TRADE & INDUSTRIAL POLICY STRATEGIES

INDUSTRY STUDY

SUSTAINABILITY IN THE CAPITAL GOODS INDUSTRY

TIPS industry studies aim to provide a comprehensive overview of key trends in leading industries in South Africa. For each industry covered, working papers will be published on basic economic trends, including value added, employment, investment and market structure; trade by major product and country; impact on the environment as well as threats and opportunities arising from the climate crisis; and the implications of emerging technologies. The studies aim to provide background for policymakers and researchers, and to strengthen our understanding of current challenges and opportunities in each industry as a basis for a more strategic response.

This industry study on sustainability in the capital goods industry details the carbon intensity throughout the capital goods value chain, identifying the concentration of emissions in the upstream, midstream, downstream, and end-use phases. It then explores the policy landscape and sustainability risks, assessing environmental regulations, decarbonisation initiatives by companies, and international risks.

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ABBREVIATIONS

BF	Blast Furnaces
BOF	Basic Oxygen Furnaces
CBAM	Carbon Border Adjustment Mechanism
CO_2e	Carbon Dioxide Equivalent
Eu	European Union
Gg	Gigagrams
GHG	Greenhouse Gas
ICE	Internal Combustion Engines
OEMs	Original Equipment Manufacturers

1. INTRODUCTION

The capital goods[1] industry produces machinery and equipment essential for industrial processes. The industry contributes minimally to greenhouse gas (GHG) emissions. While there is limited domestic pressure for the industry to decarbonise its production processes, international markets impose stricter emissions regulations that encourage the decarbonisation of capital goods.

Most GHG emissions occur in the upstream phase of the capital goods value chain, where raw materials are processed into metals. The end-use of capital goods generates substantial GHG emissions due to the energy intensity of equipment often powered by coal-fuelled electricity and petrochemicals. As a result, end-users are increasingly seeking environmentally friendly products to reduce their operational emissions. This shift in consumer preferences is largely influenced by environmental regulations that promote decarbonisation.

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2. CARBON INTENSITY OF THE VALUE CHAIN

Capital goods are machinery and equipment utilised in various industrial production processes, including mining, food processing, textiles, agriculture, and forestry. In South Africa, the capital goods industry manufactures machinery and equipment for various sectors but primarily supplies the mining sector in South Africa and across Southern Africa. The machinery and equipment produced by the capital goods industry play a crucial role in facilitating production processes. In addition, environmental concerns are driving technological change within the industry, leading to cleaner production processes (Mthembu, 2024a). Key players in the capital goods industry are Original Equipment Manufacturers (OEMs), most of which are linked to international OEMs through licensing agreements or operate as subsidiaries. South African companies include Barloworld, Bell Equipment, and Ainsworth Valves.

Manufacturing capital goods requires electricity to power production processes, with the industry in South Africa heavily relying on Eskom for its energy needs. In 2024, Eskom generated 80% of its electricity by burning fossil fuels, resulting in emissions of 190.9 million tonnes of carbon dioxide equivalent (CO_2e), which accounted for 40% of South Africa's GHG emissions (Eskom, 2024). Furthermore, mining minerals is part of the upstream phase of the capital goods value chain. Mining processes, including comminution and smelting, are energy intensive. According to the South African Energy Sector Report, energy consumption in the mining sector comprised 51% electricity, 22% oil products, and 27% coal in 2021 (DMRE, 2024).

After the processing of raw materials, most of the GHG emissions in the capital goods value chain are generated during the operation of machinery and equipment rather than during the manufacturing of capital goods. Consequently, end-users are increasingly seeking energy-efficient and environmentally friendly machinery and equipment. In response to this demand, OEMs are producing capital goods that align with consumer preferences for reducing operational emissions.

[1] Capital goods include pumps, lifting and handling equipment, machine tools, engines and turbines, weapons and ammunition, ovens, and machinery for mining, food, textile, metallurgy, agriculture and forestry. See the Industry Study: Capital Goods in South Africa for an extensive list of capital goods. The list excludes physical assets of businesses reported in financial accounting as capital goods including buildings, facilities, and vehicles.

2.1 Inputs and raw materials

The production of machinery and equipment requires various metallic and non-metallic inputs. The metallic inputs include steel, aluminium, copper, titanium, and nickel, while the non-metallic inputs include plastics, rubber, glass, ceramics, and composite materials. This section focuses on steel, as it is an important and carbon-intensive component in the production of capital goods, particularly heavy machinery. Steel production has a significant carbon footprint in South Africa and globally due to its dependence on high-temperature manufacturing processes, such as Blast Furnaces (BFs) and Basic Oxygen Furnaces (BOFs), which consume large amounts of coal and coke.

Inputs into steel production include iron ore, limestone, oxygen, coal, and electricity. In South Africa, steel is produced using BFs that primarily utilise coking coal and iron ore to produce molten pig iron and BOFs, which use molten pig iron and to a lesser extent, scrap steel (Maimele, 2025). Electric Arc Furnaces also use scrap steel and electricity to produce steel. Common metal products include tubes, pipes, bars, beams, sheets, and plates. Recycled steel requires less energy than processing raw materials.

The processing of raw materials is the most energy-intensive phase of the capital goods value chain, resulting in higher GHG emissions compared to the production of capital goods by OEMs. The primary contribution to high emissions in steel production is the use of coal-fuelled electricity and coking coal in steel production (Maimele, 2025). The BF-BOF steel production processes produce direct emissions (Scope 1) in the steel value chain. These steel industry Scope 1 emissions account for indirect emissions (Scope 3) when OEMs use steel products to produce capital goods.

In 2022, South Africa's iron and steel production emitted 6307 gigagrams of carbon dioxide equivalent (Gg CO_2e), while ferroalloys production emitted 8081 Gg CO_2e. This represents 40.3% and 51.6% of the total emissions from the metals industry (DFFE, 2024). The primary energy sources for iron and steel production in South Africa are coal, electricity, and natural gas, which accounted for 57%, 36%, and 7% of the industry's energy demand in 2021 (DMRE, 2024). For non-ferrous metal production, coal and electricity were the main energy sources, contributing 59% and 41% to the energy demand in the industry in 2021 (DMRE, 2024). The production of steel also results in the emission of pollutants such as methane and nitrous oxide.

2.2 Midstream

In the midstream phase, inputs such as metal products are further processed to produce capital goods components. OEMs use machining processes to shape metals according to specific requirements. The manufacturing process involves several steps, including material preparation, which consists of cutting, chamfering, bending, and rolling. Cutting processes can be divided into thermal methods, including oxyfuel cutting, plasma cutting, and laser cutting. These thermal cutting processes are powered by the combustion of fuel gas and electricity. Thermal cutting therefore generates pollutants such as fumes and gases, including nitrogen oxides, carbon monoxide, and heavy metal vapours. Dust and residues from thermal cutting can contaminate soil and water (Coral, 2024).

Arc welding is powered by electricity to melt and join metals. Machining includes turning, milling and boring to produce parts such as gears, axles, and hydraulic components (Bell Equipment, 2025). The surfaces of these parts are treated through cleaning, etching, or the application of protective layers to enhance corrosion resistance, hardness, or adhesion for subsequent coatings. Machining and surface treatment processes are powered by electricity. Despite the reliance on coal-fuelled electricity for

processing capital goods components in the midstream phase, manufacturers generate lower GHG emissions compared to the upstream phase of the value chain.

Most GHG emissions generated by OEMs in the midstream phase are indirect emissions (Scope 2) from the consumption of electricity purchased from Eskom. As a result, the direct emissions that OEMs control tend to be relatively small. The Carbon Tax Act No. 15 of 2019 applies specifically to direct emissions. Therefore, OEMs only pay a carbon tax when they operate furnaces, boilers, or other large-scale emitters on-site that exceed the established thresholds for the tax and have significant emissions. Eskom is responsible for the carbon tax associated with electricity generation for its downstream consumers.

2.3 Downstream

In the downstream phase of the value chain, components are sub-assembled into smaller, pre-built parts that contribute to the final assembly of a capital good. This assembling process involves combining all components into a final product. Certain OEMs in South Africa import components from their international subsidiaries or parent companies, while others specialise in remanufacturing capital goods.

Assembling requires specialised machinery and equipment, operated by skilled and experienced technicians. The machinery and equipment used in this process include cranes, click torque wrenches and robotic assembly systems. These tools can be powered by internal combustion engines, electric motors, or hydraulic systems.

Assembly can take place at the OEM's facilities before transportation to the end-user, or it can be conducted at the end-user's facilities. Due to their size, heavy machinery is often transported in parts and assembled on-site for the end-user. GHG emissions from transportation and assembling processes mainly include CO_2, along with other pollutants such as carbon monoxide and nitrous oxide.

2.4 End-use of capital goods

In the end-use phase of the capital goods value chain, final products are sold to end-users. In South Africa, the primary end-users are mining companies, followed to a lesser extent by agricultural and construction companies, as well as other entities such as State-Owned Companies that use capital goods in their industrial processes. Capital goods are distributed through networks or sold directly to end-users by OEMs for both domestic and export markets. This phase also encompasses capital goods distributors that import and sell capital goods under licensing agreements with OEMs. After-sales services in this phase include training, repairs, and the operation of machinery.

GHG emissions during end-use depend on the type of machinery and equipment used. Capital goods are typically powered either by electricity, producing Scope 2 emissions, or by fuel, which generates Scope 1 emissions. Industrial furnace burners, for instance, can operate on various fuels, including natural gas, propane, oil, and biofuels, generating GHG emissions at different levels. Technological advancements in heavy-duty vehicles such as dump trucks, excavators, and loaders have produced more fuel-efficient industrial vehicles, significantly reducing fuel consumption and GHG emissions.

3. THE POLICY LANDSCAPE AND SUSTAINABILITY RISKS

OEMs have adopted a global strategy to decarbonise their production processes. This strategy is influenced by the United Nations Sustainable Development Goals, which aim to combat climate change and promote environmental sustainability. OEMs generally aim to reduce the environmental impact of their industrial processes by sourcing renewable energy, currently through the installation of solar panels, and by reducing waste and pollution. Companies with sustainability roadmaps include Bell Equipment, Barloworld Equipment, and Sandvik. Manufacturers are encouraged to pursue environmental sustainability through the concept of double materiality, which considers both how business operations impact the environment and society, as well as how changes in the environment affect business operations and financial performance (Crown, 2025).

Manufacturers are implementing various initiatives to promote environmental sustainability. A significant shift is taking place as they move away from carbon-intensive electricity supplied by Eskom to renewable energy generated at their own facilities. This transition has been partly driven by loadshedding, which has resulted in electricity supply interruptions that disrupt industrial operations. In response, manufacturers had to rely on generators to maintain production levels. However, these generators burn diesel, contributing to carbon emissions.

To tackle these issues, manufacturers have started installing grid-solar systems. This technology helps reduce reliance on diesel-generated power and covers part of the facilities' electricity needs. By adopting internal renewable energy sources, manufacturers lessen their dependence on Eskom while decreasing operational carbon emissions. Some manufacturers have also entered into power purchase agreements with renewable energy producers. Additional in-house energy-efficient initiatives include building insulation, LED lighting, and air conditioners that use double inverter technology, which significantly enhances power-saving capabilities (Bell Equipment, 2023).

OEMs are also implementing recycling initiatives to process used equipment and manufacturing waste, which helps to reduce industrial environmental waste. OEMs remanufacture machinery and equipment components to operational conditions. End-users can therefore choose to send components that need overhauling or replacement to OEMs for refurbishment instead of buying new parts. The process of remanufacturing is often cost-effective and helps reduce waste.

The capital goods industry primarily supplies machinery and equipment to the mining sector. According to the National Business Initiative (2021), the decarbonisation of the mining sector will primarily be driven by a cleaner, renewable energy supply. This shift is expected to reduce Scope 1 and Scope 2 emissions by 73%. In addition, the electrification of mobile and stationary machinery could further decrease these emissions by 15% (National Business Initiative, 2021).

Recent decarbonisation efforts within the mining sector have increased the demand for electric machinery and equipment, such as electric trucks and excavators, aimed at reducing carbon emissions throughout the mining value chain. OEMs are now producing electric articulated dump trucks and excavators to meet this demand. The shift from diesel-powered trucks to electric trucks is crucial for decreasing operational GHG emissions in mining operations. For example, in April 2024, Anglo-American's Mogalakwena Platinum Mine in Mokopane, Limpopo, received an electric rope shovel from Komatsu. This electric shovel emits only 90 grams of CO_2 for every ton of material moved, compared to 273 grams of CO_2 emitted by a diesel-hydraulic excavator and 136 grams of CO_2 emitted by an electric hydraulic excavator (Moore, 2024).

The shift towards supporting decarbonisation efforts in the mining sector has led to global OEMs acquiring industrial battery manufacturers to streamline production processes. At the same time, OEMs are still producing heavy-duty vehicles with Internal Combustion Engines (ICE), but these vehicles have higher specifications that result in lower emissions. Such ICE heavy-duty vehicles have optimised technologies that make them efficient, leading to reduced fuel consumption and GHG emissions. These include optimised combustion engines and gas treatment systems, which reduce nitrogen oxide emissions.

These industry and company-level decarbonisation efforts are influenced by domestic and global policy responses to climate change. These are discussed in the next subsections.

3.1 Environmental regulation

This industry study on technological change in the capital goods industry highlights that environmental concerns are driving innovation, particularly through regulatory measures such as carbon taxes aimed at reducing GHG emissions (Mthembu, 2024a). The Carbon Tax Act No. 15 of 2019 was implemented in response to climate change, to reduce GHG emissions in a sustainable and cost-effective manner while rewarding efficient energy use (Republic of South Africa, 2019). This Act operates on the "polluter pays" principle, meaning that those producing the highest levels of pollution are responsible for paying for their emissions. The carbon tax is applied to entities that operate emission-generating facilities with a combined or installed capacity at or above a specified threshold. Specifically, machinery, mining, and quarrying facilities operating at or above 10 megawatts thermal are subject to this tax (Republic of South Africa, 2019).

Some manufacturers of capital goods are exempt from paying the carbon tax because they do not meet the required thresholds for Scope 1 emissions. For example, Bell Equipment falls into this category and is not required to pay the carbon tax nor report emissions. Nevertheless, Bell Equipment actively monitors its internal carbon footprint by calculating the emissions associated with the diesel consumed and the electricity used at its manufacturing facility in Richards Bay on an annual basis (Bell Equipment, 2023).

The National Environmental Management Act No. 107 of 1998 and its amendments regulate environmental management, promoting a collaborative approach to addressing environmental issues. The National Environmental Management: Integrated Coastal Management Act No. 24 of 2008 governs coastal areas. This Act guides the uMhlathuze and Richards Bay Estuarine Management Plan, which supports the collaborative management of estuaries in uMhlathuze and Richards Bay, thereby promoting sustainable industrial operations (Department of Environmental Affairs, 2018).

In addition, the National Environmental Management: Waste Act No. 59 of 2008 regulates waste management practices and facilities. This Act requires manufacturers to classify waste to determine whether it should be recycled or sent to a landfill. It also enforces careful management of hazardous waste.

3.2 International risks

South Africa's major export market for capital goods includes the European Union (EU), which has implemented several policies to promote sustainable manufacturing. These policies present both challenges and opportunities for the industry. In 2023, South Africa exported 55% of its capital goods to the African continent, 22% to the EU, and 8% to the United States (Mthembu, 2024b).

The EU's emission standards for Non-Road Mobile Machinery have become progressively stricter over the years, advancing from Euro I to the current Euro VI. These measures aim to limit emissions from diesel or petrol-powered machinery, such as excavators, loaders, harvesters, and cultivators. In contrast, South Africa's emission standards have not kept pace and only comply with Euro II standards, particularly for heavy-duty vehicles (Xie, Posada, and Sen, 2022). Plans to implement Euro VI emission standards in South Africa have been delayed because of problems with the production and supply of the specification fuels required for compliance (Moshikaro-Amani, 2025). Moreover, a lack of agreement between the state and refineries on financing measures for the transition to clean fuel standards resulted in the transition being stalled. Given the future lack of commercial viability without transitioning to a cleaner fuel standard, Enref repurposed its 120 000 barrels per day refinery into an import terminal following the December 2020 fire that resulted in damage to the refinery.

In addition, the EU's Carbon Border Adjustment Mechanism (CBAM) is set to impose a carbon tax on carbon-intensive products, including iron and steel, starting in January 2026 (Maimele, 2023). While the capital goods industry is not currently directly affected by CBAM, it will face increased costs of inputs such as steel, which CBAM covers, unless the steel industry can reduce its carbon intensity.

4. CONCLUSION

This industry study on sustainability in the capital goods industry has revealed that emissions in the capital goods value chain are primarily concentrated in the upstream phase. This concentration is mainly due to the reliance on coal-fuelled electricity and the extraction and processing of raw materials into inputs such as steel, a crucial input in capital goods, which contribute to these emissions. In contrast, the midstream phase, where metals are further processed into components for capital goods, generates significantly lower emissions despite still relying on coal-fuelled electricity for production.

The capital goods industry's efforts to decarbonise include implementing in-house energy efficiency initiatives and installing renewable energy solutions. Moreover, operational emissions during the end-use phase of the capital goods value chain have influenced consumer preferences to shift toward low-carbon machinery and equipment. As a result, the capital goods industry plays a crucial role in decarbonising the industrial processes of its end-users by offering low-emission and environmentally friendly products that help lower operational emissions.

Domestic and global policy measures are influencing decarbonisation efforts within the capital goods industry in South Africa. Domestic efforts have been influenced by the Carbon Tax Act No. 15 of 2019. However, while the Act encourages decarbonisation initiatives, certain capital goods OEMs are not liable for the carbon tax because their emissions do not reach the established threshold.

Still, the industry faces several risks related to global policy initiatives. This includes the indirect impact of CBAM, which directly affects the steel industry and would in some way impact input costs for the capital goods industry. Apart from the potential impacts of CBAM, the capital goods industry faces risks resulting from the country not meeting the EU's fuel standards for heavy-duty vehicles.

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