policy advancements, significant gaps remain between South Africa's industrial and climate policies. Industrial strategies and sector-specific master plans often prioritize immediate economic growth and employment creation, which can conflict with climate objectives that demand a longer-term outlook. Enhanced integration and coordination between climate targets and industrial policies are essential to effectively manage trade-offs, ensure cohesive implementation, and facilitate a balanced approach to economic development and environmental sustainability.

Addressing the existing alignment gaps between industrial and climate policies is an area where SAISI, as the representative body of the iron and steel industry, can play a vital role. SAISI can actively facilitate structured dialogue between industry stakeholders, policymakers, and regulators to ensure that climate ambitions are balanced with realistic industrial growth targets. By engaging proactively in policy consultations and advocacy, SAISI can help shape cohesive and integrated policy frameworks that are sensitive to the industry's practical realities and constraints. Furthermore, SAISI is positioned to lead industry-wide capacity-building initiatives, disseminate best practices in decarbonisation technologies, and assist its members in navigating the complex regulatory landscape. Through these efforts, SAISI can effectively guide the industry towards sustainable transformation, ensuring economic resilience alongside meaningful climate action.

2.3 Trade and Market Implications

As the global economy accelerates its shift towards low-carbon production and consumption, climate-related trade measures and market-based expectations are reshaping the landscape in which South Africa's steel sector operates. Increasingly, carbon intensity is not only an environmental issue but a trade risk and a market access determinant. Instruments such as the European Union's Carbon Border Adjustment Mechanism (CBAM), investor-led frameworks like the Science-Based Targets initiative (SBTi) and evolving corporate disclosure requirements under IFRS S2 are creating new pressures, and opportunities, for steel producers to decarbonise.

These developments signal a structural change in how competitiveness is defined: the carbon footprint of production is becoming as important as cost and quality. South African steelmakers face the dual challenge of remaining viable under a tightening domestic policy environment while simultaneously meeting international decarbonisation benchmarks and safeguarding access to export markets. Current domestic steel production methods, particularly coal-based BF–BOF routes, face significant challenges to reach emissions intensity benchmarks. This section explores these dynamics, focusing on key trade risks and emerging domestic demand-side measures, and highlights the strategic role SAISI can play in navigating this transition.

2.3.1 EU CBAM and implications for steel exports

The EU CBAM, effective from 2026, imposes a carbon levy on imports of steel, iron, cement, aluminium, fertilisers, electricity, and hydrogen - tying pricing to embedded emissions via certificates linked to EU Emissions Trading System (ETS) prices.

South Africa is acutely exposed in the following ways:

- Over 66% of South Africa's global iron and steel exports fall under CBAM, with around ZAR 30.8 billion destined for the EU in 2023, representing 11.6% of total sector exports (Figure 4).[21]
- Approximately 26% of iron and steel exports (valued at up to roughly US$0.52 billion) to the EU will attract CBAM costs.[22]
- Sectors reliant on coal-based power (such as the steel and iron sector in South Africa) are particularly vulnerable due to their high carbon intensity. The carbon intensity of South Africa's metals export are about 5 000 tCO_2e/US$ million, far exceeding other metal exporting countries. India, Russia and China have carbon intensities of 3 500, 2 200 and 2 500 tCO_2e/US$ million respectively, while other South African competitors range between 200 and 1 400 tCO_2e/US$ million.[22]

Sector	Total Global Exports	CBAM exports to the EU	Risk to Sectoral Exports (%)	GDP at risk (%)
Total exports (Rbn)	R2039.59	R43.40	2.13%	0.62%
Iron and steel (Rbn)	R264.50	R30.79	11.64%	0.44%
Aluminium (Rbn)	R40.92	R12.58	30.73%	0.18%
Cement and Kaolin (Rm)	R1665.53	R3.98	0.24%	0.00%
Fertilizers (Rm)	R10718.33	R32.13	0.30%	0.00%
Electrical energy (Rm)	R11250.33	R0.00	0.00%	0.00%
Hydrogen (Rm)	R1.37	R0.00	0.15%	0.00%

Figure 4: South Africa's steel sector and GDP exposure to CBAM

CBAM's introduction creates direct cost risks: compliance, carbon certificates, and reporting; and indirect trade risks through eroded competitiveness. South African exporters face additional pressures:

- Administrative burden in capturing emissions data, which significantly increases carbon liability.
- Potential export refunds for heavy industries are being considered by the EU to offset carbon tax on exports, though these mechanisms remain provisional.

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21 Trade Law Centre (Tralac) and Wesgro (2024) EU Carbon Border Adjustment Mechanism (CBAM): Factsheet – July 2024. Available at: https://www.wesgro.co.za/uploads/files/EU-CBAM-Factsheet-July-2024_2024-07-29-103656_valq.pdf

22 Monaisa, L. and Maimele, S. (2023) *The EU's Carbon Border Adjustment Mechanism and implications for South African exports*. Policy Brief 1/2023. Pretoria: Trade & Industrial Policy Strategies (TIPS). Available at: https://www.tips.org.za/images/Policy_Brief_The_EUs_Carbon_Border_Adjustment_Mechanism_and_implications_for_South_African_Exports_February_2023.pdf

- South Africa has contemplated submitting a World Trade Organisation complaint, portraying CBAM as a protectionist mechanism and raising concerns about fairness and equity.[23]

Investor expectations are evolving in parallel. Frameworks like the Science-Based Targets initiative IFRS S2 (climate-related financial disclosures by the ISSB) compel corporate emissions transparency and SBTi with respect to alignment to decarbonisation pathways. The IFRS S2 obligates companies to provide climate risk details such as scenario analysis, governance, and metrics - including carbon intensity in high-risk sectors like steel and iron. The SBTi's steel sector guidance requires companies to set scope 1-3 targets aligned to a 1.5 °C pathway - a precondition for market access and finance. While the SBTi provides a valuable global benchmark for emissions alignment, the South African steel sector has not yet adopted SBTi targets, as the current level of ambition is considered misaligned with domestic operational constraints and decarbonisation readiness. Credibility and achievability remain key principles in setting transition targets under South African conditions.

These above expectations pose further implications for South Africa's steel sector which include:

- Increased cost burden, threatening trade competitiveness unless offset by emissions reductions.
- Necessity of rigorous emissions tracking and reporting to meet EU and investor requirements.
- Critical need for investment in cleaner production technologies (EAF, DRI, CCUS) and low-carbon electricity.
- Urgent policy intervention, such as equitable financing, technical support, or CBAM revenue-recycling to support transition in developing countries.

South African steel producers face limited capacity to accelerate emissions-reduction initiatives due to significant structural constraints. These include limited access to affordable low-carbon technologies, financial barriers to capital investment, and policy misalignments between climate objectives and industrial competitiveness. Strategic emphasis must be placed on investing in accurate and transparent emissions accounting systems and participating actively in international discussions to influence equitable implementation of border adjustments. Collaborative regional approaches and international advocacy for transitional support mechanisms could also significantly mitigate adverse impacts.

To strategically manage the risks posed by the EU CBAM, SAISI can act as a central coordinating body, guiding the industry in implementing robust and transparent emissions accounting and reporting systems required under CBAM compliance. SAISI can facilitate collaborative initiatives across industry players to standardise methodologies for measuring and disclosing emissions, thus reducing administrative burdens and compliance costs. Additionally, SAISI can play a significant

[23] Reuters (2024) South Africa considers WTO complaint against EU carbon border tax. 22 May. Available at: https://www.reuters.com/world/africa/safrica-considers-complaining-wto-against-eu-carbon-border-tax-2024-05-22/

advocacy role by representing South Africa's steel sector in international policy dialogues, including WTO negotiations, to articulate concerns regarding equitable and fair implementation of border adjustments. Through international partnerships and proactive engagement, SAISI can also help secure technical and financial support, including advocating for transitional funding mechanisms like the proposed EU Equitable Decarbonisation Fund, ensuring that South African producers remain competitive in international markets.

2.3.2 Local content, product standards, demand-side measures

Local content requirements (specifying what percentage of a product's value must be sourced locally)[24], particularly in public infrastructure and downstream steel applications, can serve dual purposes: strengthening domestic demand and promoting low-carbon steel. By prioritising materials with verified emissions credentials (e.g., certified scrap-based EAF or hydrogen-DRI steel), these mandates create incentives for producers to decarbonise their operations.

Product standards and certification are an increasingly powerful tool. In the longer term, aligning South African steel standards with international benchmarks, e.g., requiring emissions-intensity declarations or certification aligned to science-based targets and IFRS S2, enhances market access and builds credibility with global buyers. These standards also support compliance with CBAM and emerging demand-side ESG requirements from major steel-using industries (automotive, construction, infrastructure).

Demand-side mechanisms include:

- Green public procurement (GPP) policies that prioritise low-carbon steel for infrastructure, railways, and energy projects. This sends a clear market signal and reduces financial mitigation burdens through scale demand. While long-term alignment with international climate standards remains important, stabilising South Africa's steel industry in the near term requires immediate demand-side interventions. Public procurement mandates for domestically produced steel, even at its current emissions profile, are essential to support local capacity, prevent deindustrialisation, and create the market stability needed to invest in future decarbonisation.
- Emissions-sensitive contracting for bulk buyers and original equipment manufacturers (OEMs), embedding carbon criteria in sourcing decisions. Such procurement practices complement international investor expectations and help bridge the pricing gap created by CBAM.

Local content mandates, emissions-aware standards, and demand-side measures can reinforce the transition by:

- Reducing domestic emission intensity, easing pressure from CBAM and investor-driven carbon pricing.

[24] https://trade.ec.europa.eu/access-to-markets/it/barriers/details?barrier_id=12300&isSps=false

- Building credibility and trust in South African low-carbon steel, which supports domestic competitiveness and accelerates policy alignment.
- Creating predictable domestic markets that support early-stage investments in decarbonisation technologies.

While these demand-side levers offer powerful incentives for accelerating decarbonisation, their implementation within South Africa must be carefully sequenced to account for prevailing structural constraints. Local content mandates and green public procurement policies require institutional capacity, verification systems, and fiscal headroom that may not be immediately available. Similarly, the enforcement of emissions-based standards must align with the sector's current technical and financial readiness to avoid unintended exclusion or cost burdens.

Nonetheless, by gradually integrating these tools, starting with pilot programmes, voluntary certification, and alignment with national infrastructure priorities, South Africa can lay the groundwork for a more demand-driven decarbonisation pathway that complements supply-side reforms and supports long-term industry competitiveness.

3 South Africa's Steel Sector: Status and Challenges

3.1 Industry Overview

3.1.1 Major producers and steel production processes

South Africa's steel industry comprises a mix of large integrated producers and several secondary steelmakers operating electric arc furnaces and induction furnaces. The industry has an estimated crude steel production capacity of approximately 7 million tonnes per year, with actual production reaching around 4.7 million tonnes in 2024 (equivalent to 0.24% of global steel production).[25] The dominant player is ArcelorMittal South Africa (AMSA), which operates blast furnace–basic oxygen furnace (BF–BOF) facilities and accounted for about 2.28 million tonnes of steel sales in 2024[26], making it the largest primary steel producer in the country.

Alongside AMSA, South Africa's secondary steel sector consists of approximately 13 operators, which primarily use scrap-based EAFs and induction furnaces to produce steel. Of the SAISI members, these include Scaw Metals, Coega Steels, Unica Iron & Steel, Veer Steel Mills, Columbus Stainless, Cape Gate, Fortune Steels and Grinding Media South Africa. Collectively, the secondary producers contribute roughly half of the country's steel output and play an increasingly important role in the sector's decarbonisation due to their lower direct emissions and adaptability to renewable electricity inputs.

[25] 2024 World Steel in Figures Report. Available here
[26] AMSA IAR 2024, Available here

An overview of South Africa's steel production landscape is shown in Table 1 below. This includes facilities in Care & Maintenance (C&M) and Business Rescue (BR). The company names indicated in bold are SAISI members.

Table 1: South Africa's steel production landscape[27]. Companies in bold are SAISI members.

Technology	Number of sites	Production capacity (kt)
BF-BOF	**AMSA Vanderbijlpark**	3 200 kt
	AMSA Newcastle	1 700 kt
	Highveld Heavy Mill (BR)	148 kt
Cordex/Midrex	AMSA Saldanha (C&M)	1 300 kt
EAF	CISCO	250 kt
	AMSA Vereeniging (C&M)	350 kt
	Cape Gate	450 kt
	Scaw metals (DRI-EAF)	540 kt
	SA Steel Mills	350 kt
	Columbus Stainless	750 kt
Induction Furnace	**Unica iron and steel**	150 kt
	SA Steel works	100 kt
	Fortune steels	240 kt
	Veer steel	220 kt
	GMSA	700 kt
	Coega steels	240 kt
	United Heavy Industries	Not available
Re-rollers	Duferco steel processing	450 kt
	SAFAL	350 kt
	Total operational capacity	**9 690 kt**

3.1.2 Sectoral contribution to economy, trade, and employment

The South African steel sector plays a vital role in the national economy, contributing approximately 1.5% of the country's GDP[28]. However, the sector's relative contribution has declined over time. In 1976, South Africa consumed around 38 million tonnes of steel per trillion rands of GDP, a figure that dropped to 12 million tonnes per trillion rands by 2022, illustrating a sharp decline in steel intensity over the past three decades (Figure 5)[29].

27 South African Iron and Steel Institute, Presentation to the Portfolio Committee on Trade, Industry and Competition 4 June 2025. Available here

28 https://www.investsa.gov.za/metals/

29 https://www.tips.org.za/images/REB_Q1_2024_Briefing_note_The_structural_crisis_in_steel.pdf

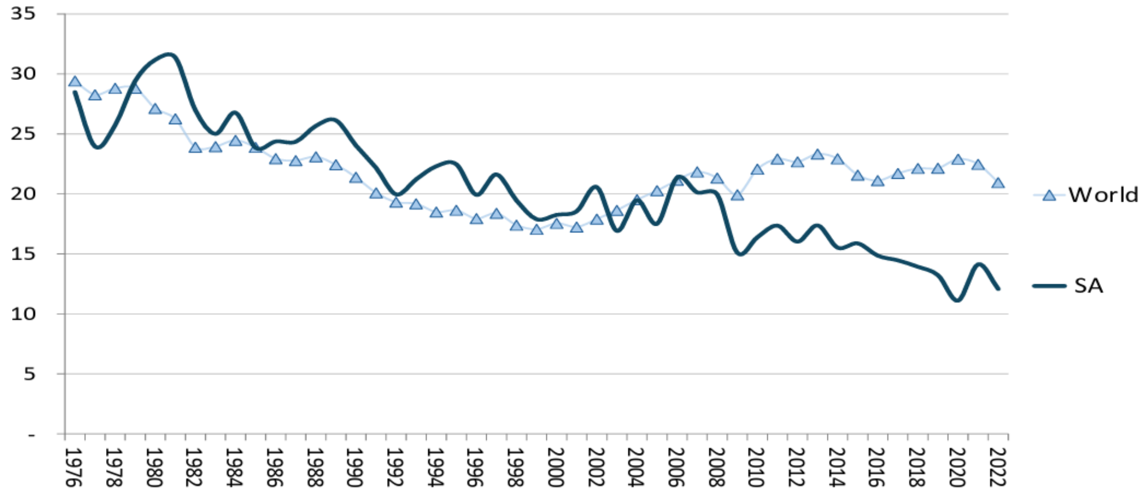

Figure 5: Million tonnes of steel produced internationally and used per trillion US dollars of GDP between 1976 and 2022

Similarly, employment in the steel industry has steadily declined over the past decade. The iron and steel industry employed 47 000 people in 2014, and in 2023 this has had declined to 36 000.[30]

Steel in South Africa is sold primarily into the construction sector, which accounts for about 63% of domestic demand[31]. Other major end-use industries include mining (9%), automotive manufacturing (7%), and energy, chemicals, and water infrastructure (3%). This distribution highlights the strong link between steel demand and broader industrial and infrastructure investment.

Since 2018, the SAISI has reported a range of challenges facing the sector. Primary steel production has declined by 30%, while exports have fallen by 31% and domestic supply has contracted by 28%[27]. At the same time, imports have surged by 71%, even as apparent steel consumption has declined by 11%, reflecting a prolonged period of weak domestic demand and constrained local supply[27]. These trends underscore the pressures facing the industry and the importance of strategic interventions to support its recovery and long-term sustainability.

3.2 Industry Emissions Profile

A pressing challenge for the South Africa's steel industry is demonstrating that steel can remain an environmentally competitive material. Achieving this will require steel producers to reduce the carbon emissions inherent in their production processes while positioning steel as key material in the decarbonisation of other sectors.

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30 TIPS Industry Study: Steel and Related products, February 2025. Available here

31 https://www.saisi.org/wp-content/uploads/2022/06/SAISI_Steel-Report_2022.pdf

3.2.1 Historic emissions

According to South Africa's National Greenhouse Gas Inventory Report for 2022, the country's total emissions (scope 1) amounted to approximately 478.88 Mega tonnes of carbon dioxide equivalent (Mt CO_2e).[32] Of this total, the iron and steel industry contributed around 6.31 MtCO_2e, accounting for approximately 1.3% of national emissions. This is more than a 50% reduction in emissions (15. 33 MtCO_2e) since 2000, due to global and local economic depression, low steel demand and plant closures. In comparison to other notable high-emitting industries, the cement industry contributed 5.02 MtCO_2e (1.05%) and energy industry contributed 224.66 MtCO_2e (46.92%) in 2022.

The GHG inventory does not consider scope 2 emissions, therefore, based on the 2024 production values and relative emission intensities of steel making processes, the estimated Scope 1 and Scope 2 emissions amount to 7.58 MtCO_2e and 2.68 MtCO_2e, respectively.

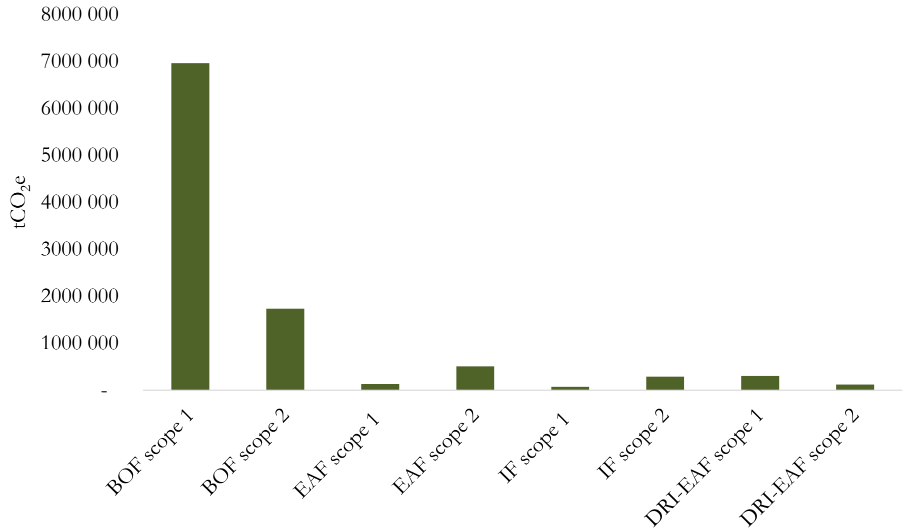

Figure 6: Estimated emissions per technology and scope in South Africa (2024)[32]

The emission intensity of steel production in South Africa is largely influenced by the type of production technology employed and the source of energy used. Blast furnace–basic oxygen furnace (BF–BOF) processes are significantly more emission-intensive due to the direct combustion of coke and coal during iron reduction. In contrast, EAF operations rely primarily on electricity, resulting in lower direct emissions, but increased indirect emissions from electricity usage. The emissions intensity of the national electricity grid, largely powered by coal, therefore still contributes substantially to the overall emissions profile of EAF-based steelmaking.

Emission intensities for secondary steel producers using EAFs and Ifs range from approximately 0.3 to 0.5 tonnes of CO_2 equivalent per tonne of steel, depending on the efficiency of the plant and the share of renewable energy used[33]. While the use of DRI in in EAF/IF can produce

[32] https://www.dffe.gov.za/sites/default/files/legislations/nemaq_nggireportt_g52067gon5850.pdf
[33] Based on SAISI member feedback

approximately 1-2 tCO_2e per tonne, in comparison the emission intensity for BF–BOF production is considerably higher, at approximately 3.36 tCO_2e per tonne of crude steel.[34]

When compared to global benchmarks, South Africa's steel industry is relatively carbon-intensive, particularly in the case of BF–BOF production. According to the International Energy Agency (IEA), the global average emission intensity for BF–BOF steel production is approximately 2.3 tCO_2e per tonne of crude steel, while EAF-based production is 0.4 tCO_2e per tonne of steel[35].

The distribution of emissions, and emissions sources, across scope 1 and scope 2 emission categories for each steelmaking process are compared in Table 2 below.

Table 2: A comparison of scope 1 and 2 emissions between steelmaking processes

Process	Scope 1	Scope 1 sources	Scope 2	Basis for Scope 2 emissions intensity	Total
BF-BOF	~ 1.9 tCO_2e/t (range 1.8 – 3.0)[36]	Coke, limestone, and BOF off-gas	~0.6 tCO_2e/t	~100 kWh electricity /t steel[37]× South African grid factor 0.96 tCO_2/MWh	3.36 tCO_2e/t
EAF/ Induction Furnace	~ 0.08 tCO_2e/t (range 0.05 – 0.10)[38]	Natural gas, electrodes, and carbon additions	~0.43 tCO_2e/t	~450 kWh electricity /t steel[38]× South African grid factor 0.96 tCO_2/MWh	0.5 tCO_2e/t

3.2.2 Emissions forecast

3.2.2.1 Steel demand and supply

Currently, about 67% of steel demand is met through local production, which has an installed capacity of 9.5 million tonnes per year. Local demand is projected to increase by 272% by 2050, reaching 13.4 Mt per year. This growth will be driven by large-scale housing and public infrastructure developments, the deployment of renewable energy infrastructure, and improvements in transportation networks, such as railway expansion.

Despite this projected growth, South Africa's local steel production capacity currently remains underutilised. In recent years, the industry has operated at less than 50% capacity (producing 4.7 Mt in 2024). As a result, demand is not expected to exceed installed capacity until around 2040.

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34 https://www.arcelormittalsa.com/inthenews/Decarbonisation.aspx
35 https://worldsteel.org/wp-content/uploads/Sustainability-Indicators-report-2024.pdf
36 https://worldsteel.org/wider-sustainability/sustainability-indicators/
37 https://worldsteel.org/wp-content/uploads/Fact-sheet-Energy-use-in-the-steel-industry.pdf
38 CEFIM SOUTH AFRICA PROJECT, September 2024. Available here

3.2.2.2 *Steel emissions*

As outlined in Section 3, the steel industry is expected to align with South Africa's national climate policy and contribute meaningfully to the country's decarbonisation objectives. Failure to do so may result in growing exposure to carbon pricing mechanisms, including an escalating carbon tax. South Africa's updated NDC, submitted in 2021, commits the country to reducing greenhouse gas emissions by 31% by 2030, and achieving net-zero emissions by 2050, with the imminent 2030-2035 NDC update potentially brining about even sharper reduction ambitions.[39]

The graph below shows the projection in emissions for the steel sector, based on the 2024 production baseline and respective emission intensities per production process, and assuming a 3.5% Compound Annual Growth Rate (CAGR).[40] This is compared to South Africa's NDC high-ambition emission reduction trajectory. The low-ambition trajectory allows a slightly lower emission reduction up until 2030, followed by the same constant reduction up until 2050.

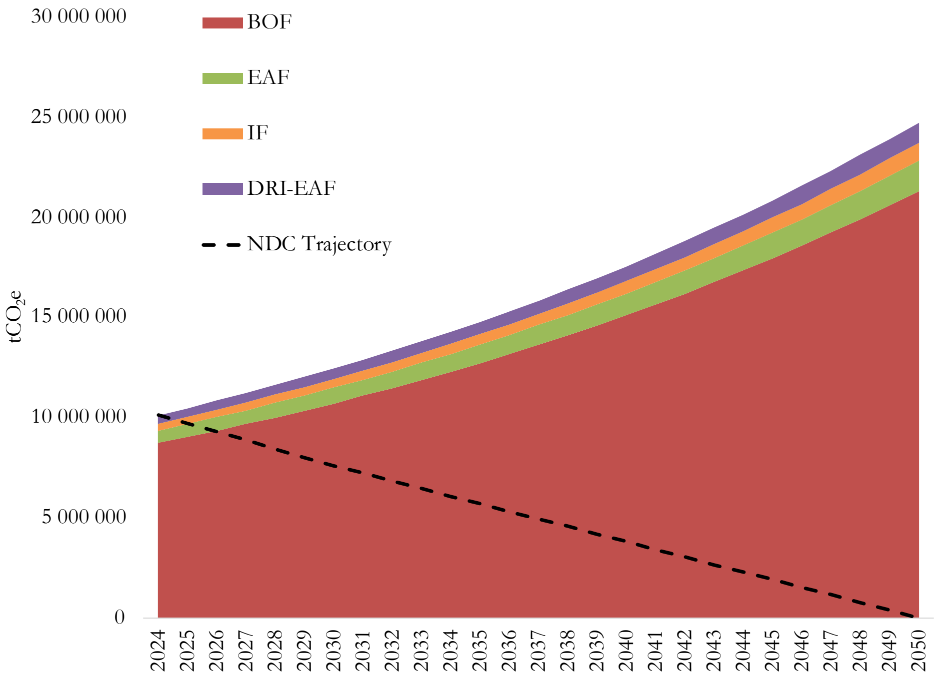

Figure 7: Projected emissions against the NDC high ambition trajectory

While this policy direction presents a clear challenge for the steel industry, further exacerbated by the expected Phase 2 of the carbon tax, it also opens up significant opportunities. As global demand for low-carbon and "green" steel grows, South Africa is well-positioned to become a player in this emerging market.

39 www.climatecommission.org.za/publications/draft-recommendations-for-south-africas-2030-2035-ndc-update

40 National Business Initiative (NBI), Business Unity South Africa (BUSA) and Boston Consulting Group (BCG), 2021. Decarbonising South Africa's heavy manufacturing sector: Just Transition and Climate Pathways Study for South Africa. Johannesburg: NBI.

3.3 Comparison to International Peers

3.3.1 Crude steel output

South Africa ranked 29th globally in crude steel production in 2024, accounting for approximately 0.2% of global output.[41] In contrast, China, India, and the European Union (EU-27) occupied the top three positions. China remains the dominant producer, contributing 53% of global crude steel production, nearly ten times that of India and over seven times the output of the EU-27 if considered as a single bloc (Table 3).

Given its relatively small scale, South Africa's steel sector is highly exposed to domestic demand fluctuations, rising logistics costs, and the pressures of low-cost imports. In response, the South African government, through the International Trade Administration Commission (ITAC), has implemented a range of safeguard and anti-dumping measures aimed at supporting domestic capacity. These interventions are intended to provide a protective buffer while the industry improves cost competitiveness and begins to align with international decarbonisation expectations, including carbon-border tariff mechanisms in key export markets. However, these interventions are not sufficient to fully protect the South African steel industry – the industry still sees an influx of cheap or unfairly traded steel. While the initiatives provide short-term relief to local producers, they do not address the underlying structural challenges that drive high imports.

3.3.2 Emissions intensity

Europe currently operates at the lower end of global emissions intensity benchmarks, averaging approximately 1.7 tonnes of CO_2 per tonne of crude steel. This is largely attributable to a greater reliance on EAF technology and a relatively clean electricity grid. While South Africa's average emissions intensity appears similar, its EAF operations are heavily dependent on a coal-dominated electricity mix, resulting in higher Scope 2 emissions.

China and India exhibit higher average intensities, largely due to their dependence on coal for both ironmaking and electricity. India, in particular, relies on an extensive use of coal-based Direct Reduced Iron (DRI), which elevates its sectoral intensity above 2.5 tCO_2/tonne.

3.3.3 Process mix

The distribution of steelmaking routes is a key factor in determining emissions intensity. The share of EAF-based production serves as a primary differentiator. Both the EU-27 and South Africa have an EAF share of around 40%, while China's share remains at approximately 10%. India, by contrast, is majority EAF-based, but this is primarily driven by coal-based DRI rather than scrap-based feedstock, limiting the emissions-reduction benefits typically associated with EAF production.

41 https://worldsteel.org/data/world-steel-in-figures/world-steel-in-figures-2024/

3.3.4 Energy mix

The composition of energy sources further distinguishes South Africa from its peers:

- South Africa relies predominantly on coking coal for BF-BOF operations and a national electricity grid that is approximately 81% coal-based[42].
- EU-27 employs a more diversified energy mix that includes coal and natural gas, but benefits from a significantly lower grid emission factor, roughly three to four times cleaner than South Africa's.
- China and India both maintain a power mix dominated by coal, with ironmaking processes similarly reliant on coal-intensive inputs.

3.3.5 Comparative summary

The comparison between South Africa, China, India and the EU highlights the following points for consideration:

- **Scrap leverage versus grid emissions penalty:** South Africa's comparatively high share of EAF capacity presents an opportunity for lower-emission steelmaking. However, the benefit is undermined by the carbon intensity of the national grid. Without direct procurement of renewable energy, either through long-term power purchase agreements or onsite generation, Scope 2 emissions will remain a limiting factor.
- **Hydrogen-based DRI as a transformative opportunity**: The EU's Hybrit and H_2 Green Steel initiatives demonstrate a technically feasible pathway to producing near-zero emissions steel (<0.4 tCO_2/t). South Africa could pursue a similar trajectory by repurposing the decommissioned Saldanha DRI facility to operate on green hydrogen powered by wind and solar resources.
- **Urgency of policy alignment**: With the EU's CBAM entering into force in 2026, South African steel exports will face rising embodied-carbon costs unless producers can align with international emissions thresholds. Yet, progress is constrained by the slow pace of enabling policies and technology development in the sector. Establishing a national green steel benchmark and ensuring access to affordable, low-carbon electricity are therefore critical to maintaining global market access and long-term competitiveness.

[42] https://www.iea.org/countries/south-africa

Table 3: Comparison of steel production, process, intensity and future decarbonisation initiatives between the European Union, China, India and South Africa

Region	2024 crude-steel output* (Mt)	2025 average CO_2 intensity ($t\ CO_2/t$)	Route mix (% of crude steel)	Typical energy inputs
EU	129.7 Mt[43]	~ 0.1 (Scrap-EAF)[44] ~ 1.9 (BF)	• BF-BOF: ~ 55.6 %[43] • Scrap-EAF: ~ 44.4 %	• Coking-coal used in BF • Growing natural-gas/biomass trials • EAFs on a much cleaner grid (0.26 t CO_2/MWh, 2022) [45]
China	1 005.1 Mt[43]	~ 0.7 (Scrap-EAF) ~ 2.2 (BF)	• BF-BOF ~ 89.9 %[43] • Scrap-EAF: ~ 10.1 %	• Dominated by coking-coal • Electricity grid is still more than 60 % coal-based • Limited gas use, but piloting of hydrogen-DRI is underway
India	149.4 Mt[43]	~ 1.2 (DRI-EAF) ~ 2.5 (BF)	• BF-BOF: ~ 41.2 %[43] • DRI-EAF: ~ 58.8 %	• Largest fleet of coal-based DRI kilns feeding EAFs • BF-BOF on domestic coking coal & imported coke; • Electricity grid is ~70 % coal-based
South Africa	4.7 Mt (down 50 % since 2006) [43, 46]	~ 0.5 (scrap-EAF) ~ 3.36 (BF)	• BF-BOF 54.9 %[43] • Scrap-EAF 45.1 %**Error! Bookmark not defined.**	• Coking-coal used in BF • EAFs powered by a coal-dominated grid (~0.96 t CO_2 /MWh)[47]

43 World Steel Association. *World Steel in Figures 2025*. Available here
44 https://www.sciencedirect.com/science/article/pii/S030626192400285X
45 https://ember-energy.org/app/uploads/2023/01/Report-European-Electricity-Review-2023.pdf
46 https://econometrix.co.za/wp-content/uploads/Econometrix-AMSA-27-Feb-2025-FINAL.pdf?
47 https://www.gov.za/sites/default/files/gcis_document/202411/51495gon5498.pdf

4 DECARBONISATION PATHWAYS TO 2030 AND 2050

Globally, the steel industry must undergo a rapid transformation to align with decarbonisation trajectories consistent with the Paris Agreement. By 2030, the sector aims to reduce carbon intensity by approximately 45% for primary steel production and 65% for secondary steel production (Figure 8).[48] Achieving net-zero emissions by 2050 will require a fundamental shift in the sector's energy profile, most notably, reducing the reliance on unabated fossil fuels, which currently make up around 86% of the global steel fuel mix, to approximately 30%. This transition will necessitate a significant scale-up of carbon capture, utilisation and storage (CCUS) technologies.

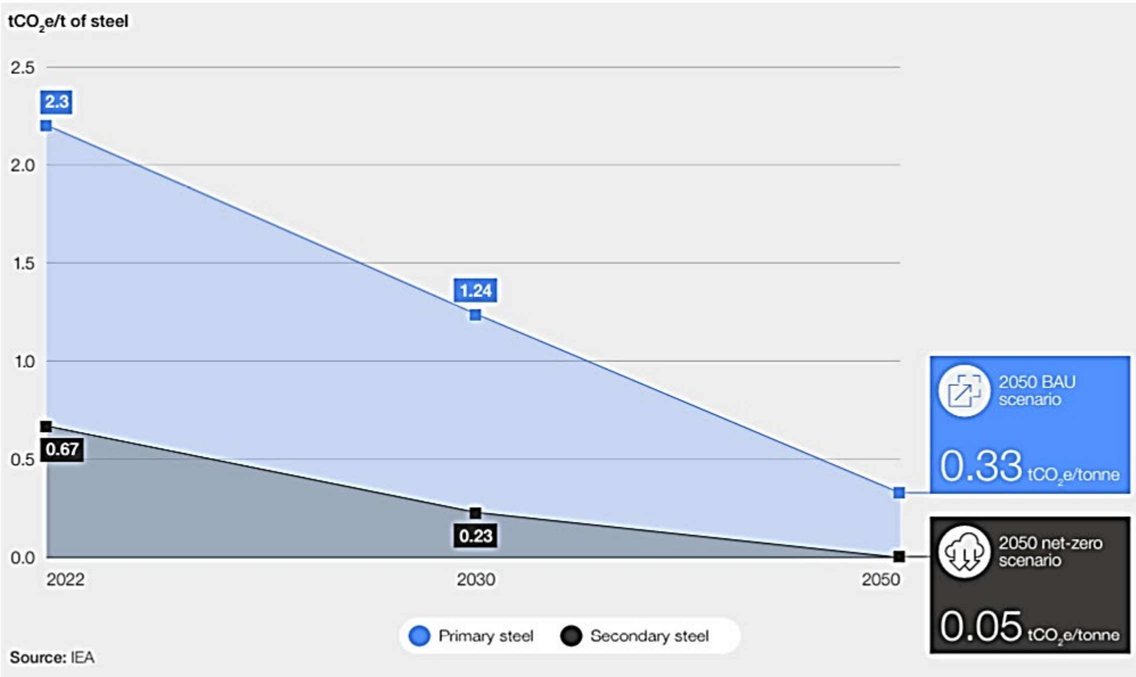

Figure 8: Emissions intensity trajectory for primary and secondary steel[48]

4.1 Technical and and Economic Constraints

South Africa's steel industry faces a complex and interlinked set of constraints that shape the pace and feasibility of its decarbonisation. One of the central challenges is maintaining economic viability while transitioning to low-carbon production pathways. Domestic steelmakers operate under sustained margin pressure due to slow local demand, the rising cost of inputs, and an increasingly competitive global environment.[49] SAISI has noted that the industry has seen a 30% drop in crude steel production since 2018, and an increase in imports of 71%[50]. These changes

48 https://www3.weforum.org/docs/WEF_Net_Zero_Tracker_2023_REPORT.pdf
49 TIPS Industry Study: Steel and Related products, February 2025. Available here
50 South African Iron and Steel Institute, Presentation to the Portfolio Committee on Trade, Industry and Competition 4 June 2025. Available here

have weakened the industry's financial base, limiting its capacity to invest in greener technologies or restructure operations without risking further losses or job cuts. The following key constraints are noted:

Maintaining economic viability during transition: Rising electricity tariffs and chronic rail-and-port congestion remain the major cost drains for South-African mills; the TIPS Industry Study 2025 lists both as core structural disadvantages, eroding margins even before any decarbonisation spend is considered.[49]

- **Optimising existing assets and investing prudently in innovation:** The steel sector attracts only about 1 – 1.8 % of the country's overall capital investment[51], therefore, mills are focusing on efficiency-improvements, such as, installing variable-speed drives, recovering waste heat, and boosting scrap use, while postponing major green-steel projects until the pay-back is clear.
- **Infrastructure and reline schedules:** Blast-furnace and BOF assets already beyond ideal life extend maintenance costs and limit process flexibility, a weakness highlighted in the industry SWOT[52].[49]
- **Sequencing and risk-adjusted strategies:** Global guidance in Making Net-Zero Steel Possible stresses that the lowest-risk moment to switch technology is at the end of an asset's investment cycle; local firms are therefore tying any EAF or hydrogen-DRI conversions to the next compulsory reline window.[53]
- **Operational downtime and maintenance costs:** Every unplanned stop now carries higher opportunity cost because capacity-utilisation has dropped from 89 % (2003) to 68 % (2023), leaving less margin to absorb maintenance overruns.[49]
- **Energy tariffs, logistics costs and competitiveness issues:** Electricity prices linked to a coal-heavy grid, and escalating road-freight surcharges have left primary producers less competitive against both mini-mills and imports.[50]
- **Capital access and investment limitations:** High operating costs and low profitability keep internal cash flows tight, while access to concessional green finance remains limited; boards consequently authorise only manageable retrofits, not full technology swaps.[49]
- **Imports and pricing pressure:** Steel prices could fall below average production cost, in part due to the price of steel imports that fall below scrap steel value deepening the import threat.[54]This may also jeopardise domestic supply chains in automotive, construction and mining. SAISI cautions that without trade remedies these downstream linkages, and the jobs they anchor, are at risk.[54]

51 TIPS Industry Study: Steel and Related products, February 2025. Available here
52 TIPS Industry Study: Steel and Related products, February 2025. Available here
53 Making Net-Zero Steel Possible, 2022. Available here
54 SAISI Steel Matters April 2025. Available here

4.2 Existing Decarbonisation Interventions

SAISI members are actively implementing and exploring decarbonisation initiatives to reduce emissions across different production routes:

- For **BF–BOF** operations, companies are exploring a shift from coal-based grid electricity to renewable energy sources, either through power purchase agreements (PPAs) or self-generation. Some producers are also considering transitioning from full BF–BOF reliance to a hybrid model that incorporates a greater share of EAF production resulting in reduced emissions.
- For **scrap-based EAF** operations, producers are focusing on increasing the share of renewable electricity, both through self-generation and green procurement contracts, as well as exploring the use of waste heat recovery systems to generate electricity from off-gasses.
- Regarding **DRI–EAF** potential, short-term decarbonisation options include efforts to improve energy efficiency and reduce emissions through higher-quality reductants, better kiln insulation, and enhanced recovery of metals from steelmaking by-products such as slags and EAF dust (e.g., zinc recovery). Long-term options include the use of hydrogen as a reductant instead of natural gas or coal.

4.3 Decarbonisation Options for Iron and Steel

The Clean Energy Finance and Investment Mobilisation (CEFIM) programme launched a project in April 2023 to strengthen investment conditions for decarbonising South Africa's steel sector.[55] It is chaired by the Department of Trade, Industry and Competition (the DTIC) and supported by the Department of Forestry, Fisheries and the Environment (DFFE). Part of the project focuses on reviewing preliminary economic assessments of three decarbonisation pathways: hydrogen-based direct reduced iron (H_2-DRI) with EAF, blast furnace with carbon capture and use (BF-CCU), and existing or new scrap-based EAFs.

The project will also evaluate cost structures, emissions reduction potential, and the impact of key assumptions such as green premiums, electricity and hydrogen prices, CAPEX, and carbon pricing. The findings will contribute to a draft country report scheduled for early 2025, with publication expected in 2025 (not yet published at the time of this report). This report is intended to guide policy development and investment mobilisation in support of South Africa's steel decarbonisation and just transition objectives.

An overview of the three key decarbonisation pathways is given below:

55 CEFIM SOUTH AFRICA PROJECT, September 2024. Available here

4.3.1 Scrap-based EAFs

Scrap-based EAFs are the most technically mature and commercially viable low-carbon option currently available in South Africa, accounting for approximately 50% of national steel production. These systems have relatively low direct emissions, with most emissions stemming from electricity use. When supplied with renewable electricity, EAFs can significantly reduce lifecycle emissions to below 0.5 tCO_2e per tonne of steel. Economic modelling indicates that scrap-based EAFs are cost-effective, especially when energy efficiency improvements and limited fossil fuel use (e.g., natural gas) are applied. However, their feasibility is constrained by the limited availability and quality of scrap metal in South Africa.

4.3.2 Hydrogen-DRI-EAF

The **Hydrogen-DRI-EAF** pathway represents a more ambitious but technically viable solution for producing near-zero carbon steel, particularly when powered by renewable electricity and green hydrogen. While this route offers the greatest emissions reductions, potentially cutting 1.5 to 3.0 tCO_2e per tonne of steel compared to conventional blast furnaces, it involves significantly higher capital expenditure. The levelised cost of steel (LCOS) in the base case is estimated to be 25% higher than that of traditional blast furnace operations. However, the pathway becomes more competitive with falling renewable electricity and hydrogen costs, and through supportive policy measures such as CAPEX subsidies, green premiums, or concessional financing (i.e. a more favourable loan rate).

While the Hydrogen-DRI-EAF pathway has been demonstrated at pilot and demonstration scale internationally, it is not yet deployed at commercial scale using 100% green hydrogen. The technology is currently assessed at Technology Readiness Level (TRL) 7 to 8, meaning that system prototypes are being demonstrated in operational environments but not yet proven at scale. In the South African context, commercial deployment will also depend heavily on the availability of competitively priced green hydrogen and renewable electricity, as well as enabling infrastructure such as hydrogen production, storage, and transport. Given these constraints, it is estimated that it will take at least a decade or 2 before hydrogen-based steelmaking becomes both technologically mature and economically feasible for large-scale adoption in South Africa.

4.3.3 Carbon Capture and Use (CCU)

Blast furnace–based steelmaking will continue to play a significant role in 2050, comprising more than 50% of global steel production, due to rising demand and limitations in the availability of scrap for recycling.[56] Therefore**, Carbon Capture and Use (CCU)** retrofits for existing blast furnaces offer a transitional solution that allows continued use of existing assets while reducing emissions by 70% to 95% (equivalent to 0.7–1.4 tCO_2e per tonne of steel). Although technically feasible, especially at integrated plants like Vanderbijlpark, CCU is capital intensive and dependent on access to storage or utilisation markets (e.g., for methanol production from off-gasses).

[56] Decarbonising steel and other base metals: let's send the right signals. Available here

Economic analysis shows that CCU provides less favourable returns than H_2-DRI when electricity prices are low,[57] but it delivers greater emissions savings per dollar spent on CAPEX subsidies. Overall, its feasibility is higher in the short term but limited by infrastructure, policy, and technology maturity constraints. Firstly, the regulatory framework for the environmental approval and permitting of carbon capture and storage (CCS) does not yet exist in South Africa,[58] posing a significant barrier to deployment. Secondly, the technology for full-chain CCUS systems is at TRL 6 to 7,[59] indicating that while components are mature, integrated systems at scale have not yet been proven in local contexts.

Finally, while South Africa possesses promising geological formations (e.g., in the Karoo Basin) for long-term CO_2 storage, these resources have not been fully proven or bankable, and there is limited certainty about their capacity, injectivity, and long-term integrity.[60] These issues must be addressed to enable CCUS as a viable pathway in South Africa.

4.3.4 Summary of Abatement Options

A summary of the abatement potential of the three key decarbonisation pathways are given in Table 4.

Table 4: Emission abatement potential for each decarbonisation lever

Case	Description	Emission Reduction Potential
1. Scrap-based EAF	Existing or new EAFs powered by electricity (partially renewable), using mostly scrap.	~0.5 tCO_2e per tonne of steel (mainly indirect emissions).
2. H_2-DRI + EAF	Hydrogen-based DRI production integrated or standalone, with EAF.	1.5–3.0 tCO_2e per tonne of steel improvement compared to BF-BOF
3. BF + CCU/CCS	Retrofit of blast furnaces with carbon capture (CCU or CCS).	0.7–1.4 tCO_2e per tonne of steel improvement

4.3.5 Leveraging Carbon Credits

Financing of decarbonisation levers is a clear barrier to the steel industry, particularly when faced with other regulatory costs, such as increasing carbon tax liability. A potential avenue to finance the transition to lower-emission technologies is the carbon market. Recently, the Voluntary Carbon Standard (VCS) methodology, VM0052[61], was released, which is designed to monetise the climate benefit of retiring profitable coal-fired power plants ahead of schedule and pairing them with new renewable capacity. It does this by issuing "transition credits" for the difference between a facility's historical, business-as-usual emissions and the lower emissions profile after retirement.

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57 IISD, Why the Cost of Carbon Capture and Storage Remains Persistently High, available here
58 S Africa's CCS-specific legislation playing catch-up, Mining Weekly, available here
59 CCUS technology innovation, IEA, available here
60 Yoro, K, et al, The Potential of CO2 Capture and Storage Technology in South Africa's Coal-Fired Thermal Power Plants, available here
61 https://verra.org/methodologies/vm0052-accelerated-retirement-of-coal-fired-power-plants-using-a-just-transition-v1-0/

Applied to South Africa's steel sector through the retrofit of emissions-intensive blast furnaces, generated carbon revenue through a similar carbon crediting methodology can:

- Bridge the green-premium gap: Selling carbon credits can lower the costs that blast-furnace operators face when they switch to lower-carbon routes such as hydrogen-DRI or scrap-based EAFs.
- Lower borrowing costs: Regular income from carbon credits improves a company's cash flow and debt-service cover, helping both the South African government and local steelmakers secure loans from development banks and commercial lenders at lower interest rates.
- Guarantee local socio-economic benefits: At least 5 % of expected credit income is earmarked for worker re-skilling, supplier diversification and community infrastructure, de-risking labour-market shocks in coal-reliant towns such as Newcastle and Vanderbijlpark.

Although VM0052 targets coal-fired power plants, its core principle of crediting the emissions gap created by retiring a high-emitting asset early and replacing it with a low-carbon alternative can be adapted to steel. A steel-specific version would:

- Use each blast furnace's verified historical Scope 1 emissions as the baseline;
- Treat the replacement or retrofit route (e.g., hydrogen-DRI or scrap-based EAF powered by renewables) as the project scenario;
- Quantify credits for the difference between baseline and project emissions over the remaining design life of the retired furnace; and
- Ring-fence a share of credit revenue for local workforce reskilling and community projects.

While the transition credit concept, modelled on VCS methodology VM0052, is innovative, it hinges on the presence of willing buyers in the regulated or voluntary carbon markets. These credits would be registered on carbon registries and purchased by corporates seeking high-quality offsets, meaning their viability ultimately depends on demand and credible emissions verification.

Achieving this will require either revising VM0052 or drafting a new VCS methodology tailored to steel production and submitting it for validation and approval. However, it is important to note that this process is not without its own cost and requires upfront expenses for the registration, verification, and issuance of credits for a potential project.

4.4 Short-Term Emissions Reduction Pathway to 2030

The following section describes the feasibility of various short term emission reduction options available to the steel industry and the associated Technology Readiness Level (TRL).

4.4.1 Energy efficiency and process improvements

A 10% reduction in emissions can be achieved in the short term by improving process and energy efficiency across steelmaking operations. Packages such as variable-speed drives, oxy-fuel burners, slag-heat recovery and digital EAF charge optimisation typically cut 5–10 % of site energy use and have around two-to-five-year paybacks.

High feasibility (TRL 8-9): These incremental measures are proven and lower in cost compared to major retrofits, making them the easier and more affordable emission reduction options.

4.4.2 Boosting scrap use and EAF capacity (TRL 9)

Secondary producers such as Scaw Metals, Veer and Coega Steels already melt approximately 2 Mt of scrap steel per annum via EAFs, and ArcelorMittal SA intends to lift its scrap charge when the Newcastle and Vanderbijlpark furnaces are re-lined. Continued export restrictions and the scrap Price-Preference System[62] keep feedstock in the country, but domestic supply is tightening and may fall short if the export duty is relaxed. In addition, there is the limited application of EAF-produced steel in infrastructure, which often requires higher-grade primary steel. Overall, emission reduction from this is placed at 6%

Moderate feasibility: this emission reduction option is technically straightforward, but is limited by scrap availability and the cost and availability of clean electricity.

4.4.3 Renewable energy sourcing (TRL 9)

Access to renewable energy, through own generation, or power purchase agreements (PPA) is advantageous, particularly to mini-mills using EAFs, in reducing steelmaking emissions. However, the primary producer, AMSA plans to procure renewable energy as a key component of the company's decarbonisation roadmap. This includes a 200 MW solar contract which was expected to start construction in 2025, which will provide 43% renewable energy penetration[63]. Embedded PV could cover up to 15 % of the energy load, while off-site PPAs can supply 30–40 % under current wheeling rules[64].

High feasibility: The business case for PPAs and behind the meters solar is more financially positive against current Eskom tariffs. However, potential inhibitors are grid-access queues and wheeling agreements.

4.4.4 Grid decarbonisation

South Africa's REIPPPP[65] and the Integrated Resource Plan target an additional 20 GW of wind/solar by 2030, potentially cutting the grid-emission factor from 0.96 tCO_2e/MWh (in 2023)

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62 The Price-Preference System (PPS) for scrap metal in South Africa is a government policy designed to prioritize local steel and other metal manufacturers by requiring scrap metal exporters to first offer their scrap to domestic industries at a discounted price. The International Trade Administration Commission (ITAC) implements the PPS by requiring scrap metal exporters to first offer their scrap to local buyers at a predetermined discount. This system, introduced in 2013, aims to ensure local industries have access to affordable raw materials, thereby supporting local production, job retention, and industrialization.

63 https://energynews.africa/2024/05/03/amsa-to-start-200-mw-solar-plant-in-vanderbijlpark-soon/

64 https://www.greenbuildingafrica.co.za/arcelor-mittal-south-africa-200mw-solar-project-update/

65 https://www.ipp-projects.co.za/

to around 0.60 tCO_2e/MWh by 2030. Realising these emission reductions will depend on Eskom's transmission build-out and policy execution.

4.5 Long-Term Emissions Reduction Pathway to 2050

In South Africa, currently the only technically and commercially feasible way to produce steel from iron ore is through the use of fossil fuels as reducing agents. However, the following breakthrough technologies are being explored:[66]

1. **Substituting hydrogen for carbon as a reductant, generating H_2O (water) rather than CO_2**, for example, hydrogen based DRI.
2. **Using carbon as a reductant while preventing the emission of fossil CO_2:** for example, using carbon capture, utilisation and storage (CCUS) and/or sustainable biomass.[67]
3. **Using electrical energy through an electrolysis based process**, for example, Molten oxide electrolysis.

4.5.1 Hydrogen-DRI (TRL 6-8)

Direct Reduced Iron (DRI) processes, such as MIDREX and HYL/Energiron, are current and common alternatives to BF iron production. These processes employ shaft furnaces and H_2-rich gas (usually from natural gas) as the reducing agent. If DRI is paired with an EAF to produce steel, it results in lower CO_2 emissions compared to the BF-BOF steel production route.

Another alternative pathway to achieve a further reduction of CO_2 emissions is the utilisation of hydrogen produced from renewable energy as the energy source and reducing agent for the production of DRI (H_2-DRI), thus, releasing H_2O instead of CO_2[68]. Global examples such as the EU's Hybrit[69] and H_2 Green Steel initiatives demonstrate a credible pathway to producing near-zero emissions steel (<0.4 tCO_2e/t)[70].

4.5.1.1 Applicability in the South African context

South Africa could pursue a similar trajectory by repurposing the non-operational Saldanha DRI facility to operate on green hydrogen powered by wind and solar resources. ArcelorMittal's

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[66] World Steel Draft 2025 Climate Change Policy Paper
[67] Public Policy Paper. Climate change and the production of iron and steel, 2024
[68] Hasanbeigi, A., Lu, H., Zhou, N. 2023. Net-Zero Roadmap for Chinese Steel Industry. Lawrence Berkeley National Laboratory, and Global Efficiency Intelligence. LBNL-2001506
[69] HYBRIT (Hydrogen Breakthrough Ironmaking Technology) is a joint project in Sweden aimed at revolutionizing steel production by using hydrogen instead of coal, significantly reducing carbon dioxide emissions.
[70] https://eeb.org/wp-content/uploads/2025/03/State-of-Steel-Report.pdf

Saldanha DRI plant is earmarked in the West Coast Green Hydrogen Master Plan for conversion to H_2-DRI.[71]

4.5.1.2 *Infrastructure and supply chain needs*

Achieving large-scale green steel production in South Africa will require significant infrastructure investment, particularly in coastal regions such as Saldanha and the Northern Cape. Key enablers include the development of coastal desalination facilities, the construction of dedicated hydrogen pipelines or liquid organic hydrogen carrier (LOHC) export terminals, and major 400 kV grid reinforcements to connect renewable energy corridors to industrial users[72]. It is estimated that 5.5MWh of renewable energy is required to produce one tonne of hydrogen, thereafter, approximately 3.5MWh and 55kg hydrogen or more are required to produce one tonne of H_2-DRI, depending on operation-specific factors. This indicates that South Africa must secure 2-3 GW of renewables for every 1 Mt H_2-DRI produced.

If implemented in a phased manner, these infrastructure upgrades could support the commissioning of a hydrogen-based direct reduced iron (H_2-DRI) demonstration unit producing 100 000 tonnes per annum by 2030, followed by the development of a first commercial-scale 1 million tonne per annum plant between 2035 and 2040.[73] With this foundation in place, South Africa could begin producing near-zero carbon flat steel (< 0.4 tCO_2 per tonne) at scale before 2045.

4.5.2 Carbon Capture, Utilisation, and Storage (CCUS) (TRL7-9)

Carbon capture, utilisation, and storage (CCUS) can be used to decarbonise different steel production routes. The main challenges for CCUS technologies are achieving further reductions in costs and improving operational efficiencies as well as having suitable CO_2 transport systems and storage sites. The captured CO_2 emissions from iron and steel production can be permanently stored underground (depending on geology), or used to produce chemicals, fuels, construction materials.

In 2023, ArcelorMittal constructed a large-scale CCUS facility in Ghent, Belgium to convert process gases to ethanol, which can be used in a wide range of applications, including the production of synthetic fuels. A similar commercial facility began operation in 2018 at Shougang Group in China, producing 30 million litres of ethanol for sale in the first year of operation.

Carbon capture and storage is applicable to AMSA's blast furnaces, which will need carbon-abatement retrofits (e.g., post-combustion CO_2 capture and storage, biomass or hydrogen

[71] https://fuelcellsworks.com/2025/06/25/green-hydrogen/csir-leads-strategic-master-planning-for-west-coast-green-hydrogen-hub

[72] https://saiia.org.za/research/the-green-hydrogen-catalyst-igniting-local-development-through-green-trade-enablers/

[73] https://gh2.org/countries/south-africa#:~:text=Capacity%20and%20capacity%20targets,of%20the%20lowest%20costs%20worldwide.

injection) if the sector is to meet the IEA's net-zero 2050 goals. AMSA's decarbonisation roadmap indicates that CCUS is being considered as an emission reduction lever post-2030.[74]

However, large-scale deployment cannot proceed until South Africa develops a dedicated regulatory regime, CO_2 pipeline corridors and/or proven geological sinks (the latter two being required if CO_2 is stored rather than used). At present no CCS-specific legislation exists, and the country scores just 40/100 on the Oil and Gas Climate Initiative (OGCI) legal-readiness index for CCS.[75]

4.5.3 Molten Oxide Electrolysis (TRL 3-4)

Molten Oxide Electrolysis (MOE) is a standalone process for producing liquid metal directly from iron ore, distinct from the traditional BOF and EAF steelmaking routes. It involves using electricity to directly reduce iron ore into liquid metal, bypassing the need for a blast furnace or carbon-based reductants, such as coke.[76] This technology is still in lab-pilot phase, therefore, it has a low TRL.

For South Africa, technical feasibility hinges on the cost of and availability of clean-power as MOE becomes cost-competitive only when electricity prices are low[77]. As such, MOE remains a promising but early-stage option whose deployment will lag hydrogen-DRI and CCUS retrofits.

4.5.4 Sustainable Biomass (TRL 5-7)

This emission reduction option uses biogenic carbon sources (e.g. charcoal from sustainably managed forests or biochar from organic residues) as a substitute for fossil coal. Biomass injection into blast furnaces is already applied commercially in Brazil.[78] However, not all types of biomass are suitable for direct injection due to their chemical and physical properties. As a result, only upgraded biomass attains this level of substitution, either via pyrolysis (charcoal) or torrefaction (bio-coal). This is a cost-competitive option which can enable early emissions reductions of up to 40%–60% per tonne of crude steel compared to natural gas and coal, however applicability may be limited in South Africa if biomass supply is not sustainable.[79]

4.6 Consolidated emission reduction pathway

The emission reductions options above are presented for the South African steel industry's emissions, in line with the pathway presented by the NBI (Figure 9).[80] This assumes reductions

74 https://arcelormittalsa.com/Decarbonisation.aspx
75 https://www.ogci.com/wp-content/uploads/2024/08/CSRC_Cycle_4_F_SubSaharan_Africa_HAL_Aug_2024.pdf
76 Iron and Steel Technology Roadmap, 2020. Available here
77 Making Net-Zero Steel Possible, 2022. Available here
78 Iron and Steel Technology Roadmap, 2020. Available here
79 Making Net-Zero Steel Possible, 2022. Available here
80 National Business Initiative (NBI), Business Unity South Africa (BUSA) and Boston Consulting Group (BCG), 2021. Decarbonising South Africa's heavy manufacturing sector: Just Transition and Climate Pathways Study for South Africa. Johannesburg: NBI.

required based on the current steel production landscape and relative proportion of technologies (i.e. BF-BOF, EF, IF and DRI-EAF). The emission reductions are shown relative to the NDC trajectory, therefore, where emission reduction initiatives alone are not enough to keep in line with the trajectory, carbon credits are given as an intermediary solution (although still at a cost) while technology adoption increases and for unabated emissions remaining once technologies are implemented.

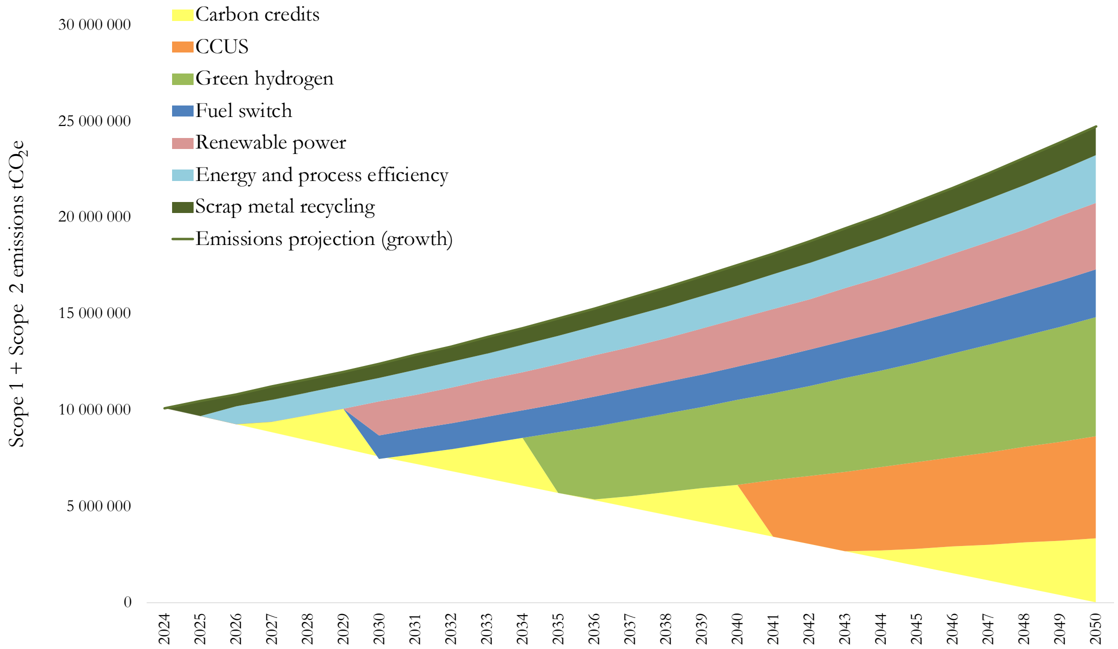

Figure 9: Emission reduction potential for the South African steel industry[81]

5 Global Case Studies and Benchmarks

South Africa's steel sector does not operate in isolation. As climate policy, trade rules and investment standards increasingly reward low-carbon production, understanding how peer jurisdictions are managing the transition is essential. This section examines international case studies and decarbonisation strategies to identify practical lessons for South Africa. It focuses on how industry associations, governments and market actors have worked together to define credible roadmaps, deploy low-carbon technologies, introduce trade-related carbon measures and create demand for green steel. These global benchmarks provide critical insights into the types of coordinated action – across policy, investment and innovation – that may be required to ensure South Africa's steel industry remains competitive and aligned with national climate commitments.

The decarbonisation strategies and international experiences from the following major steel-producing regions are considered:

[81] Current carbon credit supply constraints suggest that demand for eligible and verifiable credits may exceed availability within South Africa's compliance markets, but as the market matures and mechanisms are developed locally, the supply may increase sufficiently.

- European Union – represented by EUROFER (the European Steel Association)
- China – represented by the China Iron and Steel Association (CISA)
- India – represented by the Indian Steel Association (ISA)

Each demonstrates different approaches to coordination, investment and regulation in pursuit of low-carbon steelmaking, highlighting the tools and conditions that have enabled progress in diverse industrial and policy contexts. Table 5 provides a comparative snapshot of crude steel production and export volumes across these regions. While South Africa's output is minimal in global terms, its relatively high export orientation underscores the importance of aligning domestic decarbonisation efforts with emerging international trade mechanisms such as the CBAM.

Table 5: Comparative Steel Production and Export Volumes, 2024

	EU	China	India	South Africa
Crude Steel Production (Mt)	129.7[82]	1005.1[82]	149.4[82]	4.7[82]
Global production share (%)[83]	6.9	53.3	7.9	0.3
Export volume (Mt)	27.8[8282, 84]	117.1[8282]	9.7[8282]	0.8[85]

5.1 Strategic Roadmaps and Industry Coordination

Strategic planning and coordinated action across the steel value chain have proven essential to aligning decarbonisation objectives with long-term industrial development in major producing regions. In each case, industry associations have played a key role in convening stakeholders, articulating national visions, facilitating collaboration and influencing policy design. The experience of the European Union, China and India highlight the institutional mechanisms through which roadmaps have been developed and implemented, as well as the importance of sector-wide alignment to enable deep emissions reductions.

5.1.1 European Union: EUROFER and the Low Carbon Roadmap

The European Union's steel decarbonisation efforts are marked by strong alignment between industrial strategy and climate policy, with the European Steel Association (EUROFER) playing a key coordination role. Representing nearly all EU steel producers, EUROFER brings together national federations and major producers to coordinate sector responses and advocate on issues related to emissions trading, trade policy and low-carbon innovation.[86]

In 2019, EUROFER published the *Low Carbon Roadmap – Pathways to a CO_2-Neutral European Steel Industry*, which outlines scenarios to reduce emissions by 80–95% by 2050, compared to 1990

[82] World Steel Association. *World Steel in Figures 2025*. Available here

[83] Author's calculation using 2024 global crude steel production total of 1 884.6 Mt (source: World Steel Association, *World Steel in Figures 2024*).

[84] This figure excludes intra-regional trade

[85] SAISI. 4 June 2025. Presentation to the Portfolio Committee on Trade, Industry and Competition. Available here

[86] EUROFER. n.d. About the European Steel Association (EUROFER). Available here

levels. The roadmap includes hydrogen-based steelmaking, carbon capture and storage (CCS), and increased scrap use, but emphasises that such transitions require massive investment in renewable electricity, hydrogen infrastructure and circularity.[87] The roadmap is being implemented through the Clean Steel Partnership that consists of representatives of the European Commission and the European Steel Technology Platform (ESTEP).[88] This Partnership serves as a mechanism to trial transformative technologies that reduce emissions from EU steel production, with a focus on advancing them up to TRL 8.

Figure 10 demonstrates the EU steel sector's strategic technological pathways to reduce emissions and advance circular economy solutions.

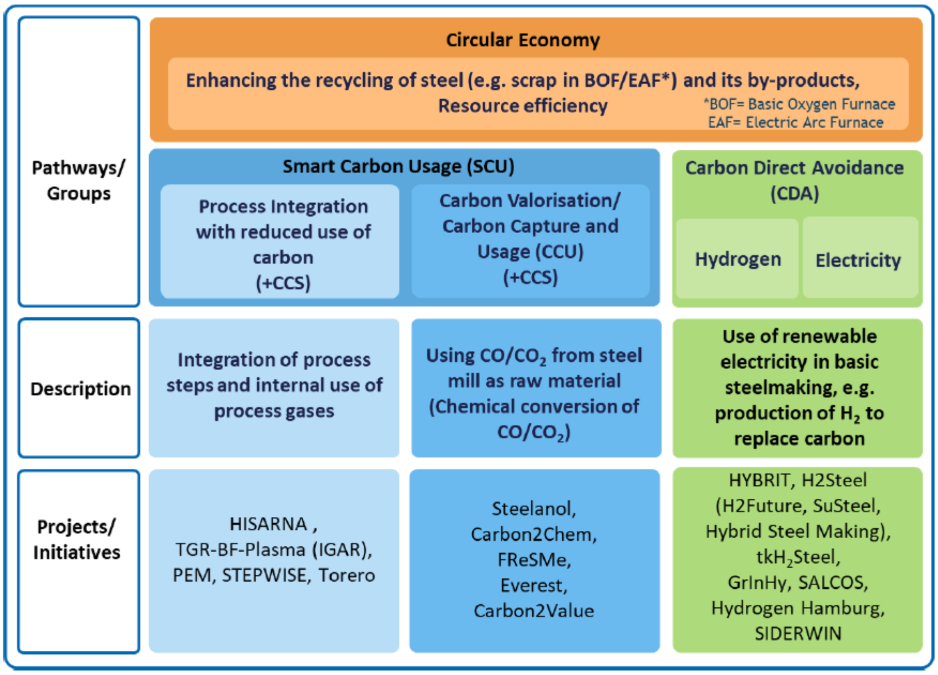

Figure 10: Strategic technological pathways for decarbonising the EU steel industry[87].

EUROFER has outlined over 60 industrial-scale projects that could deliver significant emissions reductions in the steel sector by 2030.[89] However, the association has cautioned that the enabling conditions required to realise these investments remain insufficient. In their July 2025 statement, EUROFER highlighted structural barriers, including high energy costs, delays in project implementation, limited access to scrap and low-carbon feedstocks, and ongoing uncertainty around the CBAM export framework. These constraints have already delayed or halted several projects. EUROFER has called for more decisive implementation of the EU Steel and Metals Action Plan and stronger policy coordination to support a viable business case for decarbonisation.

[87] EUROFER. 2019. Low-Carbon Roadmap: Pathways to a CO_2-Neutral European Steel Industry. EUROFER. Available here

[88] EUROFER. 2021. Launch of the Clean Steel Partnership paves the way for further research and deployment of ground-breaking technology. Available here

[89] EUROFER. 2025 The 2040 climate target requires an industrial revolution, but its enabling conditions - laudably recognised in the Steel and Metals Plan - are not there yet, warns EUROFER. Available here

5.1.2 China: CISA and Sector Reform Alignment

The China Iron and Steel Association (CISA) is a national industry organisation that serves as a bridge between government and enterprises in China's steel sector. It represents the majority of Chinese steel producers and plays a key role in policy coordination, industrial planning, standard-setting, trade regulation and international cooperation.[90]

CISA has aligned its programme with China's goal to peak steel-sector emissions by 2030 and carbon neutrality by 2060.[91] In support of these goals, the association has promoted reforms focused on improving energy efficiency, phasing out outdated capacity and shifting toward cleaner production methods.

China's "dual-carbon" strategy is embedded in the *Guiding Opinions on Promoting the High-Quality Development of the Iron & Steel Industry (2022–2025)*[92], jointly issued by the Ministry of Industry and Information Technology (MIIT), National Development and Reform Commission (NDRC) and Ministry of Ecology and Environment (MEE). The document sets national benchmarks for all provinces, including increasing the share of EAF steelmaking, reducing energy intensity and completing ultra-low emission retrofits on most capacity by 2027.

5.1.3 India: ISA and National Steel Policy Coordination

The Indian Steel Association (ISA) brings together integrated and secondary producers under a unified platform that interfaces directly with the Ministry of Steel on matters of policy, trade and decarbonisation. In 2021, ISA established a Sustainability, Energy & Climate Change (SECC) Committee, comprising chief sustainability officers from major steelmakers[93], to develop a coordinated industry roadmap and track progress toward India's 2070 net-zero target[94].

India's strategic direction is guided by the *National Steel Policy (NSP 2017*), which sets a target of 300 Mt per year of crude steel capacity by 2030-31 and calls for lower carbon intensity through energy-efficiency improvements, technology modernisation and increased scrap use.[95] To support this shift, the *Steel Scrap Recycling Policy (2019)* aims to expand domestic scrap availability from roughly 30 Mt to over 70 Mt per year by 2030.[96]

ISA plays a central role in operationalising these national strategies. It sits on the Ministry of Steel's Advisory Committee and serves as a core member across fourteen Green-Steel Task Forces, contributing industry input on raw materials, finance, infrastructure and standards. It also

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90 China Iron and Steel Association (CISA). n.d. *Brief Introduction of China Iron and Steel Association*. Available here

91 Global Efficiency Intelligence; Lawrence Berkeley National Laboratory. 2023. *Net-Zero Roadmap for China's Steel Industry*. Available here

92 MIIT, NDRC & MEE. 2022. *Guiding Opinions on Promoting the High-Quality Development of the Iron and Steel Industry*. Available here

93 Indian Steel Association (ISA). 2024. *ISA Strategic Engagement for Decarbonisation of the Indian Steel Sector*. New Delhi: Indian Steel Association. Available here

94 Indian Steel Association & McKinsey. 2023. *Steel: Shaping the Sustainable Future*. Available here

95 Ministry of Steel. 2017. *National Steel Policy*. Available at: https://steel.gov.in/national-steel-policy-nsp-2017

96 Government of India: Ministry of Steel. 2019. *Steel Scrap Recycling Policy*. Available here

convenes the annual ISA Steel Conclave, which acts as a shared knowledge platform publishing joint pathway studies and tracking sector-wide progress against decarbonisation milestones.[97]

5.2 Policy Instruments and Trade Mechanisms

Across major producing regions, policy instruments are reshaping the steel market by embedding decarbonisation signals into production, investment and trade decisions. While the European Union leads with explicit carbon pricing and border adjustments, China relies on output controls and capacity replacement rules and India emphasises fiscal incentives and market-based energy savings. These varied, but convergent approaches reflect different political economies yet share a common goal: aligning industrial competitiveness with long-term climate objectives.

5.2.1 European Union: ETS-CBAM Package as the Core Market-Shaping Lever

The European Union has adopted a carbon-pricing-first approach, anchored in the Emissions Trading System (ETS) and reinforced by the CBAM. As part of the "Fit for 55" policy package[98], the latest EU ETS reform tightens the emissions cap and initiates the full phase-out of free allowances for steel between 2026 and 2034.[99] CBAM, launched in a transitional "report-only" phase on 1 October 2023, will require importers of iron and steel to surrender CBAM certificates priced at the prevailing EU ETS level starting in 2026.[100]

In addition to CBAM and the phase-out of free ETS allowances, the EU is strengthening its resource sovereignty through trade restrictions. Under changes to the Waste Shipment Regulation set to come into force in May 2027, the EU will prohibit the export of ferrous scrap to non-Organisation for Economic Co-operation and Development (OECD) countries (of which South Africa has been a member since 2007).[101,102] This policy aims to preserve critical raw materials needed for circular steel production, particularly for EAF routes reliant on scrap, and could significantly impact global scrap availability and trade flows.

EUROFER has explicitly tied its decarbonisation strategy to this policy framework and, in its 13 February 2025 statement, warned that without swift fixes to address resource shuffling, export competitiveness and downstream-product coverage, the ETS/CBAM combination "will fail to provide adequate protection against carbon leakage" [103], subsequently undermining planned green-

97 Indian Steel Association. 2024. *ISA Steel Conclave 2024 Overview*. Available here

98 The "Fit for 55" package is the European Union's legislative framework to reduce net greenhouse gas emissions by at least 55% by 2030 and set the EU on course to achieve climate neutrality by 2050. It aims to deliver a just and socially fair transition, strengthen innovation and the global competitiveness of EU industry, and ensure a level playing field with third-country operators. Source: Council of the European Union. 2025. *Fit for 55*. Available here

99 International Carbon Action Partnership. 2023. *EU adopts landmark ETS reforms and new policies to meet 2030 target*. Available here

100 European Commission: Directorate-General for Taxation and Customs Union. 2023. *Carbon border adjustment mechanism – Information for importers of iron & steel*. Publications Office of the European Union. Available here

101 GMK Center. 2025. *Global Scrap Exports Restrictions*. Available here

102 See the OECD website for the list of OECD member countries. Available here

103 EUROFER. *EUROFER Statement: CBAM simplification and effectiveness must go hand in hand*. Available here

steel investments. The association has called for urgent implementation of anti-circumvention rules, extension of CBAM to cover downstream steel products and an export adjustment mechanism to maintain market viability for EU-based producers.

5.2.2 China: Output Discipline and Capacity-Swap Rules as De Facto Carbon Controls

China's approach combines administrative controls and output discipline, along with state support in the form of subsidies and incentives, rather than explicit carbon pricing. Since 2021, provinces have been required to cap annual crude steel production at or below the previous year's level, as part of broader "double-control" targets on energy and emissions.[104] However, the strictness of enforcement and specific application of these caps can vary year by year and between provinces, reflecting economic conditions and policy reviews.[105] Enforcement mechanisms include annual provincial production caps, power rationing notices and administrative controls issued by MIIT and local governments.

According to *Decoding China's Steel Capacity Replacement Policies*, at the investment level, new steel projects are generally permitted only if equivalent old capacity is retired. This "capacity-replacement" rule, initially introduced in 2015 and progressively tightened over the years, was suspended for revision in August 2024, with MIIT currently drafting a stricter swap formula. Even during suspension, swap compliance continues to be checked during permit reviews and grid-access approvals. These rules are reinforced by preferential state support, such as subsidised finance, tax relief and lower electricity costs, which ensure that capacity replacement aligns with national decarbonisation and industrial policy goals.

5.2.3 India: Incentive-Led Approach Combining Fiscal Levers with Market Signals

India does not use carbon pricing or binding caps. Instead, it offers incentive-based and market-driven mechanisms. The Perform-Achieve-Trade (PAT) scheme, now in its fourth cycle, sets plant-specific energy intensity reduction targets and allows trading of excess savings certificates.[106] The scheme creates market-based incentives for continuous energy efficiency improvements across participating industrial sectors, including iron and steel.

ISA supports New Delhi's incentives-led decarbonisation pathway but warns that progress will falter without stronger trade defences and an early domestic carbon pricing mechanism.[107,108] ISA has advocated for import-related trade remedies[109], the implementation of the Carbon Credit Trading Scheme (CCTS) in a format compatible with the EU's CBAM and the adoption of a national green public procurement policy that reserves a portion of public contracts for certified

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104 Reuters. 2025. *China to continue crude steel output regulation in 2025*. Available here
105 Transition Asia. 2025. *Decoding China's Steel Capacity Replacement Policies*. Available here
106 Bureau of Energy Efficiency. n.d. *Perform Achieve Trade (PAT)*. Available here
107 Indian Steel Association (ISA). 2024. *ISA Strategic Engagement for Decarbonisation of the Indian Steel Sector*. New Delhi: Indian Steel Association. Available here
108 Indian Steel Association & McKinsey. 2023.*Steel: Shaping the Sustainable Future*. Available here
109 Reuters. 2023. *India to set emission reduction mandates for 4 sectors, to start carbon trading from 2025*. Available here

low-carbon steel. Together, these measures aim to de-risk large-scale investment in H_2-DRI, scrap-EAF and CCUS technologies.

5.3 Technology and Infrastructure Transitions

All three peers are rewiring the steel value chain, but through different combinations of breakthrough pilots, enabling infrastructure and policy-driven scale-up. The EU is moving from pilot to first-of-a-kind commercial projects in hydrogen-based steelmaking, underpinned by EU funding and the emerging Hydrogen Backbone [110]. China is rapidly expanding EAF production, guided by capacity-swap approvals, scrap logistics and hydrogen trials. India is using targeted H_2-DRI pilots, scrap-policy frameworks, and corridor-based planning[111] to prepare for future scale. Across all three cases, strategic public funding, permitting support, and institutional coordination have proved critical to pushing new technologies up the readiness curve and attracting large-scale investment. All three peers are rewiring the steel process flow: the EU is trialling hydrogen-based steelmaking and carbon capture technologies; China is scaling EAF production supported by scrap logistics and infrastructure approvals; and India is piloting green H_2-DRI supported by Task Force-driven corridors[112].

While all three peers are deploying similar breakthrough technologies, the pace and scale of deployment differ significantly. The EU is furthest ahead, with several projects already entering commercial operation. China and India have reached pilot or demonstration stage in key technologies. By contrast, South Africa remains at the feasibility assessment stage. While scrap-based EAFs offer the most immediate decarbonisation potential, large-scale deployment of hydrogen-DRI and CCU technologies is still at least a decade away, pending cost reductions, enabling infrastructure, and supportive policy frameworks.

5.3.1 European Union: Scaling Hydrogen DRI and Grid Infrastructure

The EU's transition is anchored by the Clean Steel Partnership, an EU-backed public-private initiative that aims to demonstrate breakthrough low-carbon steel technologies by 2030. These include H_2-DRI, carbon capture and circular material flows. The partnership brings together €1.7 billion in funding from the EU and private sector, and aligns closely with the steel sector's long-term decarbonisation goals.[113]

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110 European Hydrogen Backbone (EHB). n.d. *The European Hydrogen Backbone (EHB) Initiative.* Available here

111 Corridor-based planning for steel generally refers to strategic approaches that focus on the development of transportation and infrastructure corridors to support the steel industry, often involving the integration of steel production, processing, and distribution within these corridors. This type of planning aims to optimize the flow of materials, products, and information, enhancing the efficiency and competitiveness of the steel sector.

112 Refers to the Indian Steel Association's Green-Steel Task Forces, which are coordinating certification standards, mapping renewable- and hydrogen-based infrastructure corridors, and aligning finance pipelines to support the industry's decarbonisation goals.

113 EUROFER. 2021. *Launch of the Clean Steel Partnership paves the way for further research and deployment of ground-breaking technology.* Available here

Key ventures like HYBRIT[114,115] and H_2 Green Steel[116] (Sweden) and SALCOS[117] (Germany) are scaling up to million-tonne production with integrated electrolysers, supported by national subsidies and grid infrastructure. Meanwhile, EU member states are working to build more than 50 000 km of hydrogen pipelines, with the first cross-border links expected by 2030.[118] However, progress has recently slowed as high energy costs have undermined the business case for hydrogen-based DRI. Despite subsidies earmarked for industrial decarbonisation, several projects have been delayed or scaled back, leading observers to caution that the EU's 'hydrogen bubble' may be stalling.[119]

Collectively, these projects represent the first wave of commercial-scale fossil-free steelmaking in Europe. HYBRIT is targeting 1.3 Mt of fossil-free steel annually[120] and SALCOS is aiming to commence commercial operations in 2026.[121] In parallel, the EU is advancing a carbon capture route. ArcelorMittal's Gent blast furnace began operating a pilot carbon capture unit in May 2024, providing a platform to test scale-up toward full-plant deployment.[122]

5.3.2 China: Driving EAF Expansion and Scrap Market Reform

A key initiative in China's technological shift is the expansion of EAF steelmaking, which enables greater use of scrap and lower emissions intensity. In 2023, CISA established a dedicated EAF Steel Division to coordinate industry policy around cleaner production, support technology adoption and promote market mechanisms for scrap utilisation.[123]

Figure 11 summarises key recommendations to scale up low-carbon scrap-based EAF production in China, focusing on coordinated action to strengthen the scrap market, support new investments, decarbonise electricity inputs, and enhance policy alignment. China's steel industry has set ambitious targets to raise the EAF share of crude steel from ~10% today to 15% by 2025 and 20% by 2030[124]. However, China's domestic production slowdown, combined with pressure to meet its 15% EAF target, risks exacerbating oversupply in a weak demand environment.

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114 Hybrit. n.d. *Pilot scale direct reduction with hydrogen.* Available here

115 World Economic Forum. 2021. *This company has delivered the world's first fossil-free steel.* Available here

116 Hydrogen Europe. n.d. *H2 Green Steel secures €4.5bn funding for world-first project.* Available here

117 Salzgitter AG. 2023 *SALCOS® milestone reached - Salzgitter AG awards contract for direct reduction plant.* Available here

118 OGE. 2023. *European Hydrogen Backbone.* Available here

119 Power Shift Africa. 2024. Is it possible to de-carbonize Southern Africa's steel industry? Webinar discussion featuring speaker Anand Pathanjali, August 2024.

120 European Commission. 2023. *The HYBRIT story: Unlocking the secret of green steel production.* Available here

121 SALCOS. n.d. *The Concept for a Sustainable Future.* Available here

122 ArcelorMittal. 2024. *Trial carbon capture unit begins operating on blast furnace at ArcelorMittal Gent, Belgium.* Available here

123 SEASI. 2025. *CISA sets up new division to promote China's EAF steelmaking.* South East Asia Iron and Steel Institute, 28 February 2025. Available here [124] Hasanbeigi, A.; Springer, C.; Sibal, A. 2025. *China's Steel Transformation: From Blast Furnaces to Electric Arc Furnaces.* Available here

124 Hasanbeigi, A.; Springer, C.; Sibal, A. 2025. *China's Steel Transformation: From Blast Furnaces to Electric Arc Furnaces.* Available here

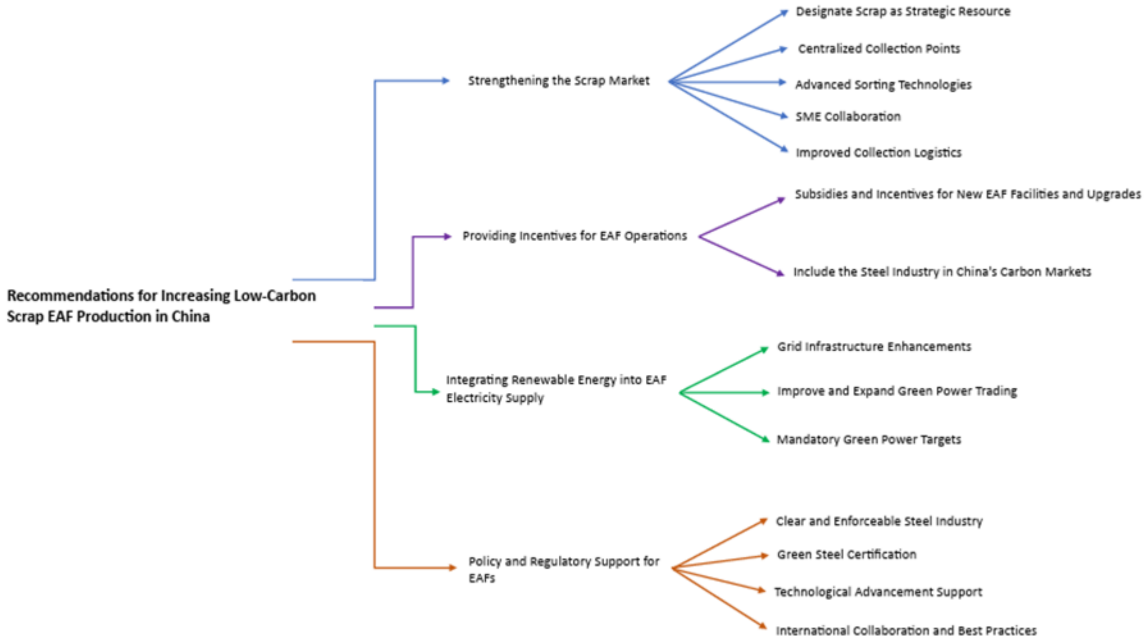

Figure 11: Priority recommendations to increase low-carbon scrap-based EAF production in China[125]

CISA plays a central role in implementing national directives through its EAF Steel Division, which reviews capacity-swap applications and checks alignment with national EAF targets before projects can secure grid connection or access green finance. The association also produces scrap availability outlooks, estimated at 350 Mt per year by 2030 and 500 Mt by 2050 in the *Net-Zero Roadmap for China's Steel Industry*, that inform investment decisions by mills, recyclers and financiers. In addition, CISA facilitates technical working groups to address key barriers such as fragmented scrap collection systems, inconsistent material quality and regional power tariff differences.

In parallel with EAF development, China is also pursuing hydrogen-based steelmaking. In 2023, HBIS delivered its first batch of green DRI from a 1.2-million-ton hydrogen metallurgy[126], one of the world's largest of its kind. China is also exploring carbon capture retrofits, with HBIS and BHP co-developing a blast furnace capture pilot under a 2024 memorandum of understanding, with the project now in detailed engineering[127].

5.3.3 India: Piloting Green Hydrogen and Building Scrap Supply Chains

India's transition is being tested through a cluster of H_2-DRI pilots and scrap-market reforms. Under the National Green Hydrogen Mission, a ₹455 crore pilot scheme was launched in 2024 to

[125] Hasanbeigi, A.; Springer, C.; Sibal, A. 2025. *China's Steel Transformation: From Blast Furnaces to Electric Arc Furnaces.* Available here

[126] Steel Technology. 2024. *HBIS Inagurated the World's First Hydrogen Metallurgy Green Automotive Sheet Continuous Casting Line.* Available here

[127] BHP. 2024. *BHP and HBIS Strengthen Partnership with New MOU to Advance Decarbonisation in Steel Value Chain.* Available here

retrofit DRI and blast furnace processes for hydrogen-readiness[128], with initial projects, including JSW Steel's 25 MW H_2 plant[129], set to begin in FY2025. In parallel, JSW Steel is also developing a 300 tonne-per-day blast furnace capture unit at its Vijayanagar works, making it the largest carbon capture project in the steel sector at the demonstration stage.[130] Figure places India's early CCUS deployment in the global landscape, showing how it joins other major steel-producing regions in testing capture technologies across diverse process routes and storage strategies.

Figure 12: Global CCUS project landscape in the steel sector. [131]

At the same time, the *2019 Steel Scrap Recycling Policy* aims to formalise a national network of collection and processing hubs to increase domestic scrap supply to over 70 Mt per year by 2030, in line with the objectives of the National Steel Policy.[132] ISA-led Green-Steel Task Forces are coordinating certification standards, mapping renewable-and-hydrogen corridors and aligning finance pipelines[133]. Together, these efforts are laying the groundwork for scalable H_2-DRI and EAF deployment.

5.4 Market Creation and Demand Signalling

Creating a market for low-carbon steel is essential to scale production and attract investment. All three peer regions are complementing their supply-side interventions with demand-side measures, ranging from procurement mandates and subsidies to export disincentives and product standards,

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128 PIB Delhi. 2024. *Government issues Pilot Project Guidelines for utilizing Green Hydrogen in Steel Sector*. Available here
129 NDTV Profit. 2024. *JSW Energy to Set Up India's Largest 25 MW Green Hydrogen Project for JSW Steel*. Available here
130 South East Asia Iron and Steel Institute. 2024. *JSW Steel trialling largest blast furnace CCUS project in Indian steel industry*. Available here
131 South East Asia Iron and Steel Institute. 2024. *JSW Steel trialling largest blast furnace CCUS project in Indian steel industry*. Available here
132 Government of India: Ministry of Steel. 2019. *Steel Scrap Recycling Policy*. Available here
133 Indian Steel Association (ISA). 2024. *ISA Strategic Engagement for Decarbonisation of the Indian Steel Sector*. New Delhi: Indian Steel Association. Available here

to monetise emissions reductions, signal product differentiation and shield first movers from carbon-intensive competition.

5.4.1 European Union: Procurement Mandates and Lead-Market Instruments

The EU is positioning public procurement as a cornerstone of demand for "near-zero" steel. Regulation (EU) 2024/3110, announced under the Steel and Metals Action Plan, introduces binding CO_2-performance criteria for EU-funded infrastructure[134], supporting the use of emerging standards such as the Low Emission Steel Standard (LESS)[135] as benchmarks for low-carbon steel.

In February 2025, the Clean Industrial Deal committed to embedding sustainability, resilience and "Made-in-Europe" criteria across procurement for strategic sectors, with steel as a pilot.[136] A forthcoming Industrial Decarbonisation Accelerator Act[137] will introduce labelling protocols and joint procurement tools to help public buyers aggregate demand and pay green premia, even when bids are not the lowest-cost. Together, these instruments strengthen demand for low-carbon steel in public works, which represent about 11% of EU steel consumption[138], helping to reduce commercial risk for emerging technologies such as H_2-DRI and CCUS.

5.4.2 China

China is reinforcing green-steel demand through a combination of trade restrictions, emerging certification standards, and prospective carbon pricing. Since 2021, China has progressively removed export tax rebates on a wide range of high-carbon steel products, including hot-rolled coil, rebar and stainless steel, as part of a broader effort to boost domestic steel supply while reducing emissions.[139] The Ministry of Finance's cancellation of the 13% value-added tax (VAT) rebates on 146 steel products raised the relative value of domestic sales and discouraged emissions-intensive exports.

In parallel, CISA released the *Low-Carbon Emission Steel Evaluation Method* in October 2024[140], which is a group standard that enables mills to certify and differentiate lower-carbon steel grades, in anticipation of future green procurement or labelling requirements. Meanwhile, the Ministry of Ecology and Environment has confirmed that the national ETS, which currently covers only the

134 Official Journal of the European Union. *Regulation (EU) 2024/3110 of the European Parliament and of the Council of 27 November 2024.* Available here
135 Wirtschaftsvereinigung Stahl. 2025. *Statement on the review of the EU Directives on public procurement |March 2025.* Available here
136 European Commission. 2025. *Clean Industrial Deal.* Available here
137 European Commission. *The Clean Industrial Deal: A joint roadmap for competitiveness and decarbonisation.* Available here
138 Wirtschaftsvereinigung Stahl. 2025. *Statement on the review of the EU Directives on public procurement |March 2025.* Available here
139 Argus Media. 2021. *China cancels steel export tax rebates to boost supply*. Available here 140 CISA. 2024. *CISA unveils "China Low Carbon Emission Steel" Standard.* Available here
140 CISA. 2024. *CISA unveils "China Low Carbon Emission Steel" Standard.* Available here

power sector[141], is proposed to include iron and steel in the near future[142]. This will introduce a direct carbon price signal that complements existing administrative controls and trade adjustments. Collectively, these measures are nudging producers and buyers toward lower-carbon options, supported by China's broader framework of state subsidies and industrial incentives.

5.4.3 India

India is building domestic demand for low-carbon steel through a layered mix of definitions, subsidies, and procurement mandates. The *Green Steel Taxonomy*, released in December 2024, introduces a 1- to 5-star rating system for products with embodied emissions below 2.2 tCO_2e/tonne, with the National Institute of Secondary Steel Technology (NISST) appointed as the measurement, reporting and verification (MRV) body, offering buyers a transparent and standardised emissions benchmark.[143] A draft Green Steel Public Procurement Policy has recently been proposed by the Ministry of Steel, mandating the use of certified low-emission steel in all central government and centrally sponsored projects from FY 2027–28 for a period of eight years.[144] Only steel meeting verified benchmarks for carbon emissions, resource efficiency and environmental impact would qualify, aiming to drive demand and accelerate low-carbon investment.

The *Production-Linked Incentive (PLI) Scheme for Specialty Steel*, with a budget of ₹6,322 (approximately US$0.8 billion)[145], offers output-based subsidies for high-value steel grades, such as electrical and coated products, that are typically produced using EAF or DRI technologies. By combining price incentives with volume guarantees, India's policy mix aims to shorten the payback period for H_2-DRI, scrap-EAF and CCUS investments, while safeguarding domestic competitiveness under emerging carbon border measures like the EU's CBAM. The PLI scheme and green-labelling efforts also aim to preserve access to key export markets, particularly under CBAM-type border measures.

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141 Ministry of Ecology and Environment of the People's Republic of China. 2024 *Progress Report of China's National Carbon* Market. Available here [142] Hasanbeigi, A., Lu, H., Zhou, N. 2023. *Net-Zero Roadmap for China's Steel Industry*. Lawrence Berkeley National Laboratory and Global Efficiency Intelligence. Report No. LBNL-2001506. Available here[143] Government of India: Ministry of Steel. 2024. *Union Minister of Steel and Heavy Industries, Shri H.D. Kumaraswamy, Releases India's Green Steel Taxonomy*. Available here

142 Hasanbeigi, A., Lu, H., Zhou, N. 2023. *Net-Zero Roadmap for China's Steel Industry*. Lawrence Berkeley National Laboratory and Global Efficiency Intelligence. Report No. LBNL-2001506. Available here[143] Government of India: Ministry of Steel. 2024. *Union Minister of Steel and Heavy Industries, Shri H.D. Kumaraswamy, Releases India's Green Steel Taxonomy*. Available here

143 Government of India: Ministry of Steel. 2024. *Union Minister of Steel and Heavy Industries, Shri H.D. Kumaraswamy, Releases India's Green Steel Taxonomy*. Available here

144 Steel Structures & Metal Buildings. 2025. *India Set to Mandate Green-Rated Steel for Central Government Projects from FY 2027–28*. Available here

145 Government of India: Ministry of Steel. 2021. *Production Linked Incentive (PLI) Scheme for Specialty Steel in India*. Available here

5.5 Implications for South Africa

South Africa's steel sector faces a critical inflection point. While international peers are accelerating the deployment of low-carbon technologies through strategic roadmaps, public-private coordination, and demand-creation measures, South Africa risks falling behind. The lessons from the EU, China and India reveal common success factors: aligned policy signals, coordinated industry platforms, targeted infrastructure investment and strong demand-side support. For South Africa, translating these lessons into actionable pathways requires addressing gaps in technology readiness, investment mobilisation and institutional capacity.

Table 6 compares the estimated TRLs of key low-carbon steelmaking pathways across selected jurisdictions. These values reflect the most advanced public deployments in each country and are used here to benchmark South Africa's position relative to its peers.

Table 6: Comparative TRLs for Key Low-Carbon Steelmaking Pathways

Decarbonisation Pathway	EU / EUROFER	China / CISA	India / ISA	South Africa / SAISI
H_2-DRI and EAF	TRL 8 - 9	TRL 6 - 7	TRL 6	TRL 7 - 8
CCUS retrofits (BF-BOF or DRI)	TRL 7 - 8:	TRL 6 - 7	TRL 6 - 7	TRL 6 - 7
Scrap-based EAF with low-carbon electricity	TRL 9	TRL 9	TRL 9	TRL 9

These TRL benchmarks highlight how South Africa remains in the early phases of piloting or feasibility in most key decarbonisation pathways, while peer regions are progressing toward commercial deployment. H_2-DRI and CCUS remain especially underdeveloped, with no major public or private pilot currently financed. Although South Africa's scrap-based EAF capacity is technically mature, its decarbonisation potential is constrained by a high grid emissions factor of approximately 0.96 tCO_2e/MWh[146], limiting climate benefits compared to countries with cleaner electricity.

Peer experiences show that enabling progress requires more than technology alone. The EU, China and India have all established clear industrial decarbonisation strategies, empowered national associations or task forces, and introduced a mix of financial support, permitting reforms and demand-side incentives. These structural enablers (mostly absent in South Africa) have proven essential to unlocking investment and accelerating scale-up.

In addition, lessons from peer jurisdictions underscore the importance of demand-side policies such as green public procurement (GPP), product certification and emissions-based labelling. While South Africa has not yet implemented a dedicated GPP scheme for current and for future

[146] Department of Forestry, Fisheries and the Environment (DFFE). 2024. *Publication of South Africa's 2022 Grid Emission Factors Report.* Available here

low-carbon steel, government-led infrastructure initiatives under the JET-IP and Infrastructure South Africa offer near-term opportunities to embed climate-aligned procurement criteria. This could include requiring emissions disclosures or prioritising scrap-EAF and hydrogen-DRI steel in public tenders. Notably, Coega Steels has already obtained an Environmental Product Declaration (EPD) for its billets[147], establishing an early precedent for emissions transparency and product-level differentiation in the South African market. SAISI and its members are well positioned to contribute technical guidance, help shape credible eligibility benchmarks, and advocate for the creation of a supportive local market for verified lower-carbon steel products.

Breakthrough technologies will also play a growing role. One such example is MOE, being developed by U.S.-based Boston Metal.[148] MOE uses renewable electricity to directly convert iron ore into high-purity iron without carbon emissions or waste. Though still in the lab-to-prototype phase (TRL 3 - 4), MOE is the only known process with the potential to achieve zero-emissions primary steelmaking at full global scale. South African institutions and research bodies may wish to track these developments closely and explore future collaboration or early-stage participation.

6 Recommendations for the Steel and Iron Industry's Just Transition

South Africa's steel sector has a narrowing window to reposition itself in line with emerging global norms. With the right mix of enabling policies, institutional coordination and upfront investment, the sector can decarbonise in a way that safeguards jobs, supports local value chains and retains access to international markets.

These recommendations outline a practical path forward, linking climate ambition to trade competitiveness, infrastructure readiness and social equity. By acting decisively, South Africa can convert the global green steel transition from a compliance risk into a long-term industrial opportunity.

All timelines are indicative. "Near-term" refers to 2025–2028 and "medium-term" to 2029–2035.

6.1 Carbon Pricing and Trade Exposure

South Africa's steel industry faces growing trade risks from carbon pricing misalignment. The European Union's CBAM, which will impose certificate obligations on iron and steel exports from 2026, effectively embeds a carbon price into traded goods. This creates an urgent need for South African producers to demonstrate emissions transparency and policy comparability to maintain market access.

147 Conserve Consultants. 2025. Pioneering Sustainable Steel: Coega Steels Becomes South Africa's First Environmental Product Declaration (EPD) Billet Manufacturer! Available here

148 Boston Metal. 2022. *Zero CO_2 Steel by Molten Oxide Electrolysis: A Path to 100% Global Steel Decarbonization*. Available here

According to a 2023 policy brief by Trade & Industrial Policy Strategies (TIPS), approximately US$1.5 billion of South African exports are exposed under CBAM (based on 2021 data), with iron, steel and aluminium making up the largest share.[149] TIPS highlights three priority areas to manage this exposure:

- Establishing a national carbon reporting system that enables exporters to quantify and verify embedded emissions in accordance with CBAM standards;
- Accelerating grid decarbonisation to lower the indirect emissions penalty embedded in steel exports;
- Reforming the Carbon Tax to raise the effective rate in line with the EU ETS, which could unlock partial CBAM exemptions.

The last point above however stands in direct contradiction to SAISI's position on the Carbon Tax, with risks compounded by South Africa's high emissions intensity. The current and scheduled tax increases already present an unaffordable burden in the absence of adequate decarbonisation support, risking further deindustrialisation, job losses, and plant closures.

Rather than increasing the carbon tax rate to align with the EU ETS in pursuit of potential CBAM exemptions, South Africa should prioritise **a context-sensitive approach that reflects the structural and economic constraints of its domestic steel industry**. Unlike EU producers, South African steelmakers do not benefit from equivalent subsidies, revenue recycling, or access to affordable low-carbon infrastructure. As such, policy efforts should focus on stabilising the current carbon tax regime, maintaining existing allowances, and supporting investment in viable local decarbonisation pathways before considering any rate increases. While SAISI does not set carbon tax or trade policy, it can play an enabling and advocacy role. SAISI could:

- Advocate for the design of a sector-specific MRV system, aligned to EU methodologies, to reduce compliance burdens and increase the transparency of embedded carbon in steel exports.
- Engage National Treasury and DFFE on a sector-sensitive review of the Carbon Tax design for trade-exposed industries, advocating for a phased, government-supported transition from fixed allowances to realistic, domestically-informed emissions benchmarks that reflect South Africa's industrial context and decarbonisation readiness..
- Support the creation of a CBAM Readiness Task Team (across Department of Trade, Industry and Competition, Department of International Relations and Cooperation, SARS, and National Treasury) to explore mutual recognition agreements, coordinate export data, and standardise carbon declarations.

SAISI can also assist members by developing template disclosures, facilitating independent benchmarking studies on carbon-intensity and engaging directly with EU institutions on transitional rules and product coverage.

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[149] Trade & Industrial Policy Strategies. 2023. *The European Union's Carbon Border Adjustment Mechanism and implications for South African exports*. Available here

6.2 Access to Green Electricity and Infrastructure

South Africa has a solid technical foundation to build a niche green steel sector, leveraging high-grade iron ore, favourable port infrastructure, and world-class renewable resources in the Northern and Western Cape. Reliable access to competitively priced renewable electricity is however a prerequisite for low-carbon steel production. South African EAF operators face grid emissions of nearly 1 tCO_2e/MWh, limiting decarbonisation gains from scrap-based production. In response, SAISI could advocate for policy and regulatory reforms that improve the accessibility and efficiency of private renewable energy procurement including wheeling agreements and grid-access processes. While wheeling is legally permitted, the lack of consistent agreements across municipalities and lengthy approval timelines can make projects unviable in practice. For example, a steel producer signing a power purchase agreement with an independent solar provider may still face delays of 12–18 months to secure wheeling approvals from multiple municipal authorities, each with different tariffs, processes, and technical requirements. Streamlining these frameworks would reduce transaction costs and uncertainty, making it easier for the sector to access clean energy at scale.

Dedicated industrial procurement windows under REIPPPP, or equivalent initiatives, could also prioritise renewable supply for hard-to-abate sectors, such as steel. In parallel, long-term infrastructure planning for hydrogen, including feasibility studies for regional hydrogen corridors and common-user infrastructure in strategic zones like Saldanha or Coega, will be vital to enable future deployment of green H_2-DRI.

6.3 Finance and Investment Incentives

Decarbonising steel will require substantial upfront investment in technologies that are not yet fully commercial. To lower financing barriers, SAISI can support the development of a steel-relevant blended finance facility, working with partners such as DBSA, JET-IP and international development institutions. Such a facility could offer concessional loans for first-of-a-kind projects like H_2-DRI, CCUS retrofits or high-efficiency EAF upgrades.

Complementary tax-based incentives could also be explored. These could include accelerated depreciation for qualifying low-carbon assets or incentives similar to Section 12L, but more targeted to the steel – for example rebates for increased use of scrap steel or recycled inputs. The steel sector needs process-based and emissions-linked incentives, not just energy-use-based incentives. SAISI could further encourage the inclusion of steel-sector pilots in national funding schemes for infrastructure and innovation, ensuring early projects receive adequate de-risking support.

6.4 Labour Transition and Skills Development

A just transition must place workers and communities at the centre of industrial change. South Africa's steel sector supports an estimated around 290 000 jobs[150], and the shift to cleaner technologies will introduce new skills requirements. SAISI can initiate a sector-wide skills mapping exercise in collaboration with a relevant Sector Education and Training Authority (SETA), such as MERSETA, and other education partners to identify training needs in areas such as hydrogen safety, digital operations and process electrification.

This could inform the development of modular programmes delivered through Technical and Vocational Education and Training (TVET) colleges and in-house training centres.

6.5 Product Differentiation and Market Access

Creating a market for low-carbon steel will be important over the medium to longer term for attracting investment and supporting the South African iron and steel sector's transition as decarbonisation efforts begin to scale. While significant challenges remain, including access to affordable renewable electricity and the emissions intensity of the national gird, early steps toward credible product differentiation can still lay the groundwork for future competitiveness. SAISI is well positioned to coordinate the development of a national green steel certification framework, aligned with SABS-ISO 20915: Life cycle inventory calculation methodology for steel products and international benchmarks such as the EU's Low Emission Steel Standard. A transparent and credible label could help facilitate market uptake, both domestically and in export markets, as enabling conditions improve. Coega Steels has already taken a leadership step by obtaining an Environmental Product Declaration (EPD) for its steel, demonstrating both the feasibility and market value of verified emissions disclosures in the South African context.

Public procurement has the potential to play a lead-market role in driving demand for green steel over the long term. Once the domestic industry is better positioned to supply low-carbon steel at scale, SAISI could engage with infrastructure entities – including SANRAL, PRASA and SANEDI – to integrate minimum green content thresholds into procurement tenders for rails, girders and pylons. These thresholds could gradually increase over time, supported by procurement tools that enable fair value-for-money assessments when bids include green premiums.

Lastly, over the longer term, SAISI could explore facilitating the formation of voluntary Green Steel Buyer Clubs, which could be platforms bringing together automotive, construction and retail buyers to signal future demand for certified low-emissions steel. While not immediately feasible given current green steel supply constraints, such initiatives could eventually mirror emerging models in Europe. These models still face challenges but are more advanced and supported than in South Africa, and they could offer greater market visibility to support investment planning as green steel production capabilities mature.

[150] The Star. 2024. *SA's big steel producers struggling 'to keep lights on'*. Available here

6.6 Institutional Coordination to Enable a Just and Credible Steel Transition

Early initiatives such as the Saldanha Green Hydrogen and DRI Hub Master Plan signal growing institutional support and set the stage for pilot-scale development, though capital cost constraints remain. Effective implementation could be supported through enhanced coordination and engagement across key stakeholders. To support and enable a credible and just transition in the steel sector, the following approaches could be explored:

- Establishing a national focal point for steel decarbonisation within the Department of Trade, Industry and Competition could help coordinate policy alignment across key stakeholders such as National Treasury, DMRE, Eskom, Transnet, and the JET-IP.
- Creating a multi-stakeholder "Steel Transition Platform", potentially facilitated by SAISI, to bring together industry, government, labour, and financial institutions could serve as a forum to identify shared priorities, address investment barriers, and assess the technical readiness of key transition pathways.
- Developing a shared monitoring and reporting dashboard to track progress on key indicators, such as emissions intensity (tCO_2e/tonne steel), renewable energy integration, adoption of green steel, and workforce transition metrics could support transparency, feedback, and adaptive decision-making.
- Facilitating the development of a forward-looking national scrap availability outlook, in partnership with recyclers and financiers, to inform planning investment in EAF capacity and secondary steelmaking. This could be complemented by a dedicated technical working group to address operational barriers such as fragmented scrap collection, inconsistent material quality, and regional power tariff disparities, drawing on elements of China's coordinated approach.

6.7 Making the Transition Just and Competitive

Figure 13 below summarises the proposed phased timeline of strategic actions aligned to near-, medium- and long-term goals in order to guide implementation.

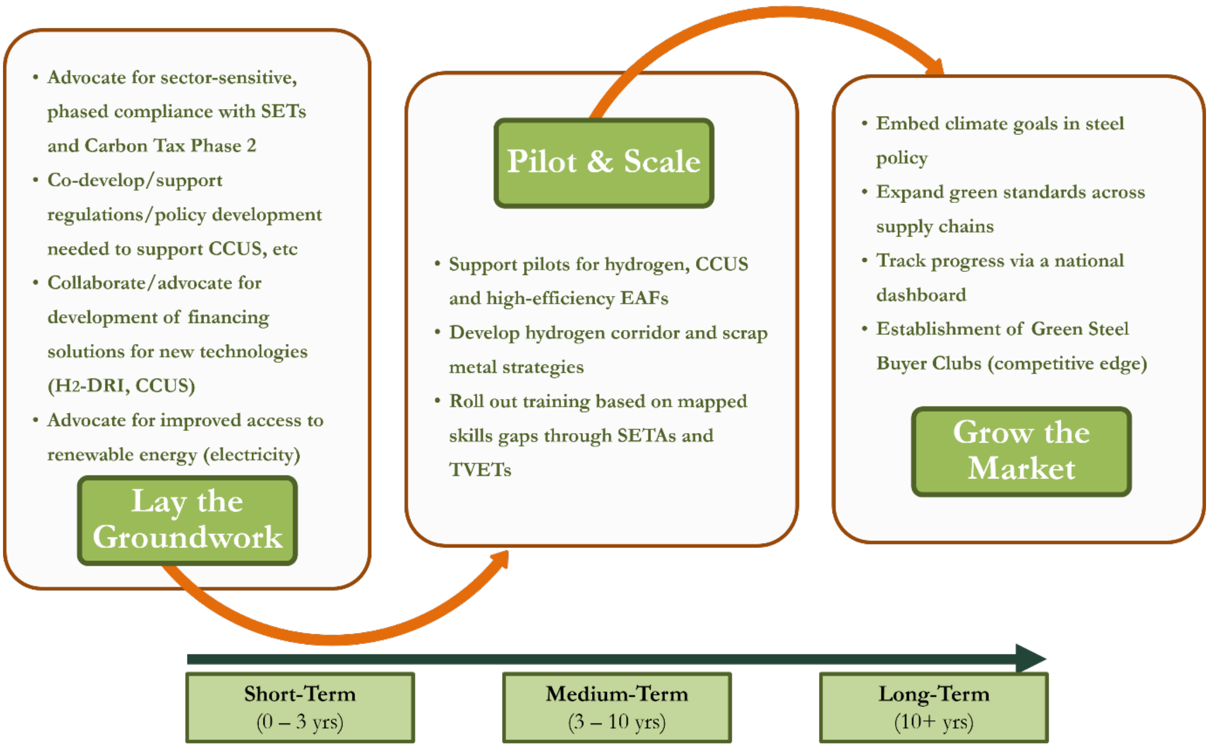

Figure 13: Phased Strategic Roadmap for a Just, Competitive and Climate-Aligned Transition

7 Annexure: Comments on the Draft National Greenhouse Gas Carbon Budget and Mitigation Plan Regulations

The South African steel sector recognises the importance of contributing to national emissions reduction targets. However, carbon budget allocation methods must account for the sector's status as a hard-to-abate, trade-exposed industry already facing severe economic and social pressures. A just transition in this context requires carbon budgets that are realistic, evidence-based, and aligned with enabling policy support.

7.1 Framing of Carbon Budgets

7.1.1 Requirements of the Climate Change Act

Section 27(2) of the Climate Change Act (CCA) sets out mandatory considerations that the Minister must take into account when allocating carbon budgets. These include:

a) The socio-economic impacts of imposing the carbon budget;
b) The best available science, evidence, and information;
c) The best practicable environmental options and alternatives for mitigating greenhouse gas emissions;
d) National strategic priorities;
e) The alignment of carbon budgets with the national greenhouse gas emissions trajectory, noting that the cumulative budgets are not equivalent to the trajectory itself; and
f) Progress on the implementation of greenhouse gas mitigation plans.

These provisions are not merely advisory; they define the legal framework within which all carbon budget allocations must be made. Yet the draft regulations do not integrate these requirements into the budget-setting methodologies themselves. The only direct reference appears in Regulation 8(2), which instructs the competent authority to "*consider all of the considerations in section 27(2)(a) to (f) of the Act*" when determining an allocation. The accompanying Technical Guidelines likewise omit any operationalisation of these factors, focusing instead on calculation procedures without embedding the statutory considerations into the process. Without clear integration, the allocation system risks failing to comply with the Climate Change Act.

While the Act leaves the Minister discretion as to how to consider the section 27(2) factors, that discretion must be exercised lawfully, reasonably, and on the basis of adequate information, as required by the Promotion of Administrative Justice Act and constitutional principles of legality. In practical terms, the methodologies used to determine carbon budgets must therefore be capable of producing, and making available to the competent authority, the evidence necessary to meaningfully address each of the section 27(2) factors.

If the methodologies do not include these evidentiary requirements, for example, collecting socio-economic impact data, assessing technical practicability, and ensuring the use of current and locally relevant science, the competent authority will lack the information needed to make a rational, properly informed decision. In such cases, "consideration" of the factors risks becoming superficial, exposing allocations to challenge as irrational or unreasonable. Embedding the section 27(2) considerations into the calculation stage is not an expansion of the Act's requirements, but a necessary safeguard for lawful, defensible, and credible decision-making.

This distinction is critical. Simply cross-referencing the Act in a general clause does not operationalise the six considerations in a way that ensures they are systematically and transparently applied. Without clear procedures, evidence requirements, and integration into the technical methods for calculating budgets, there is a substantial risk that these statutory factors will be treated as an afterthought rather than as the foundation of the allocation process. This undermines both the legal compliance and the practical credibility of the carbon budget system.

7.1.2 Alignment with existing decarbonisation actions

The Climate Change Act requires that carbon budgets be allocated in a manner aligned with the national greenhouse gas emissions trajectory. Section 27(2)(e) makes this a mandatory consideration. In terms of the Act, until such a trajectory is formally gazetted, the latest updated NDC serves as the trajectory. Sectoral Emission Targets (SETs) are in turn required to be consistent with the NDC and are to be revised in parallel with future NDC updates.

Despite the statutory hierarchy in which the NDC informs the SETs, and the SETs in turn inform carbon budgets, the current Draft Carbon Budget Regulations and associated Technical Guidelines do not operationalise this linkage. Regulation 8(2) contains only a general requirement for the competent authority to "consider" the section 27(2) factors when allocating budgets, with no formal process linking the NDC or SETs to sectoral envelopes and, ultimately, to facility-level allocations. The Technical Guidelines outline the purpose, roles, and process steps for the carbon budget regime but provide no algorithm or decision rule for translating national or sectoral targets into specific facility budgets.

While the Climate Change Act does not prescribe how the NDC must be used to determine SETs, and grants the Minister broad discretion in setting sectoral and facility-level budgets, this flexibility must be exercised within a transparent and structured framework. Such a framework should clearly set out the criteria, data sources, and decision rules applied in allocation decisions. Without this clarity, flexibility risks becoming opacity, leaving stakeholders uncertain as to how national and sectoral targets are applied to their operations and making it difficult to assess whether allocations are equitable, proportionate, and compliant with statutory requirements.

This omission creates two serious risks:

- **Procedural vulnerability**: While the Act provides that, until a national greenhouse gas emissions trajectory is gazetted, the most recent NDC serves as the trajectory, the current regulations and Technical Guidelines do not establish a transparent, step-by-step process for converting the NDC (and associated Sectoral Emission Targets) into sectoral envelopes and facility-level allocations. This absence of a clear procedural mapping makes it difficult to verify how individual budgets are derived and whether they are applied consistently, leaving determinations open to challenge for opacity, lack of replicability, or failure to properly consider relevant statutory factors.

- **Policy incoherence**: The absence of an explicit translation framework that informs the carbon budget setting process undermines confidence that facility-level allocations will be equitable, proportionate, and genuinely aligned with national decarbonisation objectives.

For SAISI members, this is not a technical nuance but a fundamental issue of certainty. The iron and steel sector's decarbonisation actions, many of which are already underway, must be integrated into a carbon budget framework that transparently links facility-level limits to South Africa's international climate commitments and sectoral trajectories. Without this integration, the carbon budget system risks both legal non-compliance and misalignment with the strategic decarbonisation pathways already adopted by the sector.

7.1.3 Alignment with existing regulatory authorisation processes

Members of SAISI construct, commission, and operate facilities only after securing the full suite of statutory authorisations, typically including an environmental authorisation (EA) under the NEMA, an AEL under the Air Quality Act, and a WUL under the National Water Act. These instruments collectively establish the lawful basis for significant capital investment and set the technical and legal parameters for operation, including fuels, processes, and emission limits.

While it is accepted that these authorisations do not confer an absolute or perpetual right to emit greenhouse gases, and that government may lawfully impose new constraints under section 24 of the Constitution to protect the environment, such constraints must still be introduced lawfully, reasonably, and with procedural fairness. In particular, when a change materially reduces the operating scope established by an EA, AEL, or WUL, it should be implemented through the statutory amendment procedures prescribed in those Acts, supported by robust evidence, proportionality, and reasonable transitional arrangements.

As currently drafted, the carbon budget regime risks creating a second set of limits that directly constrain activities already authorised under other statutes, without using the formal amendment mechanisms in those statutes. For example, a carbon budget that caps annual emissions at a level below what is achievable within an AEL's authorised throughput would, in effect, restrict lawful production capacity without formally amending the licence. This bypasses established legal processes and creates a procedural misalignment between the Climate Change Act and existing environmental authorisation frameworks.

For SAISI members, this misalignment creates uncertainty for long-term operational and investment planning, undermines legitimate expectations arising from government-issued licences, and increases the risk of abrupt capacity curtailment. A coherent regulatory approach is therefore essential, one in which carbon budgets are coordinated with, and where necessary formally incorporated into, the amendment procedures for EAs, AELs, and WULs. Such integration would preserve legal certainty, protect investor confidence, and enable carbon budgets to contribute effectively to South Africa's decarbonisation goals without undermining the stability of the country's strategic industrial base.

It is acknowledged that both the Climate Change Act and the draft regulations provide for review of carbon budgets at the end of each five-year cycle, and, in certain circumstances, upon request, as well as formal appeal mechanisms. However, these safeguards operate after a budget has been allocated and, in many cases, after operational or investment decisions have already been constrained. For capital-intensive industries such as iron and steel, the disruption and uncertainty caused by having to challenge or await the revision of a misaligned budget can be severe. Preventing procedural and substantive misalignment at the point of allocation is therefore essential, rather than relying on retrospective correction through review or appeal.

7.2 Approach to Baseline Setting

The baseline against which a carbon budget is allocated is one of the most critical determinants of a facility's future operating flexibility. Under the current Draft Carbon Budget Regulations, the baseline is established using a minimum of three consecutive years of reported historical emissions data submitted under the National Greenhouse Gas Emission Reporting Regulations. There is no provision to adjust the baseline to reflect the authorised or design capacity of the facility where recent operations have been abnormally constrained.

For SAISI members, this methodology creates a serious risk. The iron and steel sector is inherently cyclical, with output levels influenced by global market demand, domestic economic conditions, energy supply constraints, and input material availability. A steel mill that has operated significantly below its AEL-authorised throughput, for example due to suppressed market conditions, would show correspondingly lower GHG emissions in its recent reporting years. If this period is used to set the baseline, the resulting carbon budget will be anchored to this depressed operating level.

When market conditions improve and the mill seeks to ramp production back up to the level authorised in its AEL, its actual emissions could exceed the carbon budget, even though it remains fully compliant with all existing environmental licences. In effect, the carbon budget regime would impose a new legal ceiling below that authorised under other statutes, creating a regulatory conflict and constraining the utilisation of lawful, capital-intensive assets.

Section 27(2) of the Climate Change Act provides a statutory basis to address this misalignment:

- **Socio-economic impacts** (Section 27(2)(a)): Locking in a baseline during a temporary downturn can cause long-term losses in production, competitiveness, jobs, and asset value, without delivering genuine emission-reduction benefits.
- **Best practicable environmental options** (Section 27(2)(c)): A baseline methodology should promote emissions reductions through feasible technological and operational measures, not by artificially constraining lawful production capacity. If the only way to remain within a budget derived from an abnormally low baseline is to cut output rather than implement cost-effective abatement, the outcome cannot be considered a "best practicable" environmental option within the meaning of the Act.

- **National strategic priorities** (Section 27(2)(d)) The steel industry is a strategic sector; restricting it below licensed capacity undermines industrial policy goals and supply-chain resilience.

To comply with the Act and ensure a fair and workable system, the regulations should explicitly provide for baseline adjustments in cases where historical emissions data does not reflect normal or authorised operating levels, as the current draft provisions do not address situations where under-utilisation is due to market or other external factors rather than physical changes to the plant. For SAISI members, this could include:

- Using authorised capacity under an AEL or environmental authorisation as the reference point, adjusted for reasonable expected utilisation;
- Allowing operators to demonstrate that recent under-performance was due to exceptional circumstances, such as market collapse, energy shortages, or supply disruptions; and
- Ensuring that any baseline-related constraints are phased in with transitional arrangements to avoid abrupt capacity curtailment.

A baseline methodology that recognises both actual operational history and the lawful capacity to operate is essential for avoiding perverse outcomes where carbon budgets inadvertently penalise recovery and growth, rather than driving genuine, practicable emissions reductions in line with South Africa's climate and industrial objectives.

7.3 Approaches to Budget Setting

Section 27(2) of the Climate Change Act requires that carbon budgets be allocated with explicit consideration of six factors: socio-economic impacts; best available science, evidence, and information; best practicable environmental options; national strategic priorities; alignment with the national greenhouse gas emissions trajectory; and progress on implementation of mitigation plans.

The Draft Regulations propose three methodologies for setting budgets, the Fixed Target Approach, the Mitigation Potential Approach, and the Benchmarking Approach, yet none of these, in their current form, systematically address all six statutory requirements. Key considerations such as socio-economic impacts, up-to-date scientific evidence, practical feasibility, and demonstrated mitigation progress are either absent, treated superficially, or dependent on outdated or incomplete data. Without explicit mechanisms to integrate these factors into each methodology, budget allocations risk being misaligned with the Act's intent, potentially undermining both fairness and effectiveness.

7.3.1 Fixed Target Approach

The fixed target approach applies an absolute emissions cap to a facility or company for a defined period. While this can be apportioned to align with the national emissions trajectory, it offers the least flexibility for the iron and steel sector. Steelmaking is subject to large variations in annual output, feedstock mix, and energy availability, and a fixed cap does not accommodate production fluctuations caused by market demand or load-shedding. This can unfairly penalise efficient producers who increase output when demand strengthens, while failing to reward efficiency improvements beyond the cap.

Although the approach is straightforward to understand, it is static and unresponsive to real-world performance. It contains no provisions to adjust allocations based on actual mitigation progress, and risks encouraging output curtailment rather than cost-effective abatement. It also lacks mechanisms to integrate socio-economic considerations, particularly for trade-exposed and hard-to-abate sectors and does not require reliance on up-to-date scientific evidence or the assessment of best practicable environmental options. In doing so, it risks conflicting with national strategic priorities such as industrial growth or economic recovery.

For these reasons, the fixed target approach is the least suitable allocation method for the iron and steel sector and should be avoided in favour of more dynamic approaches that reflect both the cyclical nature of production and the broader requirements of the Climate Change Act.

7.3.2 Mitigation Potential Approach

This method allocates budgets based on sectoral abatement potential derived from Marginal Abatement Cost Curves (MACCs). In principle, it could incorporate socio-economic considerations such as costs and employment impacts, but the current MACCs rely on outdated assumptions that do not reflect present market, infrastructure, or policy realities. Although the approach is grounded in modelling, its data inputs are not locally validated for current constraints, such as limited gas supply or restricted scrap availability, reducing its scientific robustness.

7.3.2.1 Concerns with the approach

The current Mitigation Potential Analysis (MPA) and MACC for the irons and steel sector are based on assumptions from more than a decade ago (2014), when both the market and operating environment looked quite different. Using these outdated assumptions risks setting carbon budgets that are unrealistic and unfair, more specifically the following aspects of the MPA are problematic:

Growth assumptions are too high: The MPA assumes the sector would grow by 3.9% per year from 2010 to 2050. In reality, growth has been flat or negative for much of the past decade due to global overcapacity, domestic demand constraints, energy supply problems, and input cost increases. This means the emissions baseline and abatement potential in the MPA are both overstated.

Scrap-based electric arc furnace (EAF) expansion is overestimated: The MPA assumes that by 2030, 40% of crude steel will come from scrap-based EAFs, up from 29% in 2010. It also assumes that enough scrap metal will be available to support this. In reality, South Africa faces chronic scrap shortages due to export restrictions, theft, and poor recycling systems. Scrap quality is also an issue for producing certain grades of steel. Without major policy and infrastructure reforms, this assumption is not achievable.

Direct reduced iron (DRI) expansion relies on gas that is not available: The MPA assumes a jump from 13% to 40% of production from DRI/EAF by 2030, which depends on large new supplies of natural gas. South Africa currently has no large-scale, secure, and competitively priced gas supply for the steel sector, and planned gas projects face delays and uncertainty. This removes a major building block of the assumed abatement potential.

Technology costs and readiness have shifted: Several measures in the MPA, such as DRI-ULCORED[151], "*retrofitting CCS to blast furnaces combined with top gas-recycling blast furnaces offers a realistic solution for maximising energy efficiency whilst minimising emissions*", and "*Building state-of-the-art power plants has significant abatement potential*", remain at early commercial readiness globally, and is even less available, feasible and affordable locally. The costs in South Africa are significantly higher than assumed, due to higher capital costs, finance constraints, and currency depreciation. This changes both the cost-effectiveness ranking in the MACC and the short-term deployability of these options.

Energy system constraints are ignored: The MPA does not factor in South Africa's electricity supply instability, high tariffs, or grid constraints. These factors make it harder to shift to electricity-intensive processes like EAF and add hidden costs not reflected in the MACC.

7.3.2.2 Implications for carbon budgets

If carbon budgets are set using this outdated MPA and MACC, the allocated budgets could be based on abatement that is not technically or economically possible under current conditions. This risks:

- Forcing compliance through **reduced production** instead of **real emission reductions**.
- **Undermining the competitiveness** of domestic steel producers.
- **Accelerating job losses** in an already strained sector.
- **Discouraging investment** in realistic, phased decarbonisation pathways.

While the MPA ranks measures by cost-effectiveness, this can result in prioritising technologies that are not technically deployable in South Africa in the near term. Strategic priorities could be incorporated if model boundaries were updated in collaboration with industrial policy bodies, but this has not been done. The method can align with the national GHG trajectory if budgets are scaled accordingly, yet it lacks a feedback mechanism to integrate progress from actual mitigation plan implementation into future allocations, making it slow to adapt to on-the-ground realities.

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151 Gas-based direct reduced iron steelmaking process

7.3.3 Benchmarking Approach

This method allocates budgets by setting performance standards (tCO_2 per tonne of product) based on top performers, with benchmarks tightening over time. It has the strongest potential of the three approaches to align ambition with feasibility, particularly if benchmarks are locally calibrated, phased, and supported by enabling measures such as scrap market reform and improved renewable energy access. However, the current proposal risks applying unadjusted international best available technology (BAT) levels, which could unfairly penalise domestic producers operating under structural constraints. While the approach can be grounded in credible science if based on accurate, comparable emissions intensity data, existing data gaps and inconsistent plant boundary definitions undermine reliability. It can integrate with national strategic priorities if developed collaboratively with industrial policy, but this is not built into the draft. Alignment with the national GHG trajectory depends on careful planning of the tightening schedule, and although Monitoring, Reporting and Verification (MRV) data could inform future adjustments, the regulations contain no explicit mechanism to link observed progress to benchmark revisions.

The current proposed approach risks creating benchmarks that do not reflect the diversity and realities of South African steel production and therefore could set budgets that are technically or economically unachievable for many parts of the industry.

7.3.3.1 Sector diversity and process differences

South Africa's steel industry is not homogenous. It includes:

- **Integrated primary producers** using blast furnace–basic oxygen furnace (BF–BOF) routes.
- **Direct reduced iron (DRI) producers** using electric arc furnaces (EAF).
- **Scrap-based EAF producers**, some producing long products, others producing flat products.
- **Mini-mills** with older equipment and limited access to low-emission feedstocks.

These routes have fundamentally different baseline emissions intensities, energy requirements, product mixes, and feedstock constraints. A single "steel" benchmark, or one based on an international best performer, would fail to account for this diversity and would disadvantage producers whose process routes are inherently more carbon-intensive but unavoidable under current resource and infrastructure conditions.

7.3.3.2 Data and boundaries

Benchmarking also requires reliable, comparable data across producers. In practice, the steel sector's product scope, by-product management, allocation methods, and plant boundaries vary widely. Without agreed local definitions for system boundaries and product categories, benchmark setting could be inconsistent and distort relative performance.

7.3.3.3 International benchmarks

If international BAT benchmarks are used without local adjustment, South African producers will be compared to plants operating with:

- Abundant low-cost scrap for EAF production.
- Access to large volumes of low-carbon electricity.
- Reliable and competitively priced natural gas for DRI.
- Modern plant designs with high capital turnover cycles.

These conditions **do not currently exist** in South Africa, where scrap supply is constrained, the grid is carbon-intensive and unstable, gas supply is uncertain, and much of the installed capital stock is decades old. Without adjustment, such benchmarks effectively become **punitive rather than aspirational**.

7.3.3.4 Implications for carbon budgets

To ensure both fairness and effectiveness, benchmarks should be **process-specific, locally calibrated, and phased**. This means setting separate benchmarks for each major production route, using top-performing local plants within each route as the reference point, and adjusting for South Africa's current constraints in scrap supply, low-carbon energy access, and gas availability. Benchmark tightening should be **linked to enabling measures**, such as scrap market reforms, renewable energy procurement frameworks, and concessional finance for low-carbon technology upgrades. The table below outlines how government's proposed approach could be adapted to achieve realistic decarbonisation pathways while **protecting jobs, investment, and the competitiveness of the domestic steel industry**.

Table 7: Amended benchmark approach for the steel sector

	Current Approach	Proposed amendment for South African Steel Sector
Benchmark basis	Single product benchmark (tCO_2e per tonne of product) based on portion of largest volume performers in the sector.	Separate benchmarks for each major process route (BF–BOF, DRI–EAF, scrap EAF) and, where relevant, product type (long vs flat products) to reflect inherent intensity differences.
Reference data	Could use international BAT levels or top local performers.	Use top local performers within each process route, calibrated for local feedstock, energy, and infrastructure constraints. International BAT used only as a long-term aspiration, not initial allocation basis.
Boundary	Based on defined production process and scope from input to final product.	Establish locally agreed boundaries with industry input, covering system scope, allocation of by-products, and inclusion/exclusion of downstream processes, ensuring fair comparability.

Treatment of diversity	Assumes relative homogeneity of production methods within a sector.	Explicitly accounts for diversity in production routes, age of assets, and feedstock access, avoiding penalising routes without immediate low-carbon alternatives.
Trajectory	Benchmarks fixed or tightened over set intervals.	Phased tightening linked to enabling measures (e.g., scrap market reform, low-carbon energy access, gas supply availability, technology readiness).
Adjustment for local constraints	No explicit adjustment mechanism for differing local circumstances.	Built-in adjustment factors at process level for faced realities: high-carbon grid, scrap shortages, limited gas availability, and logistics constraints, reviewed periodically.
Support mechanisms	Not explicitly linked to industrial policy support.	Benchmarks integrated with industrial policy, tightening accompanied by targeted incentives, concessional finance, and enabling infrastructure to meet new performance levels.

7.4 Recommendations for Fair Carbon Budgets

The steel sector recognises the importance of South Africa's carbon budget system as a tool for managing national GHG emissions and aligning with international climate commitments. However, the approach to setting carbon budgets must be grounded in current realities and designed to enable real decarbonisation rather than imposing unachievable targets that undermine economic viability. This is particularly important for hard-to-abate sectors such as iron and steel, where technology pathways are constrained, infrastructure change is capital-intensive, and global competitiveness is already under pressure. Table 2 provides a summary overview of the current gaps in the regulations in terms of its consideration of Section 27(2) of the Climate Change Act.

Table 8: Gaps in the draft regulations in terms of Section 27(2) of the Climate Change Act

Section 27(2) Factor	Fixed Target	Mitigation Potential	Benchmarking
Socio-economic impacts	Not considered	Potential but outdated assumptions	Only if localised and phased
Best available science	No requirement	Outdated 2014 data	Dependent on data quality and boundaries
Best practicable options	Ignores practicality	May include non-deployable technology	If tied to enabling measures
Strategic priorities	Not integrated	Possible if updated	Requires policy alignment
NDC alignment	Possible if designed correctly	Built into method	Needs careful trajectory mapping

Section 27(2) Factor	Fixed Target	Mitigation Potential	Benchmarking
Progress on plans	Not linked	Not linked	Not linked

While the proposed methods each touch on some of the section 27(2) criteria, none of them provides the means of comprehensively addressing them. The Draft Regulations contain no explicit procedures or data requirements to assess socio-economic impacts, ensure reliance on current and locally relevant scientific evidence, or incorporate progress on mitigation measures into future allocations. As a result, the carbon budgets produced under these methods risk being both legally vulnerable and practically unworkable for affected sectors.

By omitting the integration of section 27(2) considerations into the methodologies that generate carbon budget allocations, the Draft Regulations fail to give proper effect to the Climate Change Act. This omission is not a minor technical defect but a structural flaw, leaving the regulations non-compliant with their enabling legislation and open to challenge on grounds of invalidity.

The following recommendations should be considered for setting reasonable and achievable carbon budgets for the iron and steel sector.

7.4.1 Benchmarking

The proposed benchmarking approach must account for the diversity of production routes and resource constraints in South Africa. The sector includes BF–BOF, DRI–EAF, and scrap EAF operations, each with different emissions profiles, energy demands, and technology options. Applying a single, unadjusted benchmark or one derived from international best performers would create inequitable outcomes and penalise facilities operating under structural constraints.

Benchmarks should therefore be route-specific, based on the best-performing local operations, and phased in gradually to allow for investment cycles, infrastructure upgrades, and the rollout of enabling measures such as renewable energy access and scrap market development.

Importantly, any tightening of benchmarks must be directly linked to industrial policy support, including targeted incentives, concessional finance, and enabling infrastructure, so that companies are not expected to meet higher standards without the means to invest in the required changes.

7.4.2 Mitigation potential

The use of the MPA and associated MACCs to set budgets needs urgent revision. These analyses rely on assumptions that no longer hold true and are based on historic growth rates far above the sector's actual performance in the last decade. They also include high-costs or immature technologies in timelines unsupported by local or global deployment experience.

Retaining outdated assumptions risks imposing budgets that are disconnected from technical and economic feasibility. Government should work with industry to update the MPA using recent market, infrastructure, and technology data, ensuring the tool is used as a long-term strategic guide rather than as the sole determinant of near-term compliance obligations.

A fairer and more effective approach is to update the MPA with current data on:

- Actual sector growth and production trends.
- Realistic scrap availability and quality.
- Realistic gas supply timelines and costs.
- Current technology costs and readiness levels.
- System constraints in electricity and logistics.

7.4.3 Fixed target

The fixed-target approach, while simpler to administer, is the least flexible and least fair for a sector subject to demand fluctuations, energy supply variability, and long lead times for technology shifts. Fixed caps risk constraining production rather than driving meaningful decarbonisation and should be avoided for the iron and steel sector.

7.4.4 Monitoring, reporting, and verification

The cost of compliance itself must be recognised. Reliable, accurate, and efficient monitoring, reporting, and verification (MRV) systems, essential for credible carbon budgets, require skilled personnel, specialised systems and equipment, and ongoing operational expenditure. These costs are not absorbed automatically by industry. While government provides a national greenhouse gas reporting platform, it should also reflect and account for the costs of MRV while allocating carbon budgets and consider support to organisations for monitoring and verification.

Fair carbon budgets for the steel sector must be built on updated and realistic assumptions, differentiate between production routes, be phased in aligning with enabling policy measures, and avoid rigid caps that stand in opposition to a just transition. A collaborative process between government and industry is essential to design a system that supports both emissions reduction and the long-term viability of South Africa's iron and steel industry.

7.5 Other Supporting Policy Interventions

In parallel with carbon budget allocation, government should strengthen incentives for the steel sector to invest in low-carbon transitions. Achieving meaningful decarbonisation in the steel sector will require more than the allocation of carbon budgets. It depends equally on a coherent suite of policy measures, investment incentives, and infrastructure development that lowers the cost and risk of low-carbon transitions. **Without these enabling conditions, even the most carefully calibrated budgets will struggle to deliver practical change.**

7.5.1 Aligning climate policy with industrial policy

The starting point is to ensure alignment between climate policy and industrial policy. Decarbonisation should not be approached as a compliance burden alone, but as a driver of industrial renewal and competitiveness. This means designing targeted incentives that help bridge the cost gap (or green premium) between current high-carbon routes and cleaner alternatives.

For example, government could ring-fence and adapt existing instruments such as the Manufacturing Competitiveness Enhancement Programme (MCEP) and the Support Programme for Industrial Innovation (SPII) to support steel-specific decarbonisation projects. The MCEP already provides grants and concessional loans for energy and resource efficiency capital expenditure, while SPII can de-risk investments in new process technologies. By tailoring these to fund scrap processing capacity, hydrogen-ready DRI pilots, or advanced waste heat recovery systems, government can accelerate the sector's transition without undermining its competitiveness.

7.5.2 Investing in enabling infrastructure

Infrastructure development is critical to unlocking many low-carbon pathways. The feasibility of greater EAF deployment or gas-based DRI is constrained by factors like scrap availability, electricity grid emission intensity, and gas supply. Addressing these requires coordinated public–private investment in scrap collection and processing networks, grid decarbonisation and wheeling access, and the expansion of low-carbon industrial gas infrastructure. Without these enabling measures, carbon budgets risk becoming punitive rather than transformational.

7.5.2.1 Incentivising incremental efficiency gains

Support for the steel sector should not be limited to large-scale, long-term technology shifts. Well-targeted incentives for smaller, incremental improvements can unlock meaningful emissions reductions in the near term while building the technical capability and financial resilience needed for future transformation. These measures are often lower cost, quicker to implement, and deliver immediate benefits to both industry and the environment.

7.5.2.2 Accelerated depreciation for low-carbon investments

A mechanism similar to the existing Section 12B allowance could allow companies to front-load tax write-offs for qualifying low-carbon equipment, such as scrap sorting systems, high-efficiency EAF upgrades, or waste-heat recovery units. By improving cash flow and shortening payback periods, accelerated depreciation can make borderline retrofits financially viable and encourage earlier adoption of cleaner technologies.

7.5.2.3 A CO_2-based version of the Section 12L incentive

The Section 12L incentive could be adapted to reward actual emissions reductions rather than only energy savings. Under this model, companies would receive a payment per tonne of verified CO_2

avoided (R/tCO_2) rather than per kWh saved (R/kWh). This structure is particularly important for processes like shifting from BF–BOF to EAF production, which increases electricity use but significantly reduces overall emissions. Linking the incentive to decarbonisation outcomes, rather than energy intensity alone, ensures policy alignment with climate goals.

7.5.2.4 Reforming scrap supply through a scrap-use rebate

The current Price Preference System (PPS) requires recyclers to sell scrap domestically at a steep discount, undermining profitability and discouraging local supply. Under the PPS, a recycler must first offer scrap to local mills at a forced discount, the buyer therefore gains, but the recycler is disincentivised as this results in a loss, and so, material is often withheld, undermining local supply. A scrap-use rebate would be an incentive, rather than a deterrent, as recyclers would sell scrap at the market price and receive a modest rebate (for example R200/tonne) that can be funded from Treasury through the carbon tax revenue. This approach fairly compensates recyclers, secures a steady feedstock for mills, and cuts emissions by displacing virgin ironmaking, and saving CO_2 emissions, a scenario that is beneficial to all stakeholders in the value chain.

7.5.2.5 Public procurement mandate for lower-carbon steel

Large public infrastructure projects in transport, energy, and housing could be required to source a minimum share of steel meeting a defined and **South African appropriate** emissions intensity threshold, for example, less than 2.2 tCO_2 per tonne of finished steel. To keep this practical, government could:

- Cap the allowable "green premium" in tenders (for example 5 to 8% above the lowest compliant bid). This would prevent suppliers from charging excessively high prices while still recognising that low-carbon steel costs more. It strikes a balance between supporting early adopters and market development, without wasting taxpayer money.

- Verify compliance through the existing GHG/carbon tax MRV systems or Environmental Product Declarations.

- Remain technology-neutral so both high-scrap EAF routes and upgraded BF–BOF processes can qualify.

A guaranteed demand floor with supply-side incentives, could de-risk early adopters, accelerate learning curves, and attract private finance without requiring large new public budgets.

7.5.3 Leveraging carbon market mechanisms

Integration of carbon market mechanisms to help finance high-cost transitions could offer a promising supporting avenue for the steel sector's transition. Verra's methodology for the accelerated retirement of coal-fired power plants under a just transition framework could be adapted for blast furnace conversions, enabling companies to generate carbon revenue from emissions reductions. This revenue could offset part of the capital costs of moving to lower-carbon production routes such as hydrogen-based DRI or scrap-based EAFs. This not only provides a new revenue stream but also creates a direct link between emissions reduction and financial benefit.

7.6 Conclusion and Call to Action

South Africa's steel sector is a cornerstone of our industrial economy, a key employer and contributor to our GDP, and an enabler of the infrastructure needed for our country's development. Yet, it is also a hard-to-abate industry operating under severe competitive, economic, and social constraints. The carbon budget framework, if applied without fair consideration of these realities, risks accelerating decline rather than driving transformation.

Government has a clear opportunity to turn this risk into an industrial renewal story, by coupling realistic and equitable carbon budgets with enabling policies, targeted incentives, and coordinated infrastructure investments. This will **safeguard jobs, skills, and strategic industrial capacity**, and also ensure the sector can contribute meaningfully to South Africa's climate commitments. The steel industry calls on government to work with us: urgently, constructively, and with a shared commitment to fairness, to design a carbon budget system that is both environmentally effective and economically sustainable.