TRADE & INDUSTRIAL POLICY STRATEGIES

INDUSTRY STUDY

SUSTAINABILITY REPORT: FOOD PROCESSING

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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 study examines the carbon intensity across the food processing value chain, identifying where emissions are concentrated — from upstream raw materials to downstream waste. In parallel, it evaluates the policy landscape shaping the sector's sustainability.

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ABBREVIATIONS

CBAM	Carbon Border Adjustment Mechanism
CH_4	Methane
CO_2	Carbon Dioxide
CSIR	Council for Scientific and Industrial Research
DFFE	Department of Forestry and Fisheries and Environment
DMRE	Department of Mineral Resources and Energy
EPR	Extended Producer Responsibility
EU	European Union
FAO	Food and Agriculture Organization
GHG	Greenhouse Gas
N_2O	Nitrous Oxide
TJ	Terajoules

1. INTRODUCTION

The food processing industry[1] in South Africa plays a central role in supporting economic growth, providing employment, and ensuring food security. However, this sector also has a significant environmental footprint, largely due to its high carbon intensity across various stages of the value chain. As global and domestic pressures mount for industries to transition towards more sustainable practices, the food processing industry faces an urgent imperative to reduce its greenhouse gas (GHG) emissions, manage resource-intensive operations, and mitigate associated environmental risks.

Extensive energy use, substantial water demands, and heavy reliance on fossil fuels are key features of the food processing industry in South Africa. The industry contributes greatly to South Africa's GHG emissions, particularly carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Emissions within this sector are found across several stages, from raw material inputs through to waste management. Agriculture and food systems globally account for up to one-third of all human-induced emissions (Tubiello, 2022), industry-wide measures to reduce emissions and transition toward resource-efficient, climate-friendly practices, are needed urgently.

This study examines the carbon intensity across the food processing value chain, identifying where emissions are concentrated. In parallel, it evaluates the policy landscape shaping the sector's sustainability trajectory, analysing both domestic decarbonisation efforts and potential international policy risks, particularly the risk posed by the European Union's (EU) Carbon Border Adjustment Mechanism (CBAM).

2. CARBON INTENSITY OF THE VALUE CHAIN

This section explores the key segments of the food processing value chain, focusing on the environmental implications at each stage. The aim is to highlight the primary sources of emissions, the factors contributing to resource intensity, and the overall environmental impact of the sector.

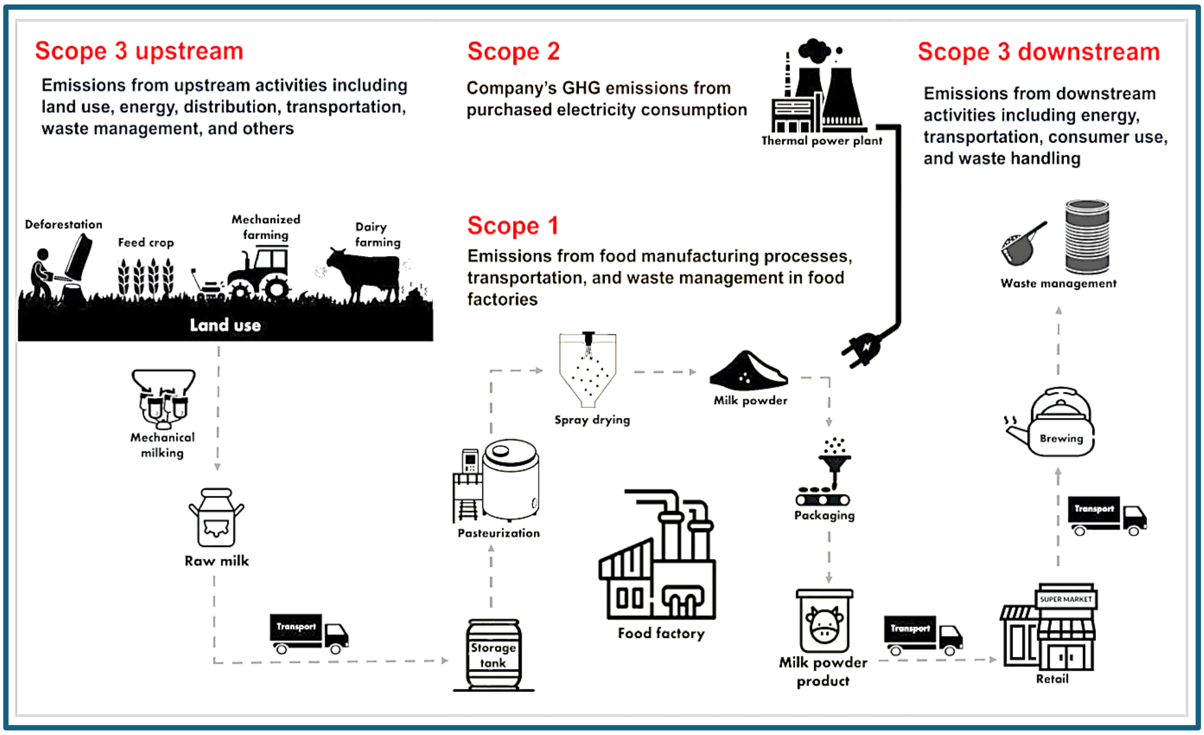
The food processing value chain is a multi-stage system that encompasses production, processing, distribution, and disposal of food products. The sector can be divided into first-phase and second-phase activities. The first-phase or food processing refers to the transformation of raw agricultural materials into consumable products, enhancing their value to consumers. This phase encompasses activities such as milling, pasteurising, and basic preservation, ensuring that raw materials are safe for consumption or further processing, with outputs sold to both consumers and businesses. The second phase, known as food manufacturing, entails more sophisticated and value-added production activities. During this phase, processed inputs from the first phase are transformed into finished products — such as baked goods, packaged meals, and beverages — through physical, chemical, or biological processes.

The food value chain by its nature attracts multiple sources of global GHG emissions, and is a significant contributor. As highlighted by the Food and Agriculture Organization (FAO), when pre- and post-production activities along agri-food system supply chains are considered, food and agriculture activities account for up to one-third of all human-induced emissions globally (Tubiello, 2022). According to the FAO (n.d.), the agri-food system in South Africa produced about 50 000 kt of CO_2 emissions in 2022, 35.57 kt of direct emissions (N_2O) and 12.83 kt of indirect emissions (N_2O).

[1] The food processing industry is an integral component of the broader agro-processing industry, encompassing diverse processes across key subsectors such as maize and wheat milling, manufacturing of sugar and confectionaries, dairy processing and meat processing.

Figure 1 illustrates the emissions cycle within the food processing value chain, using the example of production of milk powder, from upstream to downstream activities, demonstrating the various stages at which emissions occur. Notably, the processing and post-production phases are identified as the primary sources of emissions, driven by high energy consumption and a significant reliance on petroleum and coal (Liu et al., 2023)

Figure 1. Emission sources during milk powder production



Source: Liu, Wu and Chau, 2023.

2.1. Agricultural inputs

The food processing industry in South Africa depends on a well-established agricultural sector, characterised by diverse commercial farming and supply chains. The sector is divided into three main categories: field crops (such as maize, wheat, oilseeds, and sugarcane), horticulture (including grapes, citrus fruits, vegetables, and rooibos), and animal products (such as wool, eggs, livestock, and fresh milk) (Who Owns Whom, 2023). Although the processing of food is energy intensive, most emissions in the food value chain stem from the agricultural or farm stage due to the generation of methane emissions from fermentation in livestock, land use and land use change activities such as CO_2 emissions from deforestation and land conversion (Liu et al., 2023). For example, among protein sources, beef production is widely recognised as the largest emitter of GHGs, surpassing poultry. In 2020, cattle accounted for 6.7% of South Africa's total emissions and were responsible for 70% of the country's methane emissions (Wegerif, 2024).

The agricultural sector is threatened by climate change, but at the same time is a substantial contributor to GHGs. Climate Watch (2024) has noted that at a global level, the agricultural sector is the second-largest contributor of GHG emissions after the energy sector, and it is responsible for more land-clearing than any other sector. According to National GHG Inventory Report (DFFE, 2024), the agricultural sector produced 53 519 Gg CO_2e, or 11% of South Africa's total emissions in 2022. The bulk of these emissions emerged from enteric fermentation[2] which contributed 36 352 Gg CO_2e or 68% of total agricultural sector emissions. Notably, emissions for 2022 have been 9% lower than in 2000 – due to a decrease in livestock population numbers, as a result of droughts in 2015 and 2016. Recently, livestock populations have also been affected by a combination of other factors, including lower consumer demand for red meat, affordability concerns, and outbreaks of foot-and-mouth disease (Sihlobo, 2023).

In contrast, emissions from manure management[3] have risen by 8% since 2000. Biggest contributors were N_2O[4] which contributed 56% of the total emissions from manure management, and methane, which contributed 44% of total emissions from manure management in 2022 (DFFE, 2024).

Synthetic nitrogen fertilizer, applied to crops like maize, sorghum, wheat and sugarcane, is a major contributor of emissions in the sector. As per Climate Watch data (2024), in South Africa fertilizer use in agriculture amounted to 1.3 million tonnes and pesticide use amounted to 43 thousand tonnes of active ingredients in 2021.

2.2. Circularity and recycling

Packaging

Packaging in particular plays a crucial role in protecting food from damage and contamination, while also extending shelf life. The WWF estimates that South Africans use around 3.5 million tonnes of packaging per year, with about 50% being recycled. Nonetheless, reduction of packaging, especially the use of single-use plastics, needs to be emphasised (WWF, 2020). In 2023, approximately 1568 kilotonnes (kt) of virgin polymer for plastic production was consumed in South Africa. Of this, flexible packaging accounted for 20% and rigid packaging for 28%, jointly representing nearly half of total virgin polymer consumption (Plastics SA, 2024).

The choice of packaging materials influences environmental impact. For example, switching from recycled glass and non-recyclable bottles to recyclable stainless steel barrels for beer packaging can reduce GHG emissions by 93% and 96%, respectively (Liu et al., 2023). Plastic-based packaging typically produces over 3 kg CO_2 per kilogram, whereas cellulosic fibre-based packaging emits less than 1.5 kg CO_2 per kilogram. However, fibre-based packaging often requires more material than plastic to provide the same level of protection (Liu et al., 2023; Mpact, n.d.).

Consumer demand for more sustainable packaging is driving significant changes within the food industry in South Africa, spurred by growing environmental awareness. Consumers are increasingly concerned about the waste generated by food packaging and are seeking more recyclable or reusable options. Changing consumer habits have also been shaped by recent Extended Producer Responsibility (EPR) policies, which mandate producers to manage the entire lifecycle of their packaging, promoting a circular economy and reducing plastic pollution.

This heightened awareness has encouraged companies to explore environmentally responsible packaging solutions to meet these expectations, which is now influencing buying decisions and enhancing brand loyalty. The food packaging industry is undergoing a notable shift towards eco-friendly innovations. These include the use of biodegradable and compostable materials, recyclable

[2] Enteric fermentation is a digestive process by which plant material consumed by an animal is broken down, leading to the production of methane as a by-product (DFFE, 2024).
[3] Manure management involves the collection, storage, treatment, and use of animal waste.
[4] N_2O refers to nitrous oxide, of which agriculture is the largest producer, globally.

solutions, and reusable packaging systems. Examples of sustainable alternatives include plant-based plastics, mushroom packaging derived from agricultural waste and mycelium, seaweed-based packaging, and biodegradable films made from natural polymers. Reusable packaging systems are also gaining traction, involving durable materials that can be used multiple times, reducing overall waste. Common approaches include returnable containers, deposit schemes where consumers are refunded upon returning packaging, refill stations allowing consumers to bring their own containers, and subscription services providing reusable packaging models. A company in the sector that has invested heavily in this is Nestlé through its Nestlé Institute of Packaging Sciences, which focuses on advancing biodegradable, compostable, and recyclable materials (CBN, 2024).

Food waste

A clear link exists between packaging and food waste, caused by inefficiencies in the food system and consumer behaviour — such as inadequate planning, damage during handling, poor storage, and overconsumption. As food waste decomposes, it releases carbon dioxide and methane, two major GHGs that drive global warming. In fact, food wastage occurs throughout the value chain and waste largely depends on the type of commodity — soft and leafy fruit and vegetables are regarded as being more likely to be wasted than roots or tubers (DFFE and CSIR, 2021). According to a 2021 report by the Department of Forestry and Fisheries and Environment (DFFE) and the Council for Scientific and Industrial Research (CSIR), drivers of food wastage in food processing vary, such as rejected outputs, losses in the process, quality concerns, labelling errors and "off-spec" production (Table 1)[5]. Against the background of the African continent's food insecurity, exacerbated by climate change, food waste is a serious concern.

Table 1. Drivers of wastage from processing food

DRIVER	CAUSE	RESULT
Rejected input	• Product rejected for not meeting quality specification	Discarded
Losses in the process	• Food safety concerns • Inefficient process flows • Accidental spillages • Washing, peeling, slicing, and boiling • Machine failures • Trimming • Process interruptions e.g. power outages • Maintenance runs	Condemnation Discarded
Quality Specification	• Over-demanding quality specifications	Discarded
Labelling errors	• Incorrect information on printed label • Skewed labelling	Discarded
"Off-spec" production	• Poor product formulation	Discarded

Source: Adapted from DFFE and CSIR report: Food waste prevention and management: A guideline for South Africa, 2021.

[5] The report also includes drivers of food wastage at the farm and during distribution. See: www.csir.co.za for more.

According to the CSIR, about 10.3 million tonnes of edible food meant for human consumption is wasted every year in South Africa, equivalent to 34% of local food production and because South Africa is a net exporter of food, the losses are equivalent to 45% of the available food supply in the country (CSIR, 2021). Furthermore, about 68% of food loss and waste occurs in the early stages of production, with 19% being lost during the post-harvest handling and storage, and 49% during processing and packaging (Yende, 2022).

3. POLICY LANDSCAPE AND SUSTAINABILITY RISKS

South Africa's economy remains highly carbon-intensive, primarily due to its historical reliance on coal-powered energy generation. This dependence extends to the food processing sector, where agriculture is expected to become a major contributor to GHG emissions by 2050 as food demand rises. Expanding agricultural land use, increased transportation, and growing food waste will further amplify the sector's environmental impact (BiobiN, 2021). he production and processing of food are particularly energy-intensive, making the fossil fuel-reliant sector a considerable source of carbon emissions. In South Africa, the food processing industry uses a great deal of electricity, which is essential across the value chain for powering machinery, ensuring quality control, and maintaining hygiene standards.

According to the Department of Mineral Resources and Energy (DMRE, 2023), the sector — including beverages and tobacco — consumed 9 296 terajoules (TJ) of energy in 2021, with natural gas contributing 32%, oil 31%, electricity 28%, and coal 9%. Beyond processing, agricultural inputs, including forestry, depend heavily on oil products, which accounted for 69% of the sector's total energy consumption in 2021. The DMRE (2023) attributes this largely to the transportation of agricultural raw materials, animal feed, intermediates, and finished products from farms. Additionally, electricity accounted for 31% of total energy use in the agricultural and forestry sector, amounting to 21,649 TJ in 2021.

As climate change increasingly threatens food security, particularly in Southern Africa, the adoption of more sustainable practices is gaining momentum in the sector. This includes renewable energy, regenerative agriculture, and smart farming techniques. In addition, various sustainable technologies are being implemented, such as solar dryers, no-till tractors, bio-stimulants, farm management apps, precision spray drones, drip irrigation systems, and anaerobic digestion. These innovations are helping to reduce environmental impact while improving efficiency and resilience in food production (Who Owns Whom, 2023). Furthermore, major firms in the food and beverage sectors have been investing heavily in greening their production processes. According to a TIPS Industry Study, companies like Heineken, Pepsi-Co, TERRAGRN, Nestlé South Africa, Tiger Brands, and McCain Foods have invested large sums in adopting renewable energy at production facilities and using climate change technologies (Hector, 2024).

Many countries are working to reduce the high emissions generated by agricultural inputs. Brazil, for example, has introduced key regulations aimed at sustainability, with goals of reducing GHGs and adapting to climate change. Notable initiatives include the Low-Carbon Agriculture Plan, the Safra Plan, and the National Program for the Conversion of Degraded Pastures into Production Systems (USDA, 2024). South Africa has few climate change mitigation policies specifically targeting the agricultural sector. The National Climate Change Response White Paper (Republic of South Africa, 2011) highlights climate-smart agriculture as a key practice. In 2018, the then-Department of Agriculture, Forestry, and Fisheries introduced two draft policies for public consultation, the Conservation Agriculture Policy and the Climate Smart Agriculture Strategic Framework. Moreover, efforts have been made to decarbonise value chains in South Africa, such as Sasol's use of green hydrogen to produce ammonia, a critical ingredient in nitrogen-based fertilisers (Scholvin et al., 2024).

South Africa has a suite of policies — both recent and longstanding — that affect the food processing sector. The Carbon Tax, introduced in 2019, imposes levies on high-emission companies and may have cost implications for the industry going forward. Furthermore, the Climate Change Act (2024) sets out sectoral emissions targets and mandates greenhouse gas reporting, covering agriculture and related sectors. Additionally, EPR measures hold producers accountable for managing problematic waste, such as the plastics used in food packaging. The 2020 South African Food Loss and Waste Voluntary Agreement, initiated by the Consumer Goods Council of South Africa, the Department of Trade, Industry and Competition, and the DFFE, compels food manufacturers, distributors, and retailers to take steps to reduce food waste. On organic waste specifically, the National Norms and Standards for Organic Waste Composting (2021) together with the Treatment of Organic Waste (2022) were implemented to establish unified and sustainable practices for managing organic waste across the country.[6]

The food value chain in South Africa faces growing pressure to adopt climate-friendly practices due to the EU's upcoming CBAM, which will levy tariffs on products from carbon-intensive industries. In 2023, about 22% of South Africa's food and beverage exports went to the EU, making it a key market for South Africa (Hector, 2024). Although the food sector is not directly included in CBAM's initial phases, its high emissions and energy intensity mean it could face indirect impacts, potentially raising costs and reducing export competitiveness if it does not adapt in time.

Greening South Africa's food value chain represents a considerable economic commitment, especially in the agricultural input phase, as sustainable agricultural practices, such as regenerative agriculture and smart-agricultural technologies will require significant financial investment. Climate policies, including the Carbon Tax, are likely to have substantial impacts on the food production chain by increasing costs and potentially affecting both competitiveness and consumer prices. Although the green transition promises job creation in certain sectors, it may also lead to job losses in carbon-intensive areas, underscoring the importance of robust reskilling and upskilling initiatives. With specific exemptions, the Carbon Tax could ultimately support employment and production within the agriculture and food sectors, offering a measured path to sustainable growth. Taken together, these shifts equip South Africa's food value chain to remain competitive while advancing environmental objectives and reinforcing its resilience in a changing global market.

Beyond the associated costs, however, this shift opens significant economic opportunities. The EU's CBAM suggests that demand for sustainably produced agricultural products will grow, creating new market possibilities for South African farmers who adopt eco-friendly methods. By aligning with the EU's stringent environmental standards, South African producers could not only meet the demand for sustainable goods in Europe but also leverage this competitive advantage to access environmentally conscious markets globally. While the initial costs of adopting sustainable practices are high, these practices can yield cost savings over time through energy efficiency, resource conservation, and reduced waste disposal expenses. Moreover, greening the sector can contribute to the improvement of biodiversity, soil health, and bolster water resource management, all of which are critical to building climate resilience within agriculture (Bohlmann and Kalaba, 2019; World Bank Group, 2022; Steenkamp, 2023; Burger, 2024).

[6] There have been instances where local governments have taken a step towards banning organic waste from landfills. The Western Cape Government is a prime example, whereby it seeks to outright ban organic waste from landfill by 2027. For more see: *Reducing waste in Western Cape landfills | Western Cape Government*.

4. CONCLUSION

The food processing value chain in South Africa, encompassing both first-phase food processing and second-phase manufacturing, plays a crucial role in the economy but is also a major contributor to greenhouse gas emissions. Given the sector's heavy reliance on energy, particularly from fossil fuels, and the substantial emissions generated at both the agricultural and processing stages, adoption of sustainable practices is urgent. The transition toward a low-carbon, resource-efficient value chain is increasingly vital, especially as global pressures mount through mechanisms like the EU’s CBAM. This could negatively affect South African exports if the sector fails to adapt.

The path toward greening the food production sector, while costly, holds long-term environmental benefits. By integrating renewable energy sources, advancing sustainable packaging, and reducing food waste, the industry can reduce its carbon footprint and enhance its resilience against climate change impacts. These sustainable practices are likely to reduce operational costs over time, create new market opportunities, and foster environmental resilience. Policymakers and industry players must continue to collaborate on incentives and regulatory support to facilitate this transition, which is not only critical to meeting environmental objectives but also essential for maintaining South Africa’s food production sector’s competitiveness at a global level.

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