GREEN HYDROGEN SOUTH AFRICA

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GREEN SHIPPING BASELINE ANALYSIS: FIVE CRITICAL DIMENSIONS OF SOUTH AFRICA'S MARITIME TRANSPORT SECTOR

IMPRINT

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ABBREVIATIONS

ABS	American Bureau of Shipping
AfCFTA	African Continental Free Trade Area
BMWK	German Federal Ministry for Economic Affairs and Climate Action
BMUV	German Federal Ministry for the Environment Nature Conservation Nuclear Safety and Consumer Protection
CBAM	Carbon Border Adjustment Mechanism
CAPEX	Capital Expenditure
CC(U)S	Carbon Capture (Usage) Storage
CEF	Central Energy Fund
CH4	Methane
CII	Carbon Intensity Indicator
CMTP	Comprehensive Maritime Transport Policy
CO2	Carbon Dioxide
CO2eq	Carbon Dioxide Equivalent
DEDEAT	Department of Economic Development Environmental Affairs and Tourism
DFFE	Department of Forestry Fisheries and Environment
DIRCO	Department of International Relations and Cooperation
DMRE	Department of Mineral Resources and Energy
DoT/DOT	Department of Transport
DSTI	Department of Science Technology and Innovation
DTIC	Department of Trade Industry and Competition
ECA	Emission Control Area
EEDI	Energy Efficiency Design Index
EEXI	Energy Efficiency Existing Ship Index
ERT	Economic Regulation Transport Act
ESG	Environmental Social and Governance
ETS	Emissions Trading System
EU	European Union
GDP	Gross Domestic Product
GHG	Greenhouse Gas Emissions
GH2	Green Hydrogen
GHCS	Green Hydrogen Commercialisation Strategy
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GJ	Gigajoule
Gt	Gross tonnage
GWh	Gigawatt Hour
GWP	Global Warming Potential
H2	Hydrogen
HFO	Heavy Fuel Oil
IDC	Industrial Development Corporation
IDZ	Industrial Development Zone
IKI	Internationale Klimaschutzinitiative (International Climate Initiative)

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IMO	International Maritime Organization
IRENA	International Renewable Energy Agency
ITAC	International Trade Administration Commission
kg	Kilogram
kJ	Kilojoule
kt	Kilotonne
kW	Kilowatt
LNG	Liquefied Natural Gas
MARPOL	Marine Pollution Convention
MDO	Marine Diesel Oil
MEPC	Marine Environment Protection Committee
MGO	Marine Gas Oil
Mt	Megatonne
MW	Megawatt
MWh	Megawatt hour
N2O	Nitrous Oxide
NAEIS	National Atmospheric Emissions Inventory System
NATMAP	National Transport Master Plan
NDP	National Development Plan
NEMA	National Environmental Management Act
NH3	Ammonia
NZE	Net Zero Emission by 2050 Scenario
OEC	Observatory of Economic Complexity
PE	Port Elizabeth
PMAESA	Port Management Association of Eastern and Southern Africa
ppm	Parts per million
PtX	Power-to-X
RoRo	Roll-on/Roll-off
SA	South Africa
SADC	Southern African Development Community
SAMSA	South African Maritime Safety Authority
SARS	South African Revenue Service
SEZ	Special Economic Zone
SI	International System of Units
SMR	Steam Methane Reforming
SOLAS	Safety of Life at Sea
t	Tonne
TNPA	Transnet National Ports Authority
TWh	Terawatt Hour
UNCLOS	United Nations Convention on the Law of the Sea
UNCTAD	United Nations Conference on Trade and Development
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
VAT	Value Added Tax
WTW	Well-to-Wake
ZAR	South African Rand

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Executive Summary

South Africa's maritime sector stands at a pivotal point as the global shipping industry transitions toward defossilisation to meet global climate targets. Globally, the drive for maritime decarbonisation is policy-driven, with the International Maritime Organization (IMO) at the forefront of the agenda, mandating net-zero emissions by 2050, and requiring at least 5-10% green marine fuel consumption by 2030(IMO, 2023). In response, South Africa must strategically adapt to both comply with international regulations and capitalise on emerging future opportunities in the green shipping economy.
This desktop study examines five critical dimensions of South Africa's maritime transport sector: (1) the current state and development opportunities of the maritime industry; (2) how South Africa connects to global markets through maritime transport, including analysis of ship traffic, freight volumes, and emissions; (3) the impact of regional policy regimes such as the European Union (EU)'s Carbon Border Adjustment Mechanism (CBAM) on traded commodities; (4) the economic role of ports in Gross Domestic Product (GDP) and employment and (5) the stakeholder ecosystem driving maritime transformation. Through quantitative analysis of vessel movements, trade data, and emissions profiles, combined with a regulatory assessment and stakeholder mapping, this research provides insights to inform the green shipping transition and development of the South African maritime decarbonisation action plan.

Key findings:

1. **The current state and development opportunities of the maritime industry and its economic contribution:** South African ports play a critical role in African maritime trade, serving as a gateway for regional commerce, particularly for landlocked Southern African Development Community (SADC) countries. Maritime transport is a key contributor to South Africa (SA)'s economy, with approximately 95% of SA's total import and export volumes is transported by foreign vessels, and international exports by ship accounting for approximately 30% of the country's GDP (DFFE, 2022). The Transnet National Ports Authority (TNPA) operates eight commercial ports that handle substantial cargo volumes, with the Port of Durban being the largest container terminal in sub-Saharan Africa, handling approximately 60% of the country's container traffic. Despite its strategic position, South Africa accounts for only 1% of the total global seaborne trade, highlighting the potential for growth, provided that existing barriers such as a limited domestic fleet and port inefficiencies are addressed. Looking ahead, the government has set ambitious objectives, aiming to position South Africa as a major maritime centre by 2030 (DoT, 2024). As the global maritime defossilisation agenda unfolds, SA's maritime sector must adapt to facilitate the transition. Embracing sustainable maritime practices not only aligns with SA's duty as an IMO member state but provides an opportunity to expand business around the supply of alternative Power-to-X (PtX) fuels.

2. **Global market connections through maritime transport:** The analysis of ship traffic data from TNPA highlights how South Africa's maritime transport connects SA's economy to global markets. In 2023, the country recorded 8,970 vessel arrivals, with international (ocean-going) vessels comprising 82% of traffic compared to 18% domestic (coastwise) vessels. The composition of international arrivals demonstrates the diverse nature of seaborne trade, led by bulk carriers (3,158 arrivals), followed by container ships (1,563), tankers (1,373), cargo ships (995), and passenger vessels (223). Port distribution shows clear specialisation, with Durban port receiving most vessels at 2,933 arrivals, Cape Town receiving 1,823, and Richards Bay handling 1,397 vessels. Notably, foreign-flagged vessels dominate South African waters, as the domestic merchant fleet consists merely of port service vessels, domestic fishing vessels amongst other small-craft categories, highlighting SA's dependency on international shipping.

   The emissions analysis based on the ship traffic data shows that in 2023, the total emissions in South African waters are approximately 10 million tonnes based on vessel arrivals and departures. International vessel categories contribute approximately 97% of emissions, with domestic only contributing 3% (~302 000 tons CO_{2eq}) in 2023. Port-level analysis reveals Durban as the highest emitter at 3.5Mt, followed by Cape Town (1.4Mt), Saldanha Bay (1.3Mt), and Richards Bay (1Mt). By vessel category, bulk carriers emerge as the primary contributors at 37.6% of emissions,

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followed by cargo vessels (26%) and container ships (21.2%), directly corresponding with traffic patterns and highlighting the need for targeted interventions in these areas. South Africa's trade and freight landscape varies across its ports, with Durban handling approximately 1 trillion ZAR in import trade in 2023. In terms of export value, Durban remains the largest port (307 billion ZAR), followed by Richards Bay (214 billion ZAR), Saldanha Bay (132 billion ZAR) and the Port of Cape Town (127 billion ZAR). Key exports include gold (15.4%), platinum (13%), and coal briquettes (8.7%), while refined petroleum (15.2%), cars (4.1%) and crude petroleum (3.8%) were among the top imports. Asia remains South Africa's largest trade partner, followed by Europe, North America, and Africa. Regionally, Durban, Richards Bay, and Saldanha Bay facilitate most trade with Asia, while significant trade volumes to Europe are distributed across all major ports. This highlights the strategic importance of South Africa's port infrastructure in supporting global and regional trade flows.

3. **Commodities under regional policy regimes-** Emerging international trade regulations are reshaping South Africa's maritime sector, creating urgent adaptation needs while creating opportunity to integrate 'green' practices into trade and shipping. Currently, around ZAR 50 billion worth of exports to the European Union fall under the Carbon Border Adjustment Mechanism (CBAM), representing 16% of total EU export value. This exposure varies significantly by port, with Saldanha Bay facing the highest impact at ZAR 25 billion, primarily from iron exports, while Richards Bay confronts ZAR 13 billion in aluminium exports. The growing importance of EU trade, which increased from 27% of total export value in 2011 to 32% in 2023, amplifies the significance of these policy impacts.
   Looking forward, the regulatory landscape will become increasingly complex and demanding. The FuelEU Maritime regulation will require vessels operating on EU-South Africa routes to progressively adopt cleaner fuels, potentially affecting shipping routes and trade flows. The expansion of the EU Emissions Trading System (ETS) to include maritime transport will directly increase operational costs for South African shipping companies serving European markets. Additionally, the IMO's proposed universal greenhouse gas (GHG) levy, currently under negotiation, could affect bunker fuel costs and create new compliance requirements at South African ports. Nonetheless, to remain competitive, the South African maritime sector must adapt to evolving regulations to maintain trade relations, whilst exploring opportunities to improve trade facilitation with foreign, but also regional partners, such as through the African Continental Free Trade Area (AfCFTA).

4. **Economic role of ports-** South Africa's port system demonstrates substantial economic contribution while revealing significant development potential. Revenue distribution across ports reflects operational intensity, with Durban contributing 52% of total port revenue, followed by Cape Town (14%), Richards Bay (13%), and Saldanha Bay (8%). Notably, cargo dues constitute 60% of all port revenue, highlighting the direct link between trade volumes and port financial sustainability.

   Investment commitments highlight recognition of infrastructure needs, with TNPA pledging ZAR 16.1 billion for port upgrades in the Western Cape region and the establishment of public-private partnerships to support port upgrades and modernisation. The presence of Special Economic Zones located at various major ports, provide economic incentives in forms of tax reductions and reduced trade fees further leverage and facilitate the green shipping transition. These zones, particularly in Saldanha Bay, Coega, and Richards Bay, are strategically positioned to become PtX fuel production hubs, potentially transforming ports from mere transit points to integrated fuel-distribution centers.

5. **Stakeholder Ecosystem**: The transformation to green shipping requires coordinated action from key main groups of stakeholders, each playing distinct but interconnected roles. Understanding who these players are and what they control is essential for successful implementation. **The Governmental departments** have the authority to drive change. The Department of Transport acts as the main architect of maritime policy, controlling regulations that govern how ships operate in South African waters. The Department of Trade, Industry and Competition manages the Green Hydrogen Strategy and supports policy development around PtX fuels. **The Port and Maritime Authorities** serve as the operational backbone of the sector. Transnet National Ports Authority (TNPA) functions as

the owners of the commercial ports, managing infrastructure investments and decisions regarding the implementation of green technologies. The South African Maritime Safety Authority (SAMSA) acts as the regulatory authority, approving licenses for ship fuel suppliers and enforcing safety standards. Their role becomes crucial as they must adapt regulations to accommodate PtX fuels**.**

The industry sector comprises a diverse range of companies providing commercial services within the maritime space, critical in implementing technological innovations and operational practices that contribute to reducing carbon emissions. The industry's role in defossilisation is amplified by its ability to leverage market-driven solutions. Working alongside industry, **the financial sector** includes institutions providing funding and investment services essential to maritime decarbonisation. These organisations are instrumental in mobilising capital and creating financial mechanisms that enable the transition to low-carbon shipping. Financial stakeholders drive decarbonisation initiatives by allocating funds, providing incentives, and integrating sustainability criteria into investment decisions. **The civil society and education and training stakeholders** ensure the transition is both technically sound and socially just. Universities and maritime training institutions must rapidly develop new curricula to train workers in green shipping technologies—from handling hydrogen safely to maintaining electric port equipment. Environmental groups play a critical role in advocating for sustainable practices. These groups are essential in raising awareness, promoting community involvement, and ensuring that environmental considerations are integrated into maritime policies and operations. In line with the Just Transition mandate, contribution and feedback from these stakeholders is critical to ensure a constitutional imperative for transition. While each of these stakeholders has a primary role in the defossilisation process, their responsibilities overlap. Defossilisation of South Africa's shipping industry is a complex endeavour that requires a coordinated approach across all stakeholders. Coordinated decision-making can ensure that the maritime sector in South Africa evolves towards a sustainable future, aligning with global efforts to combat climate change and reduce carbon emissions.

Recommendations

Based on the key findings of this study, the following recommendations are proposed to advance maritime defossilisation in South Africa:

- **Facilitate Uptake of Zero-Carbon Fuels**: South Africa should work towards supplying alternative green bunker fuels, including PtX fuels for vessels visiting its ports. Developing the green hydrogen supply chain and producing PtX fuels can present opportunity for South Africa to meet future demand and establish itself as a supplier in zero-carbon fuel markets along the “Cape-route”.
- **Align Maritime Legislation with Global Standards**: Adapt existing regulations to integrate environmental fuel compliance measures and enforce stricter regulations on fuel standards, such as the IMO's sulphur cap, in South African territorial waters.
- **Modernize Port Infrastructure and Digitalisation:** Prioritize investments in upgrading port facilities to improve efficiencies and increase trade turnover, with key focus on strengthening multimodal connections with less carbon-intensive rail networks. Simultaneously develop appropriate data infrastructure to monitor maritime traffic and related indicators at the port level to inform management and defossilisation efforts.
- **Implement Emissions Control Measures**: Establish mechanisms to monitor emissions from international vessels, facilitate low-carbon fuel bunkering, and mandate carbon-neutral standards for new domestic fleet developments.
- **Develop Green Trade Strategies**: Focus on producing and exporting PtX products, establish bilateral green shipping corridors with key trading partners, and strengthen partnerships through frameworks like the AfCFTA to mitigate impacts from emerging carbon regulations.

These recommendations require coordinated implementation by government departments, state-owned enterprises, and industry stakeholders to position South Africa advantageously in the global maritime defossilisation transition.

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ASSESSMENT OF SOUTH AFRICAN MARITIME TRANSPORT SECTOR AND REGULATORY LANDSCAPE

This desktop study foccussed on how South Africa's economy is linked to global markets through the maritime transport sector. This included assessing the role of South Africa's ports on the economy and employment landscape, identifying challenges and opportunities for development, mapping out key stakeholders to lead the defossilisation agenda and to evaluate the impacts of changes in regional policy on the maritime landscape. The following chapter describes each section in detailed analysis in relation to the terms of reference of the research project.

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Maritime Defossilisation & Green Shipping

Maritime Defossilisation in Global Context

Global maritime transport is responsible for 80-90% of the world's trade (UNCTAD, 2023), and is underpinned by an extensive global network driven by changes in demand and consumption. Due to this heavy reliance on maritime transport, disruptions in global trade can have tremendous knock-on effects on global supply chains, with far-reaching economic repercussions.

Global shipping is confronted by multiple challenges, including dynamic trade policies, geopolitical tensions and shifting patterns of globalisation. The COVID-19 pandemic notably disrupted global maritime activities, causing substantial delays and logistical challenges. Compounding these challenges are more recent geopolitical events, such as the 2021 Suez Canal blockage, ongoing conflicts between Russia and Ukraine and terror attacks along the Red Sea shipping routes (Bogetic et al., 2024), which have further strained growth in the sector.

As of January 2023, the global fleet comprised 105,493 vessels of 100 gross tons capacity and above, with an annual capacity expansion rate of 3.2% in 2022, reaching a total of 2.27 billion deadweight tons (UNCTAD, 2023). The global fleet has also been said to be aging, highlighting the need for investments into more modern, energy efficient vessels. The maritime industry is concurrently facing the imperative to defossilise to align with the climate change objectives of the 2015 Paris Agreement. According to the International Maritime Organisation's (IMO) Fourth Greenhouse Gas (GHG) study, the sector emits approximately 1 billion tonnes per year of carbon dioxide equivalent, contributing 3% to annual global GHG emissions (equivalent to emissions emitted by Germany) (IMO, 2020).

In response, the IMO set forth an initial emissions reduction strategy in 2018 to reduce emissions by at least 50% by 2050 from 2008 levels and to achieve a 40% reduction in emissions intensity by 2030 (Chircop, 2019; IMO, 2018). Despite this, there were increasing concerns that the targets were insufficient to meet the goals of the Paris Agreement (Bullock et al., 2022). Hence, the IMO targets were revised to be more stringent, such that emissions are reduced by 34% by 2030, and to achieve net-zero emissions by or around 2050 (IMO, 2023). Furthermore, in July 2023, the IMO Marine Environment Protection Committee (MEPC) committed to: "the uptake of zero or near-zero GHG emission technologies, fuels and/or energy sources to represent at least 5%, striving for 10%, of the energy used by international shipping by 2030", such that at least 5% of marine bunker fuel consumption is green by 2030 (IMO, 2023). These regulations further build onto other existing maritime sustainability standards, including the Energy Efficiency Existing Ship Index (EEXI) (2021) similar to the Energy Efficiency Design Index (EEDI) from 2011, and the Carbon Intensity Indicators (CII) (2021) which aim to monitor a ship's energy efficiency and emission compliance (Figure 1).

Stakeholders in the maritime sector are therefore tasked to navigate complexities of technological advancements, financial costs, and regulatory requirements associated with defossilisation. While IMO member states and regulatory bodies play a pivotal role to lead the transition and ensure compliance, it is within ship owner's interests to come on board. This will include investing in future fleet capabilities, sustainable fuels, and onboard green technologies, which will critically shape the emissions profile of the global fleet and its capacity to meet the IMO's emission targets (UNCTAD, 2023).

A significant component of this transition involves the replacement of fossil fuel-based bunker fuels with greener alternatives that produce minimal or zero GHG emissions across their production lifecycle (well-to-wake) (IMO, 2024). This further demands an overhaul of fuel production and distribution value chains. Green hydrogen-based fuels, specifically ammonia and methanol, are increasingly recognized for their potential to defossilise the shipping sector (IRENA, 2021). However, the large-scale implementation of these alternative fuels will require substantial changes

and investments in the existing fuel infrastructure or vessels in operation.

This study focuses on assessing the potential defossilisation strategies for the maritime sector in South Africa and thereby aims to provide insights into the broader implications and opportunities for implementing defossilisation efforts at a national level, to ensure the sector's alignment to international maritime goals.

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Maritime Transport in South Africa

Maritime shipping is the backbone of Africa's economy, with over 90% of the continent's imports and exports transported by sea (African Union, 2019; Mlambo, 2021). South Africa particularly plays a pivotal role in the African maritime landscape. As home to some of the continent's most developed and busiest ports, the country serves as a gateway for trade, not just for the country itself but also for landlocked nations within the Southern African Development Community (SADC). The maritime transport sector contributes largely to carriage of goods traded, Gross Domestic product (GDP), and employment in South Africa. With regard to trade, approximately 95% of SA's total import and export volumes are transported by foreign vessels, accounting for ~80% of its trade value (DFFE, 2022). International exports by ship have been reported to contribute ~30% to SA's GDP (Veitch, 2021). Furthermore, maritime transport forms a crucial component of SA's ocean economy, identified as a critical area for development under the nation's 'Operation Phakisa' initiative. This initiative, launched to unlock the economic potential of South Africa's oceans, projects that the broader ocean economy could contribute between ZAR 129 billion and ZAR 177 billion to the national economy and generate between 800,000 and 1 million direct jobs by 2033 (DFFE, 2022). Within this framework, marine transport and manufacturing are expected to play a leading role, making the largest contribution to GDP and job creation (DEDEAT, 2022).

Box 1. Port Employment & Skills

Transnet National Ports Authority (TNPA) manages the national port system on behalf of the South African state. The most recent TNPA report reflected 3,939 employees on its payroll in the 2022 fiscal year which was a slight increase from 2021. The majority of the employees are within the ages of 36-45 years. The employees include both skilled and unskilled persons that serve the operational capacity of ports system. Identified skills include 8 categories of which *Operations* are at the heart of port management, in addition to cargo handling, vessel scheduling, logistics, and safety which are essential for the smooth functioning of the ports.

South Africa's southern geographic location strategically positions the country along major global trading routes, particularly those connecting the American and Asian markets. This geography becomes particularly favourable during disruptions to trade routes via the Suez Canal, as vessels are rerouted around the southern tip of Africa. The maritime transport sector in South Africa specifically encompasses cargo handling within its ports and the ocean transportation of goods. This includes operations conducted by South African-registered ships, those operating in South African waters, and vessels owned or managed by South Africans (DFFE, 2022). Despite the country's advantageous location in the global shipping network, South Africa only generates about 1% of the total global seaborne trade, indicating substantial room for growth (DOT, 2017).

South Africa operates a network of eight commercial ports along its coast, each providing vital infrastructure to facilitate seaborne trade (Figure 1 and Table 1). The National Ports Authority is a landlord Port Authority that provides port infrastructure and maritime-related services at the eight operational ports. In 2023, South African ports recorded 8,965 vessel arrivals. Of these, ocean-going ships accounted for a total of 7,312 port calls, with the remaining comprising coastwise vessels, foreign fishing vessels, domestic fishing trawlers, and various other types of vessels such as tugs, naval vessels, barges, and yachts (TNPA, 2023a). In the same year, the port system managed over 210 million tonnes of cargo, including dry bulk, liquid bulk, and breakbulk cargo, and handled approximately 840,000 vehicles, reflecting the substantial trade volumes moving through the port system (TNPA, 2023a). Across the ports there are (TNPA, 2019):

- 106 berths (20 container, 26 dry bulk, 38 break-bulk,16 liquid bulk, 6 automotive)
- 57 maritime craft vessels (30 tugs, 9 pilot boats, 7 workboats, 3 pilot helicopters, 5 dredgers, 4 survey boats).

The financial performance of South Africa's commercial ports has shown considerable growth in the past decade, with total revenue reaching ZAR 13.3 billion in 2023 (TNPA, 2023b) up from ZAR 8.1 billion in 2011 (TNPA, 2012). Of this revenue, the Port of Durban contributed around 52%, followed by Cape Town (14%), Richards Bay (13%), Saldanha (8%), Port of Port Elisabeth and Ngqura (5% each), East London (2%) and Mossel Bay (1%). Cargo dues accounted for approximately 60% of all revenue. Moreover, ports also create employment opportunities to a range of skills in the maritime transport sector (Box 1).

Measuring the exact economic contribution of seaborne transport to South Africa remains challenging, primarily because most of the country's exports are carried by foreign-flagged vessels. The limited size of a domestic fleet of merchant ships (consisting of 4 domestic vessels) diminishes the country's control over its maritime trade and results in high external costs for maritime transport services, estimated to exceed ZAR 45 billion annually (Veitch, 2021). Moreover, the ports currently operate on average at 65% capacity, largely due to storage capacity and handling equipment constraints. However, given the substantial role of the ports to the economy, the maritime sector holds considerable potential for growth and development.

The South African government has set an ambitious objective to establish the country as a major maritime centre by 2030, as outlined by the Comprehensive Maritime Transport Policy (DOT, 2017). Achieving this status will require addressing several substantial challenges within the sector, which include expanding the domestic fleet capacity, improving port infrastructure, and increasing the competitiveness of South African shipping services at a global level. Success in these areas will be crucial for South Africa to leverage its maritime potential and secure a more influential role in international trade.

Vessel Tonnage Across South Africa's Commercial Ports

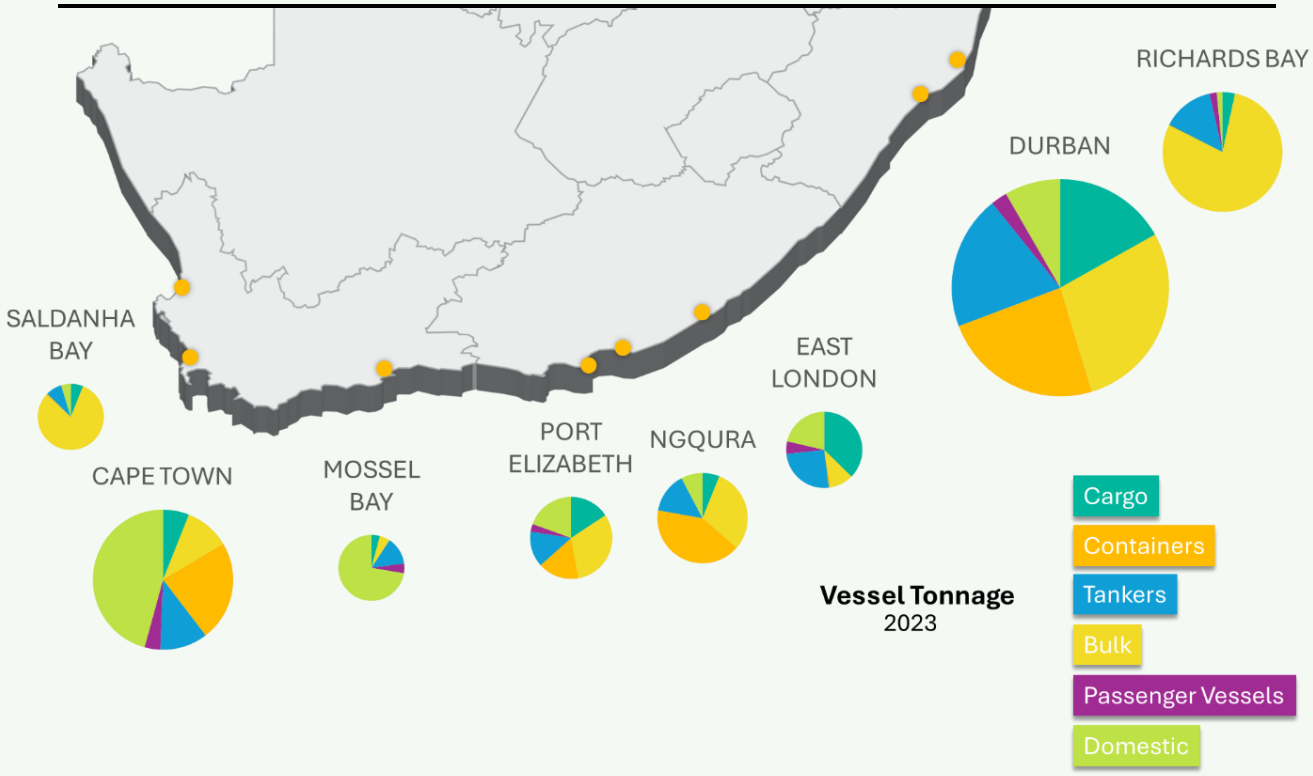

Figure 1: TNPA, 2023a

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Table 1: Overview of South African Ports

Port	Description
Durban	The busiest port in South Africa and the largest container terminal in sub-Saharan Africa, handling approximately 60% of SA's container traffic.
Cape Town	Known for its role in the export of fresh products and other goods to Europe and the Americas, it also handles significant cargo volumes and a dedicated cruise ship terminal.
Richards Bay	Primarily focused on bulk cargo, especially coal, it is one of the largest export ports in the country.
Saldanha	Specialized in handling large volumes of iron ore, it is a deep-water port capable of accommodating large vessels.
Ngqura	A relatively new port designed to handle transshipment cargo, positioned to become a key link in international shipping routes.
Port Elizabeth	Serves both general cargo and automotive exports, playing a vital role in regional trade.
East London	The only river port in South Africa, it supports automotive and bulk grain exports.
Mossel Bay	A smaller port focused on the fishing industry and offshore oil and gas services.

Challenges and Opportunities in South Africa's Maritime Transport Sector

Undoubtably, SA's maritime transport sector faces significant challenges that constrain its growth. Various reports, including the National Transport Master Plan (NATMAP) 2050 (DOT, 2011) and the more recent Department of Transport's (DOT) annual performance plan (DoT, 2024), highlight weaknesses within South Africa's port system as a primary impediment to the sector's development. These inefficiencies are reflected in the decreasing port traffic statistics as recorded by TNPA, 2023b. Moreover, the World Bank and S&P Global's 2023 container port performance assessment positioned Cape Town and Port of Ngqura as the least competitive among 405 ports worldwide (IOL News, 2024). Due to the highly interconnected nature of global shipping, the inefficiencies in one port can have a ripple effect and disrupt supply chains in trade partner countries. The primary factors contributing to the lack of competitiveness in South African ports include bottlenecks in road and rail infrastructure, significant congestion leading to prolonged waiting and discharge times, and capacity constraints that limit operational efficiency (Table 2).

Despite these challenges, South Africa's maritime sector holds substantial opportunities (Table 2). Situated along critical global trade routes, the country has the potential to expand into broader markets and accommodate larger trade volumes, provided that the existing inefficiencies are addressed. Moreover, as the global maritime defossilisation agenda unfolds, SA's maritime sector must adapt to facilitate the transition. Embracing sustainable maritime practices not only aligns with international environmental standards but provides SA with opportunity to expand business opportunities around the supply of sustainable maritime fuels. Therefore, by addressing current inefficiencies and leveraging its geographical advantage, South Africa can transform its maritime sector to be more competitive and sustainable in the global maritime market.

Table 2: Assessment of barriers and opportunities across the port system in South Africa

Barriers	Opportunities
Port inefficiencies (DFFE, 2022; DOT, 2011) owed to bottlenecks in the road and rail infrastructure, and under-investment in port infrastructure; causing - capacity constraints - port congestion - high berth occupancy rates - above average anchorage times	- Investments in port infrastructure (e.g. TNPA invests R16.1 billion to improve port efficiency in the western Cape region, specifically ports of Mossel Bay (R2.2bn), Saldanha Bay (R8.4bn) and Cape Town (R5.5bn) through CAPEX investments over the next seven-years (Comins, 2022)). - Public-Private partnerships (e.g. International container terminal services Inc. has agreed to a 25-year joint venture with Transnet Port terminals to build and modernise Durban container terminal pier 2 (Labrut, 2023)). - Digitalisation (e.g. the current e-navigation system digitally integrates and exchanges maritime information on board ships, and provides an effective way for South African ports to track and monitor vessels at sea (SAMSA, 2024)
Tax uncertainty for international shipping and regulatory constraints making it challenging to meet the global market (e.g. bunkering)	- According to Deloitte, 2024, tax incentives exist as identified in the Green Hydrogen Commercialisation Strategy report through potential levies to support the green hydrogen value chain. For example: Section 12B(1)(h) of the Income Tax Act: Deduction in respect of certain machinery, plant, implements, utensils, and articles used in farming or production of renewable energy, and Section 12K of the Income Tax Act: Exemption for the amounts accrued in respect of the disposal of any certified emission reduction credit derived in the furtherance of a qualifying clean development mechanism.
Small domestic fleet	- Expansion of a national fleet, with potential for a green fleet - Potential for transformation of intra-continental trade across Africa through the African Continental Free Trade Agreement (AfCFTA) - Operation Phakisa - key intervention including increasing the number of South African-flagged ships for the export of commodities
Green port implementation	- Implement and expand efforts under the African *Green Ports Initiative* was launched in December 2020 by the Port Management Association of Eastern and Southern Africa (PMAESA). Currently, the port of Ngqura is the only southern African port to have achieved this green status (DFFE, 2022)
Defossilisation and related costs	Global re-fleeting to comply with defossilisation targets, requires shipping companies to have a competitive registry and support from defossilisation programmes. Re-fleeting may include

	retrofitting existing vessels or developing new alternative-fuel based or battery powered vessels (UNCTAD, 2023) . - Marine-bunkering, including scope for local manufactures to produce MARPOL-compliant marine fuels (LNG, ammonia, hydrogen) for local demand and passing traffic.
Maritime skill capacity	- Job opportunities along the maritime value chain, particularly for South African seafarers and engineers

Recognising the Need for Maritime Defossilisation

Defossilisation of the maritime sector, as mandated by the IMO, will transform the market landscape, influencing costs, trade patterns, and the pace of growth within the sector. As global trade adapts to stricter environmental standards, South Africa must align its policies and practices to maintain competitiveness and compliance.

One of the pivotal changes on the horizon is the adaptation to international trade schemes, such as the European Union's Carbon Border Adjustment Mechanism (CBAM). Such mechanisms could potentially impact South Africa's export dynamics by imposing carbon costs on non-compliant trade with countries in the European Union (EU) (EU, 2021; Monaisa, 2023). This adjustment necessitates that South Africa's maritime sector is responsive and prepared for these external regulatory pressures.

Despite the country's commitment to achieving net-zero emissions by 2050, as articulated in the Department of Transport's "Green Transport Strategy for South Africa" (DOT, 2018), South Africa currently allows vessels with heavy fuel oils exceeding the international sulphur content limit of 0.5% to enter its waters, provided they are equipped with exhaust gas cleaning systems, commonly known as 'scrubbers' (SAMSA, 2020). While these scrubbers enable vessels to meet the sulphur cap, they essentially permit the continued use of non-compliant fuels within South African waters. This practice is at odds with the increasing global demand for zero-carbon shipping fuels to meet stringent defossilisation targets. South Africa's non-compliance with IMO low-sulphur fuel regulations is not intentional but rather a consequence of lacking national legislation to enforce these rules (SAMSA, pers comm). At present, there is no national regulation mandating low-sulphur fuel and no regulations to govern emission control areas (ECAs). As a signatory to the IMO, South Africa should thereby strive to adapt national legislation to enable enforcement in line with global defossilisation targets, such as compliance with low to zero-carbon fuels.

South Africa's maritime sector should adapt in tandem with the defossilisation transition, and although the country does not have a large national fleet to transform, it should focus on accommodating and facilitating the transition driven by global demand and the requirements of incoming vessels. South Africa is well-positioned to navigate these changes due to its solid legislative framework and a robust maritime policy landscape that supports future developments in the sector. As the maritime industry evolves to meet defossilisation targets, South Africa's readiness to adapt will be essential in sustaining its' role as a key player in the global maritime arena.

Legislative and Regulatory Landscape

Global Maritime Legilsation and Policy

The global maritime industry operates within a complex framework of international regulations and policies aimed at ensuring safety, environmental protection, and sustainability. Central to defossilisation is the **2015 Paris Agreement,** which sets a critical goal of achieving net-zero GHG emissions by 2050. This international treaty mandates global efforts to limit temperature increases to well below 2°C and pursue efforts to limit the increase to 1.5°C above pre-industrial levels, in order to mitigate the impacts of climate change (UNFCCC, 2015).

In line with the objectives of the Paris Agreement, several multilateral instruments govern developments the maritime sector.
These include the **United Nations Convention on the Law of the Sea (UNCLOS),** which establishes the legal framework for maritime activities; the **International Convention for the Safety of Life at Sea (SOLAS),** which focuses on vessel safety standards; and the **Marine Environment Protection Convention (MARPOL**), which specifically addresses the prevention of marine pollution and is administered by the IMO. MARPOL, in particular **Annex VI**, includes key regulatory measures for defossilising shipping.

National Maritime Legislation and Policy Relevant to Defossilisation

South Africa's maritime defossilisation policy landscape is shaped by an interplay of its maritime and climate change frameworks. Maritime policy is guided by several key documents. Firstly, **The Constitution of the Republic of South Africa (1996)** outlines the legislative responsibilities for various levels of government regarding transport and infrastructure, including maritime activities (DOT, 2024). Sections 223 and 225 of the constitution, further outlines SA's responsibilities to international agreements such as acceded to with the IMO.

This constitutional mandate is operationalized through policies such as the **Comprehensive Maritime Transport Policy (CMTP**), the **Revised White Paper on National Transport Policy**, the **Green Transport Strategy for South Africa: 2018-2050, and the National Transport Master Plan**. While the Green Transport Strategy includes maritime transport, it primarily addresses the emissions from the local marine fishing sector and disregards emissions from international vessels in South African territorial waters (DOT, 2018). However, the green transport strategy does outline taxation mechanisms that are intended to ensure environmental compliance, though these are not yet integrated and implemented into maritime policy in South Africa, creating a potential area to consider for maritime defossilisation. Current taxation measures include:

- **Fuel taxation:** Petrol, diesel and biodiesel are classified as fuel levy goods in terms of the Customs and Excise Act, No. 91 of 1964. They are therefore subject to fuel taxes and levies but are zero-rated for VAT purposes. The fuel taxes aim to ensure that the negative environmental externalities of fossil fuels are incorporated into fuel prices (DOT, 2018).
- **Carbon Taxation:** The carbon-tax in its designed form will be an additional tax to the current fuel tax regime (DOT, 2018). The carbon tax is applicable to the sectors that are required to report their greenhouse gas emissions to the Department of Forestry, Fisheries and the Environment (DFFE) under the National Atmospheric Emissions Inventory System (NAEIS). Under the current NAEIS, domestic shipping is included under water-borne navigation under energy consumption. However, foreign vessels fall outside this emission reporting scope, and by implication are exempt from carbon tax (SARS, 2023) as these are dealt with under international agreements.

The SA maritime landscape is further influenced by several legislative instruments, see DoT, 2024 for a comprehensive overview, though with regard to defossilisation it is foreseen that the following legislative Acts are of particular importance:

- **Marine Pollution Act, 1986:** To provide for the protection of the sea from pollution by oil

and other harmful substances discharged from ships. In this case, monitoring emissions from ships (domestic and foreign) should be treated similarly to monitoring oil pollution.

- **Merchant Shipping Act, 1951:** To provide for the control of merchant shipping and matters thereto.
- **SAMSA Act, 1998:** To provide for the establishment and functions of the South African Maritime Safety Authorities to undertake port state control. This may include compliance monitoring for vessel fuel standards.
- **National Ports Act 2005:** To provide for the establishment of the National Ports Authority and the Ports Regulator; to provide for the administration of certain ports by the National Ports Authority; and to provide for matters connected therewith. If an authority should set out to establish shoreside operations (e.g. refuelling infrastructure) section 56 would be appliable.
- **Economic Regulation Transport Act 2024 (ERT):** To consolidate the economic regulation of transport within a single framework and policy; to establish the Transport Economic Regulator; to establish the Transport Economic Council; to make consequential amendments to various other Acts; and to provide for related incidental matters. More specifically, S (2)(3) indicates that the ERT is only subservient to the Public Fund Management Act. Otherwise, all other transport statutes are subservient to the ERT. Therefore, the SAMSA ACT, Merchant shipping ACT and other current predominant statutes will be subject to the ERT.
- **National Environmental Management Act, 2014 (NEMA):** outlines the environmental impact assessment regulations which are necessary to obtain environmental authorisation for the development of relevant maritime-fuel infrastructure

National Climate and Energy Policy Relevant for Maritime Defossilisation

To align with global defossilisation, South Africa is governed by a suite of climate change and energy-related policies that directly impact defossilisation in the maritime sector. These include:

- **Climate Change Bill**: Facilitates the development of a climate-resilient economy, supporting the long-term shift to low-carbon activities, including domestic shipping, in its current form.
- **Carbon Tax Act 15 of 2019:** As mentioned above, carbon taxation implements pricing on GHG emissions across most sectors, incentivizing reductions and cleaner practices.
- **Low Emissions Development Strategy**: Outlines a pathway to achieving net-zero emissions by 2050, including the maritime sector's role in this transition.
- **Hydrogen Society Roadmap**: Focuses on integrating hydrogen technology into the economy to significantly lower GHG emissions. Recognises the need to reduce emissions in the transport sector through the uptake of Power-to-X fuels (DSI, 2021).
- **Green Hydrogen Commercialisation Strategy**: Devotes a subsection to "Focal export sub-markets – shipping fuel and sustainable aviation fuels" (DTIC, 2023).
- **National Energy Act**: Ensures comprehensive planning for renewable energy generation and consumption, which is vital for transitioning away from fossil fuels. This is particularly relevant for the expansion of renewable energy generation to produce green bunker fuels and Power-to-X (PtX) products.
- **National Development Plan (NDP)**: Aims to eliminate poverty and reduce inequality by 2030 while integrating goals for reducing GHG emissions. Lays out voluntary national development contributions (NDCs).
- **National Climate Change Response Policy**: Provides a strategic framework for mitigating and adapting to climate change impacts up to 2050.

South Africa's commitment to achieving net-zero emissions by 2050 requires harmonizing its maritime policies with the broader national climate frameworks. In conclusion, the legislative frameworks and strategic policies outlined here provide a robust foundation for integrating defossilisation within the maritime sector. Aligning with global and national climate objectives will not only ensure compliance but also position South Africa in the evolving IMO maritime objectives.

Maritime Stakeholders in South Africa

The defossilisation of South Africa's shipping industry is a multifaceted challenge that hinges on the effective collaboration and synergies among key stakeholders within the quadruple helix model illustrated in Figure 2. This model as adopted in South Africa through Operation Phakisa (2015) emphasizes the importance of synergies across fourprimary sectors: government, industry and finance sector, academia, and civil society. As illustrated, these stakeholders play distinct yet interconnected roles in driving the green energy transition in the maritime sector (Table 3, 4 and 5). These stakeholders are namely, government ministerial departments and the key parastatals that drive more defined mandates. Secondly is the private sector, comprising both industry and financial institutions. The industry component includes a cumulation of companies that offer various commercial services and their affiliate associations, while financial institutions provide critical funding mechanisms and incentives for green shipping initiatives. Thirdly, the education and training institutions and lastly the civil community that covers participation of traditional coastal communities and environmental groups.

Government and Parastatals

Governmental departments, particularly ministerial bodies, play a pivotal role in shaping and implementing the policy frameworks necessary for defossilisation (Table 3 and Table 4). These entities are responsible for developing regulations, allocating resources, and providing the necessary financial support and stimulus for green energy initiatives. Among the key governmental stakeholders, the ***Department of Transport*** stands out as the leading ministry driving maritime industry reforms. This department, through its parastatals such as the Transnet National Ports Authority (TNPA), oversees the strategic management and operations of all ports in South Africa. TNPA, often referred to as the "landlord" of South Africa's ports, plays a crucial role in the adoption of sustainable green practices across the maritime sector. In addition, the South African Maritime Safety Authority (SAMSA) is responsible for ensuring the safety of life and property at sea, preventing marine pollution, and promoting the maritime interests of South Africa. In this instance, SAMSA along with South African Revenue Service (SARS) regulates and approves bunkering licenses across the country which will have an impact in determining what that entails for green ammonia and or methanol licensing.

The second government stakeholder that equally shares a critical ministerial mandate is the Department of Trade, Industry and Competition (DTIC), which instituted the Green Hydrogen Commercialisation Strategy for South Africa (Table 3). In addition, trade agreements that incentivise traffic through South African Ports and corridors rest with the mandate of the DTIC. The mandate of the DTIC further extends to the Special Economic Zones (SEZ), which have the developmental capacity and initiatives to enable Green Hydrogen production. The SEZ are mandated through the SEZ Act No. 16 of 2014. The advantage of these areas is key and strategic to enable business opportunities through tax incentives for businesses operating within the SEZs making them ideal custodians of off-taking GH_2 production. For example, SEZs operate at reduced corporate income tax rates (15% compared to the national rate of 28%) for companies located within SEZs (DTIC, 2024).

Export focus of these SEZs are noted as follows:

- Automotive Manufacturing: SEZs like the Coega Development Corporation have attracted global automotive manufacturers like Volkswagen, producing vehicles for export to international markets. Whilst East London Industrial Development Zone (IDZ) similarly has Mercedes Benz as its main industrial player.
- Metals and Minerals Beneficiation: Given South Africa's natural resource wealth, SEZs

focus on the beneficiation of raw materials (e.g., refining and processing) to export of higher-value products. For example, Freeport Saldanha (previously the Saldanha Bay Industrial Development Zone) serves as the primary oil, gas and Marine Repair engineering and logistics services complex in Africa, servicing the needs of the upstream Oil Exploration Industry and Production service companies operating in the oil and gas fields off Sub-Saharan Africa.

- Agro-processing: SEZs such as Dube Trade Port near Durban, focus on food processing and agriculture-related industries for export, capitalizing on South Africa's agricultural sector (DTIC, 2024).

It cannot be overstated the significant role that the SEZs in the primary commercial ports continue to play in driving for alternative fuels production and export with an emphasis of green hydrogen being undertaken through a tripartite strategic collaboration amongst, Freeport Saldanha, Northern Cape and the COEGA IDZ.

Industry and Finance

The industry sector comprises a diverse range of companies providing commercial services within the maritime space, alongside their respective trade associations (

Table **5**). These organisations are critical in implementing technological innovations and operational practices that contribute to reducing carbon emissions. This includes maritime shipping companies—companies like Vuka Marine, international shipping lines operating in South African waters, shipyards, bunkering operators, and cargo owners, all of whom play key roles in the maritime value chain. The industry's role in defossilisation is amplified by its ability to leverage market-driven solutions, such as investing in alternative fuels, improving energy efficiency in vessels, and adopting cleaner technologies. Wind and solar energy producers are key stakeholders in the production of renewable power and GH_2. Producers of electricity required in the production of green hydrogen include Solar plants and wind farms such as Jeffreys Bay Wind Farm which produces 138 MW. Companies such as HIVE in COEGA ensure the facilitation of infrastructure of wind farms in areas such as the Eastern Cape.

Working alongside industry, the financial sector includes a wide range of institutions providing funding and investment services essential to maritime decarbonisation (Table 5). These organisations are instrumental in mobilising capital and creating financial mechanisms that enable the transition to low-carbon shipping. This includes commercial banks such as Standard Bank and Nedbank, development finance institutions like the Development Bank of South Africa (DBSA) and Industrial Development Corporation (IDC), investment funds, and specialised maritime finance providers, all of whom serve crucial functions in the green shipping finance ecosystem. Financial stakeholders can drive decarbonisation initiatives by allocating funds, providing incentives, and integrating sustainability criteria into investment decisions. The financial sector's contribution to decarbonisation is strengthened by its ability to develop innovative funding solutions, such as green bonds, sustainability-linked loans, and blended finance instruments that address the higher upfront costs of cleaner technologies. Climate finance institutions and international funds are also significant stakeholders in channeling investment towards maritime sustainability projects. Providers of capital for low-carbon infrastructure include entities such as the Green Climate Fund which supports climate action in developing countries. Organisations such as the African Development Bank are facilitating access to sustainable finance mechanisms in regions like Southern Africa where significant port and shipping infrastructure investments are needed.

Education and Training Institutions

Education and training institutions are instrumental in advancing defossilisation through research, innovation, and the development of a skilled workforce (

Table **5**). These institutions should contribute by conducting research on green technologies, offering specialised training programs, and fostering innovation in maritime operations. Their role is vital in ensuring that the industry is equipped with the knowledge and

skills required to transition towards more sustainable practices.

Civil Society

Civil society, encompassing traditional coastal leadership and environmental groups, plays a critical role in advocating for sustainable practices and holding other stakeholders accountable. These groups are essential in raising awareness, promoting community involvement, and ensuring that environmental considerations are integrated into maritime policies and operations. In line with the *Just Transition* mandate, contribution and feedback from these stakeholders is critical to ensure a constitutional imperative for transition. Their engagement ensures that the defossilisation process is inclusive and reflective of the broader societal and environmental interests.

Interconnected Roles and Responsibilities

While each of these stakeholders has a primary role in the defossilisation process, their responsibilities often overlap, as depicted in Table 3,Table 4 and

Table **5**. For instance, government bodies not only set policies but also collaborate with industry and academic institutions to drive innovation and ensure that policies are effectively implemented. Similarly, industry players may work closely with academic institutions to develop new technologies, while also engaging with civil society to address social and environmental concerns. Meanwhile, financial institutions play a cross-cutting role by providing necessary capital to industry for green transition through targeted funding mechanisms developed with government input.

Defossilisation of South Africa's shipping industry is a complex endeavour that requires a coordinated approach across the quadruple helix of stakeholders. Governmental departments, with their mandate to develop and enforce policies, are at the forefront of this transition, supported by the vital contributions of industry and financial institutions, academia, and civil society. Together, these stakeholders can ensure that the maritime sector in South Africa evolves towards a sustainable future, aligning with global efforts to combat climate change and reduce carbon emissions.

Stakeholder map of key players involved in maritime defossilisation in South Africa

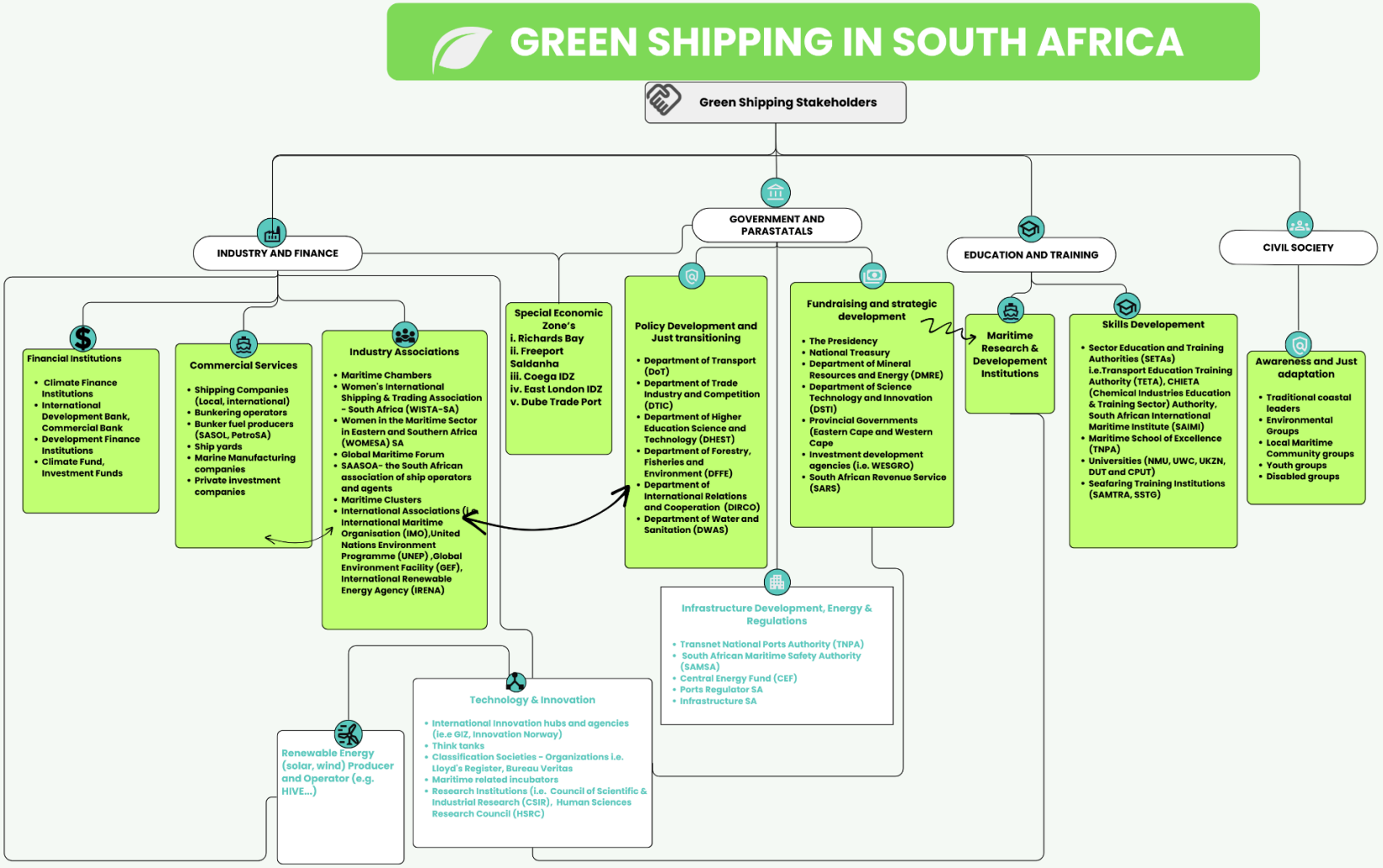

Figure 2. Own Illustration

Table 3: Government Stakeholders Impact Analysis

Stakeholder name	Impact *how much does the topic impact them? (low, medium, high)*	Influence *how much influence do they have over the process? (low, medium, high)*	Stakeholder mandate primal (p)and secondary (s)	National policy directive	Potential factors that could hinder or delay the process if not addressed	Suggested approach to support the process
Department of Transport (DoT)	High	High	Policy development (p) Finance investment (s)	Comprehensive Maritime Transport Policy (CMTP)	Gaps in implementation of supportive policies and enforcement mechanisms	Drive sustainable maritime shipping towards green energy through comprehensive policy development, including a phased implementation roadmap with clear 2030 milestones and strengthened inter-ministerial coordination mechanisms
Department of Trade, Industry and Competition (DTIC)	High	High	Finance and investment and policy directives (p) technology and innovation (s)	Green Hydrogen Commercialisation Strategy for South Africa (GHCS) Customs and Excise Act 91 of 1964	Need for implementation of a long-term strategy to comply and adjust with international standards and regulations	Facilitate implementation of a multi-stakeholder Green Hydrogen Commercialisation Strategy through regular working group meetings, supported by export facilitation mechanisms and matched funding programs for

						demonstration projects
Department of Science, Technology and Innovation (DSTI)	High	Medium	Technology and innovation (p) investment (s)		Insufficient long-term research funding and strategic planning	Advance research and development in green technologies by establishing a dedicated fund, creating technology transfer offices at major ports, and supporting demonstration projects
Department of Higher Education, Science and Technology (DHEST)	Medium	Medium	Skills development and research (p), Technology and innovation (s)	National Skills Framework	Curriculum gaps in emerging green energy competencies	Transform skills development for green energy transition through a national maritime program targeting workers, complemented by Centers of Excellence at universities
The Presidency	High	Medium	Finance and investment (p) Policy development (s)	National Development Plan (Vision 2030) Carbon Tax Act 2019	Limited integration of green shipping priorities in national planning	Include in National Budget Plans green energy agenda
Department of Forestry Fisheries and Environment (DFFE)	Medium	Medium	Just Transition (p)	Paris Agreement 2015 Ratifications	Incomplete regulatory policy framework for the alternative marine fuel adoption such	Facilitate environmental management of

					aszero and near-zero GHG fuels	resources utilised for GH_2 production
Department of Mineral Resources and Energy (DMRE)	High	High	Policy development (p) Energy infrastructure regulation (s)	Integrated Resource Plan (IRP), Green Hydrogen Commercialisation Strategy for South Africa (GHCS)	Higher priority towards fossil fuel, regulatory framework gaps for adoption of alternative marine fuels	Develop specific maritime alternative fuels framework aligned with national hydrogen strategy
Department of International Relations and Cooperation (DIRCO)	Medium	Medium	International climate diplomacy (p), trade facilitation (s)	Foreign Policy Framework Africa Continental Free Trade Area implementation	Misalignment between international commitments and domestic implementation, Limited maritime-specific expertise	Establish dedicated liaison for IMO and maritime climate negotiations
Department of Water and Sanitation (DWAS)	Medium	Medium	Water resource management (p) Port water quality monitoring (s) Marine pollution prevention (s)	National Water Resource Strategy	Limited focus on maritime-specific water issues, Coordination gaps with other maritime agencies	Develop specific maritime water quality standards for green shipping
Provincial Governments (Western Cape, Eastern Cape Government)	High	Medium	Local economic development (p), Environmental management (s)	Provincial Growth and Development Strategies, Coastal Management Programmes	Varying levels of capacity and resources across provinces, Competition rather than collaboration between port cities	Establish Provincial Maritime Defossilisation Committees with harmonized incentives

Table 4: Parastatals Stakeholders Impact Analysis

Stakeholder name	Impact *how much does the topic impact them? (low, medium, high)*	Influence *how much influence do they have over the process? (low, medium, high)*	Stakeholder Mandate Primal (p)and Secondary (s)	National Policy Directive	Potential Factors that could hinder or delay the Process if not addressed	Suggested Approach to support the Process
Transnet National Ports Authority (TNPA)	*High*	*High*	Infrastructure development (p)	Department of Transport	Long term Infrastructure planning of ports not sufficiently aligned with IMO green transition timelines to accommodate future demand of vessels.	Port Infrastructure Development plan adapted to green shipping through incentives
South African Maritime Safety Authority (SAMSA)	*High*	High	Regulations and Policy (p)	Department of Transport	Regulatory framework gaps for green fuel standards and operations	Regulate bunkering operations that enable green fuels within SA, complemented by certification programs and robust inspection procedures
Port Regulators South Africa	Medium	Medium	Infrastructure development	Department of Transport	Limited integration of sustainability criteria in port investment decisions	Enable development of climate-smart ports through an integrated approach combing green certification systems, emissions monitoring infrastructure, and performance-based benchmarks (MRV obligations)

Central Energy Fund (CEF)	*High*	*High*	Energy investment and infrastructure (p), Renewable energy (s)	Department of Mineral Resources & Energy	Delayed transition away from fossil energy portfolio; investment uncertainty emerging green fuels	Green shipping investment facility; support infrastructure for green hydrogen and PtX fuels at strategic ports
Infrastructure SA	*Medium*	*High*	Infrastructure coordination and planning (p) Strategic infrastructure prioritisation (s)	The Presidency	Insufficient integration of defossilisation requirements in infrastructure planning	Prioritize green shipping infrastructure in national strategic infrastructure planning and investment coordination

Table 5:Industry, Finance and other Stakeholders Impact Analysis

Stakeholder name	**Impact** ***how much does the topic impact them? (low, medium, high)***	**Influence** ***how much influence do they have over the process? (low, medium, high)***	**Stakeholder Mandate Primal (p)and Secondary (s)**	**National Policy Directive**	**Potential Factors that could hinder the Process**	**Suggested Approach to support the Process**
Local Shipping Companies (e.g. Vuka Marine, Ocean Africa Container Lines…)	*High*	*High*	Transition to green fuels ships (p), Supporting South African maritime sovereignty (s)	IMO, EU ETS UNICLOS, MARPOL AfCTA, SAMSA regulations Operation Phakisa commitments	Limited capital for technology investments, Higher per-vessel transition costs, Potential competitive disadvantage	Investment and support adoption of green fuels through grants and subsidies
International Shipping Companies (e.g. Maersk, MSC, CMA CGM…)	*High*	*High*	Fleet modernisation across multiple markets (p),	IMO, EU ETS, FuelEU Maritime, UNICLOS, MARPOL	Uneven global regulatory landscape, Uncertainty in South	Coordinate international green corridor initiatives

			Compliance with varied international regulations (s)	AfCTA	African bunkering infrastructure, Route adjustments to avoid stringent markets	with South African ports and incentivize early adoption of alternative fuels in regional operations
Shipyards	*High*	*Medium*	Construction of green ships (p) Retrofitting existing vessels (p) Technical innovation (s)	ISO 14001, ISO 9001 Classification society standards, IMO regulations for shipbuilding	Insufficient technical capacity for new technologies, High investment costs for facility adaptation	Develop technical capacity and skills for green ship construction and retrofitting
Cargo Owners (shippers)	*High*	*High*	Procurement of shipping services (p), Supply chain management (p), Corporate sustainability goals (s)	Corporate ESG standards, ISO 14064 (Carbon footprinting), Science-Based Targets initiative	Resistance to higher shipping costs, Lack of awareness of maritime emissions impact	Create incentives and recognition for cargo owners choosing green shipping options
Bunkering operators	*High*	*High*	Buy and Sell Alternative Fuels (p)	IMO, UNICLOS MARPOL, AfCTA	Resource mobilisation and infrastructure to produce alternative fuel	Tax incentives and regulatory support
Special Economic Zones (SEZ)	*High*	*High*	Technology and Innovation (p) Research and Development (p) Infrastructure development (s) Investment and Finance (s)	Department of Trade, Industry and Competition	Insufficient integration of green energy initiatives in SEZ strategic planning	Leverage SEZ capabilities to accelerate Green Hydrogen Strategy Implementation and Drive Industrial Participation

Financial Institutions	*High*	*High*	Financing green shipping projects (p), Risk assessment (p), ESG investment criteria (s)	Climate Bonds Initiative	Insufficient understanding of maritime decarbonisation technologies, Risk aversion toward new technologies	Develop specialised green shipping financial products and knowledge sharing platforms
Renewable Energy Producer and Operator	*High*	*High*	Production of renewable energy for alternative marine fuels (p) Development of energy infrastructure supporting maritime decarbonisation (s)	Paris Agreement climate targets, Renewable Energy Independent Power Producer Procurement Programme (REIPPPP), Green hydrogen certification schemes, ISO 14001, ISO 50001	Uncertain demand during transition period, Grid connection and transmission constraints, Policy and regulatory uncertainty for renewable energy developments, Competition for land and resources near port areas	Create dedicated renewable energy capacity for maritime fuel production through power purchase agreements and develop strategic partnerships between energy producers and maritime sector stakeholders
Higher Education Instituitions and Researchers	*High*	Medium	Skills development (p) Research and Innovation (p)	IMO	Skills development gaps and limited capacity for green fuel technology training	Build research capacity for green shipping through specialized MSc programs at universities, and providing annual research grants
Industry Associations	Medium	Medium	Skills support and Advisory (p)	IMO	Misalignment between current industry members priorities and	Drive knowledge sharing and industry transformation

			Employment support (s)		emerging green shipping requirements	through green certification schemes, monthly best-practice forums, and peer networks
International Governmental Organisations (such as UNEP,IMO…)	High	High	Setting global maritime regulations and environmental standards (p), Facilitating international cooperation on maritime decarbonisation (s)	IMO GHG Strategy 2023 (net-zero by 2050), Paris Agreement climate targets, UN Sustainable Development Goals, MARPOL Convention	Uneven implementation of global standards across regions, Competing priorities among member states delaying action, Limited enforcement mechanisms for compliance	Strengthen South Africa's representation and active participation in international maritime forums while domestically adopting international standards through coordinated national implementation plans
Environmental Groups	*High*	Medium	Environmental support (p) Accountability to ensure transition (p) Just Transition (p)	Paris Agreement 2015 ratifications	Limited coordination between environmental advocacy and maritime policy development	Ensure just transition through community-centered impact assessments, transparent emissions monitoring, and inclusive regular stakeholder dialogues
Maritime Labour Unions	*High*	Medium	Worker representation (p) Skills development advocacy (p) Health and safety standards (s)	ILO Maritime Labour Convention, ITF standards, Maritime Labour Convention 2006	Resistance to job changes or skill adaptation requirements, Inadequate training programs for green technologies	Partner on comprehensive skills development programs for green shipping technologies

Traditional coastal communities/leaders	Medium	Medium	Community representation and advocacy (p) Cultural and environmental stewardship of coastal areas (p) Local economic development and livelihoods protection (s)	UN Declaration on the Rights of Indigenous Peoples, South African Traditional Leadership and Governance Framework Act	Exclusion from maritime decision-making processes, Loss of traditional livelihoods during transition, Unequal distribution of benefits from maritime defossilisation	Establish formal consultation mechanisms between maritime authorities and traditional leadership structures while creating specific opportunities for coastal communities in the green maritime economy

ASSESSMENT OF SOUTH AFRICAS MARITIME TRAFFIC AND TRADE ACROSS PORTS

This desktop study foccusses on how South Africa's economy is linked to global markets through the maritime transport sector. This includes assessing the role of South Africa's ports on the economy and employment landscape, identifying challenges and opportunities for development, mapping out key stakeholders to lead the defossilisation agenda and to evaluate the impacts of changes in regional policy on the maritime landscape. The following chapter analyses vessel arrivals, emissions, and trade dynamics.

GREEN HYDROGEN SOUTH AFRICA
International PtX Hub
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Federal Ministry for Economic Affairs and Energy
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IKI INTERNATIONAL CLIMATE INITIATIVE
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Maritime Traffic and Trade Across SA Ports

To facilitate the assessment of maritime defossilisation in South Africa, this section analyses vessel arrivals, emissions, and trade dynamics to better understand the status of ship traffic and how these factors interact and evolve over time (Figure 3). This analysis will also provide insights into the sector's operational trends, which will support the development of policy recommendations.

Figure 3 outlines the analysis boundary that was relevant to the assessment of maritime defossilisation in SA forthis analysis. The boundary thereby considers ship traffic across different ports and by different vessel categories. This is necessary to quantify the emissions from vessel arrivals. An overview of vessel arrivals further provides an overview of energy demand and fuel consumption across SA ports and how this demand can be met through the provision of alternative sustainable fuels. Lastly, the assessment provides an overview of the trade dynamics in SA, providing insights into the trends in exports and imports, across trade partner countries, the types of goods traded and how these products are affected by regional trade policies.

Key dynamics related to maritime defossilisation in South Africa

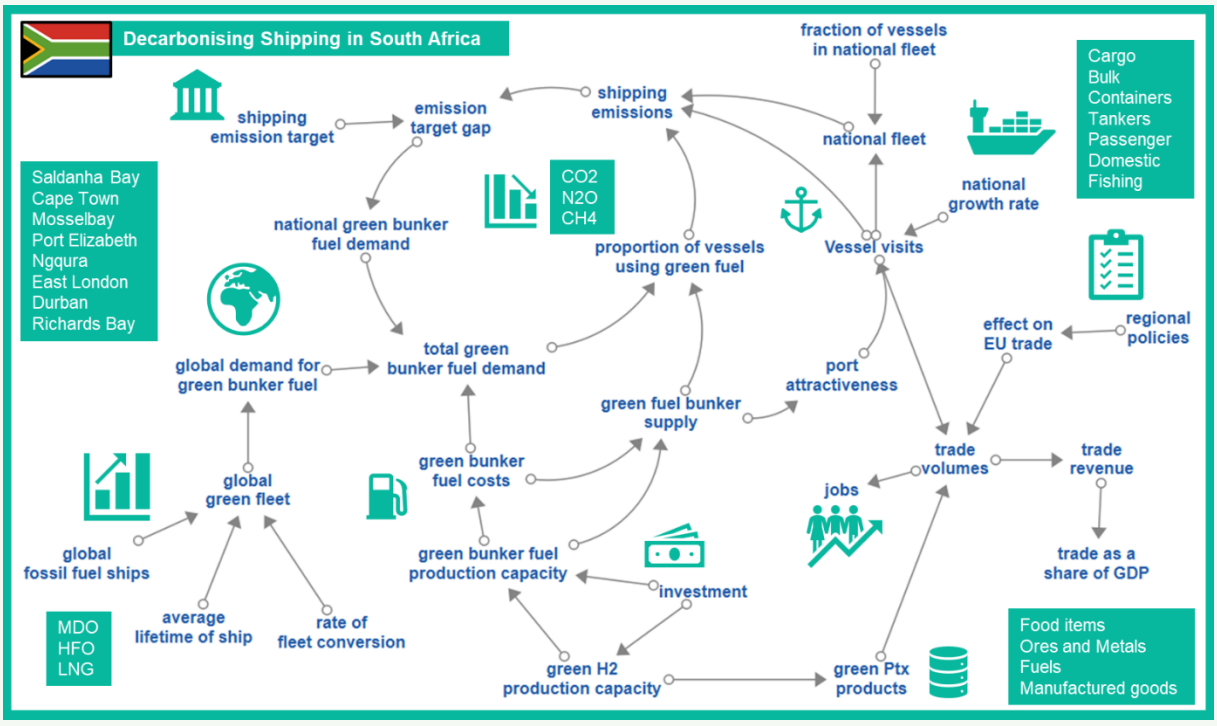

Figure 3: Own Illustration

GREEN HYDROGEN SOUTH AFRICA
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Assessment of Vessel Traffic

The following section aims to investigate vessel traffic across commercial ports in SA. Data on vessel movements and arrivals is collected annually and recorded for the eight commercial ports (Richards Bay, Durban, East London, Ngqura, Port Elizabeth, Mossel Bay, Cape Town and Saldanha Bay) by Transnet National Ports Authority. Figure 4 gives an overview of the annual vessel arrivals by port during periods of data availability (2016 - 2023) (TNPA, 2023a). Most recent data shows that a total of 8,970 vessels arrived in SA during 2023, with the most arrivals received at the port of Durban (2,933), followed by Cape Town (1,823), Richards Bay (1,397), Port Elizabeth (948), Ngqura (675), Saldanha Bay (594), Mossel Bay (314) and East London (281).

Further analysis shows the disaggregation of vessel arrivals between different vessel categories split between international (ocean-going) arrivals and domestic (coastwise) arrivals (Figure 4), the former consisting of the largest share ~82% versus 18% domestic arrivals during 2023. Figure 4 further shows that the most international vessel arrivals consisted of bulk carriers (3,158), followed by containers (1,563), tankers (1,373), cargo (995) and lastly passenger (cruise) vessels (223). A total of 1,653 domestic vessels are recorded in 2023, including port service vessels, barge, yachts, naval vessels and other categories. Figure 5 further depicts the categories of vessels received across the different ports, showing that most bulk vessel arrivals are received at the port of Durban, Richards Bay and Saldanha Bay, and with the major container traffic passing through the ports of Durban and Cape Town.

Moreover, the data shows a decrease in vessel arrivals over the recorded period, with a total of 11,199 recorded in 2016, with 2,234 more arrivals relative to 2023 (Figure 4). While it has been suggested that fewer vessel arrivals correspond with an increased tonnage, as recorded in global data sets (UNCTAD, 2023), this distribution is not reflected by national data, rather suggesting a decrease in tonnage in overall port arrivals, as verified by the negative growth rate in vessel arrivals. This may well be the resultant impacts from port inefficiencies (Table 2), further hampered by impacts from the COVID-19 pandemic. Notwithstanding, the trend in vessel arrivals show growth of 1.6% between 2022-2023, evident of recovery (Figure 4).

Total vessel arrivals by port (left) and vessel type (right) across South African commercial ports. Missing data interpolated for 2017 and 2019.

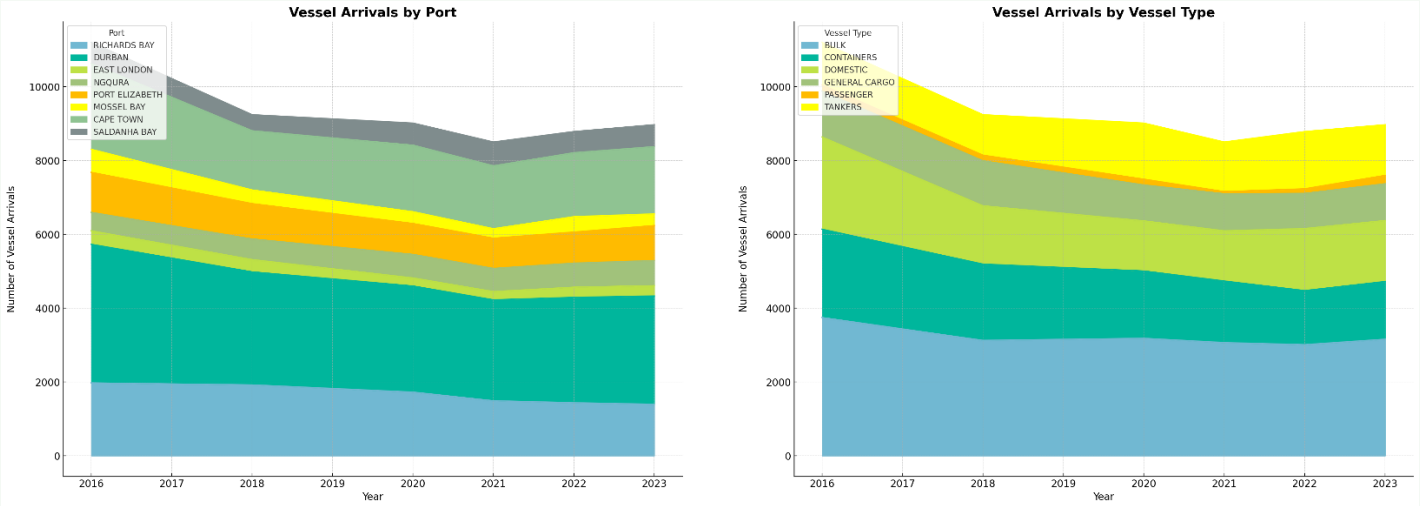

Figure 4: TNPA, 2023a

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Overview of vessel arrivals by port and vessel type for 2023

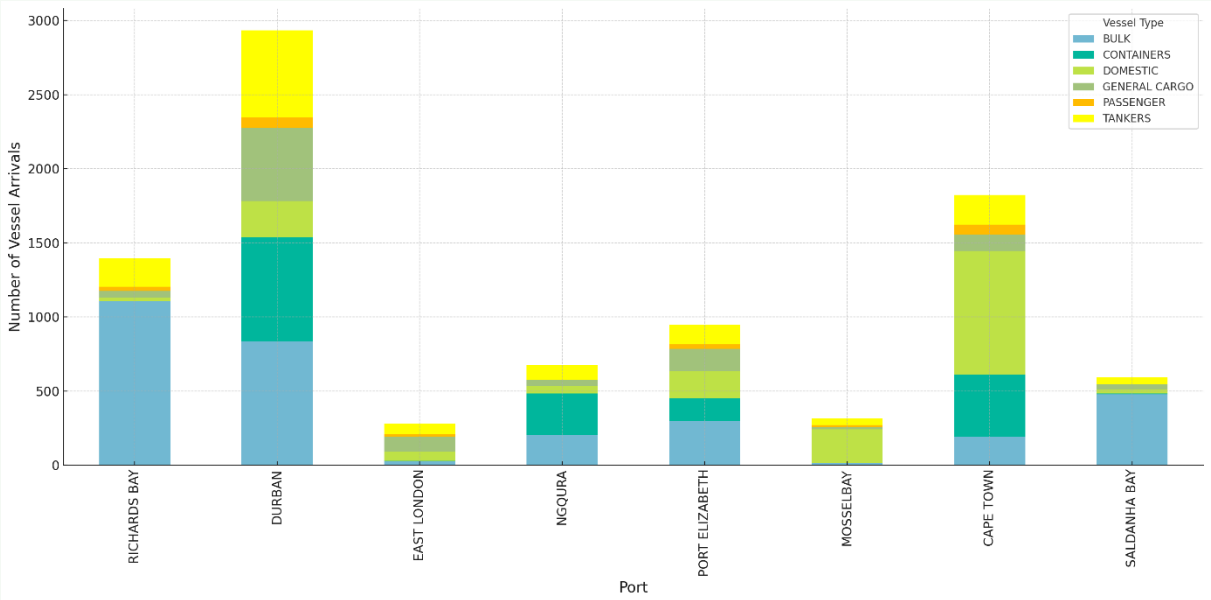

Figure 5: TNPA, 2023a

Assessment of Emissions

Using the data and information based on ship traffic, the following section focuses on the estimation of emissions from shipping, using methodology as graphically represented in Appendix A. Data and Assumptions. Using the available data and guidelines from the 'Fourth IMO Greenhouse Gas study' (IMO, 2020), a bottom-up, vessel type-based approach was adopted to estimate fuel consumption and emissions. To calculate energy demand and fuel consumption, data on vessel arrivals was disaggregated by vessel category and size distribution and mapped with corresponding fuel consumption estimates (Appendix A. Data and Assumptions). The time spent in SA's Economic Exclusive Zone (EEZ) was additionally calculated and factored into the calculation. The analysis further incorporates different types of fuels, predominantly used by the global fleet, consisting largely of Heavy Fuel Oil (HFO), Marine Diesel Oil (MDO), and a smaller fraction of Liquefied Natural Gas (LNG), while factoring in growth in low-zero-carbon fuels as the energy transition evolves. Lastly, to calculate the total GHG emissions, the emission factors for three main pollutants are included, specifically Carbon Dioxide (CO_2), Nitrous Oxide (N_2O) and Methane (CH_4) and aggregated according to the global-warming potential over a 100-year horizon (GWP100) (IMO, 2024).

Figure 6 illustrates the total GHG emissions in (CO_2 equivalent tons) across all vessel categories and ports from 2016 - 2023. Based on the assumptions, the total emissions are approximately 10 million tonnes based on vessel arrivals and departures in 2023. International vessel categories contribute approximately 97% of emissions, with domestic only contributing 3% (~302 000 tons CO_{2eq}) in 2023. Figure 7 further disaggregates the emissions profile by port and vessel category, showing the majority of the emissions are contributed by the large vessel categories, predominantly, bulk carriers (~3,76Mt), cargo (~2.6Mt) and containers (~2.12Mt), with the highest emissions estimated for the port of Durban (~3.5Mt), Cape Town (~1.4Mt), Saldanha Bay (1.3Mt) and Richards Bay (~1Mt) for the year 2023. The emission profiles across ports shows slight temporal variability, with most reduction in emissions during 2020-2021 corresponding to global pandemic, specifically for the ports of East London and Mossel bay, and for the passenger vessel category (Figure 7).

Total emissions for vessel arrivals and departures across commercial ports and vessel categories

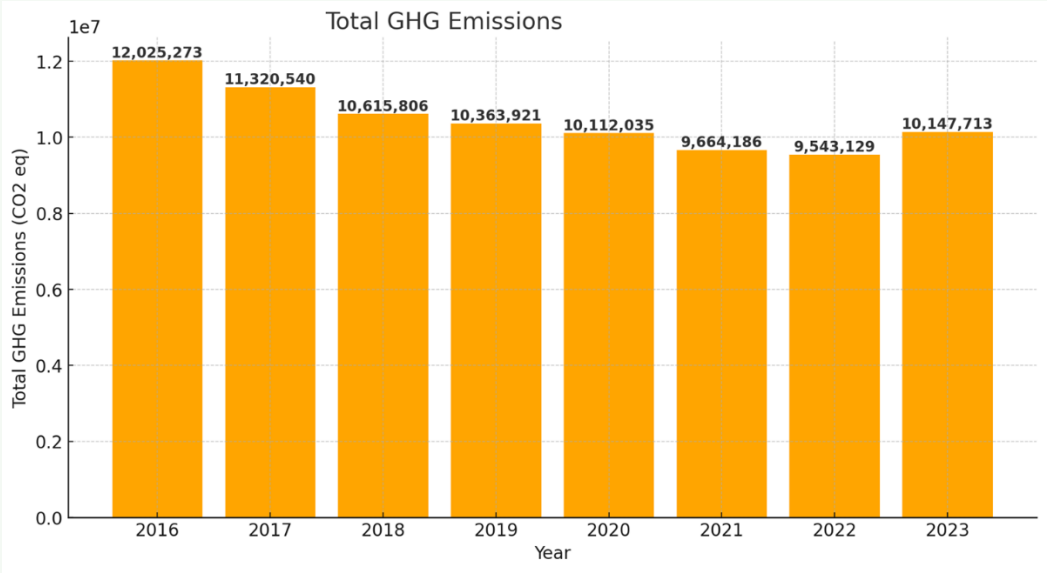

Figure 6: Own calculations

To place the emission results into perspective, it was essential to compare the results to estimates across global and national assessments. Globally, shipping emissions, which include carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) expressed in CO_{2eq}, increased from 977 million tonnes in 2012 to 1,076 million tonnes in 2018, marking a 9.6% increase (IMO, 2020). It has been mentioned that SA contributes approximately 1% of global seaborne trade (DOT, 2017), and if this translates to shipping emissions, this would be in an order of 10Mt CO_{2eq} contribution to global shipping emissions.

At a national scale, SA's total gross GHG emissions, which exclude CO_2 sinks from forestry and land use, ranged around 541 million tonnes CO_{2eq} annually between 2015 and 2017 (RSA, 2020; Stevens, 2021). The country aims to reduce these emissions to 510 million tonnes CO_{2eq} by 2025 and between 398 to 440 million tonnes CO_{2eq} by 2030 (RSA, 2020). According to South Africa's national GHG inventory (Stevens, 2021), the country only accounts for domestic maritime emissions in its national inventory, classifying them under transport within the energy sector. In 2017, domestic water-borne navigation contributed 356 $ktCO_{2eq}$, in line with the current estimate of ~300kt in 2023, while international bunkers accounted for 6,634 kt CO_{2eq}, with an additional 1,674kt from international waterborne transport (Stevens, 2021, p117).

Another analysis from Abhold & Shaw (2022) reveals that internationally departing vessels generated the largest quantities of CO_{2eq} for South Africa in 2018, totalling 11,733 kt, with international arrivals contributing 10,192 kt CO_{2eq}. In summary, the aggregation of all maritime activities in 2018—encompassing emissions to, from, and within South Africa—amounts to 22,713 kt CO_{2eq} (approximately 23 million tonnes). The most polluting ship types for South Africa were bulk carriers, container ships, and oil tankers, collectively responsible for an average of 76.8% of the 2018 GHG emissions. Domestic navigation GHG emissions represented about 5.7% and 6.5% of the total CO_{2eq} generated by international departures and arrivals, respectively. Though these emissions estimates appear much higher, this approach applied a voyage-based considering emissions along the entire voyage, form the port of SA to the port of arrival, whereas the vessel-based approach in this analysis only considers the emissions from international vessels while in SA waters. In the absence of data, the current analysis additionally excludes the contribution of emissions from vessels passing by our EEZ, without calling ports. Abhold and Shaw, 2022, further suggest that the total GHG emissions within South Africa's Exclusive Economic Zone (EEZ) are estimated at around

11,516 kt CO_{2eq}, which is comparable to the emissions from international departures. These results show that the emissions estimates are vastly dependent on the data and assumptions used for the calculations, but that comparisons across assessments can support in establishing appropriate boundaries to develop policy to better monitor, control and manage emissions from the maritime sector.

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Emissions profile for SA commercial ports from 2016-2023 by vessel category

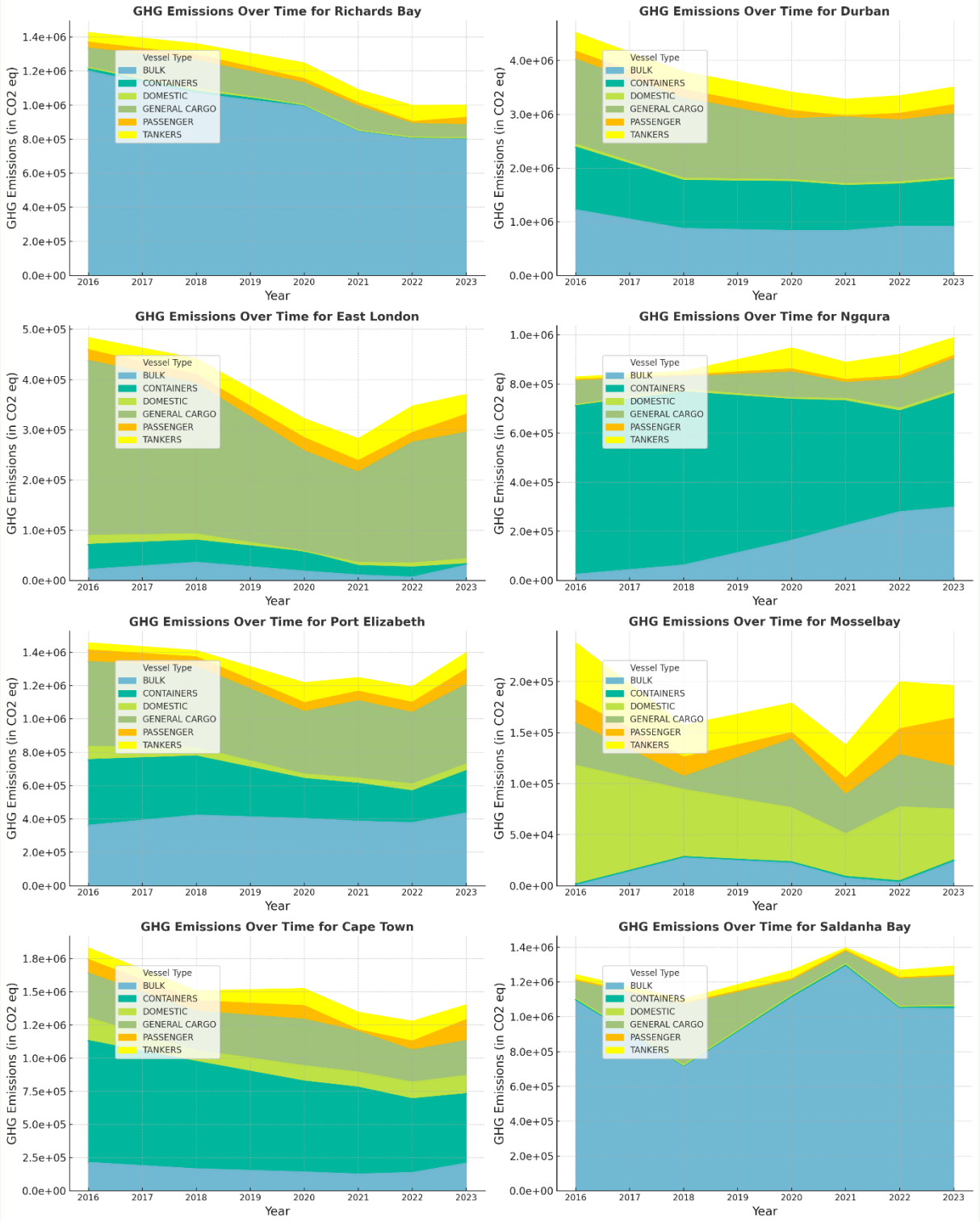

Figure 7: Own calculations

Assessment of Freight

Maritime defossilisation is crucial not only for reducing emissions associated with the global transport of goods but also for addressing the carbon intensity of imported and exported products. Emerging trade regulations, such as the European Union's Carbon Border Adjustment Mechanism (CBAM) and the Fuel EU policy, are likely to impose stricter controls on traded goods and carbon emissions, potentially impacting trade routes and the export of goods from SA.

Trade plays a substantial role in SA's economy. Figure 8 illustrates the total value of exports and imports across SA ports since 2010. Durban, being the busiest port in SA region, not to mention the busiest container port in Africa, also contributes the most in terms of trade value. In terms of total import value, the port of Durban, facilitated ~1 trillion ZAR of trade in 2023 alone, followed by Port of Cape Town (~ 180 billion ZAR), Port Elizabeth (~ 127 billion) with East London, Richards Bay, Mossel Bay and Saldanha Bay contributing around and below R50 billion in 2023. In terms of export value, Durban remains the largest port (307 billion ZAR), though Richards Bay (214 billion) and Saldanha Bay (132 billion) present a larger share of the value compared to imports, followed by, Cape Town (126 billion), Port Elizabeth (112 billion), East London (60 billion) and Mossel Bay (46 billion) (Figure 8). In total, SA's yearly exports were valued at ZAR1.96 trillion and imports at ZAR 1.97 trillion, indicating a trade deficit in 2023.

Further analysis of the data revealed that the top 5 exports by product in 2022 (in absence of commodity product data for 2023) consisted of Gold (15.4%), Platinum (13%), Coal Briquettes (8.7%), Cars (4.7%), and Iron ore (3.3%). In contrast, total imports consisted of refined petroleum (15.2%), Cars (4.1%), Crude Petroleum (3.8%), Motor vehicle components (3.3%) and Gold (2%), followed by other commodity groups including chemical products, metals, textiles, animal products, foodstuffs and more.

In terms of global trade, South Africa's main trade partner for exports is largely Asia (China, India and Japan), followed by Europe (Germany, United Kingdom, Netherlands), North America (USA), Africa (Mozambique, Namibia, Zambia), with smaller partners including Australia and Brazil. At an inter-regional level, trade patterns vary across the ports (Figure 9), though majority of trade to Asia occurs through the Port of Durban, Richards Bay and Saldanha Bay, with a significant contribution of trade flowing to Europe from each port (Figure 9).

Total exports (orange) and import value (blue) (ZAR) across South Africa's main ports from 2010-2023

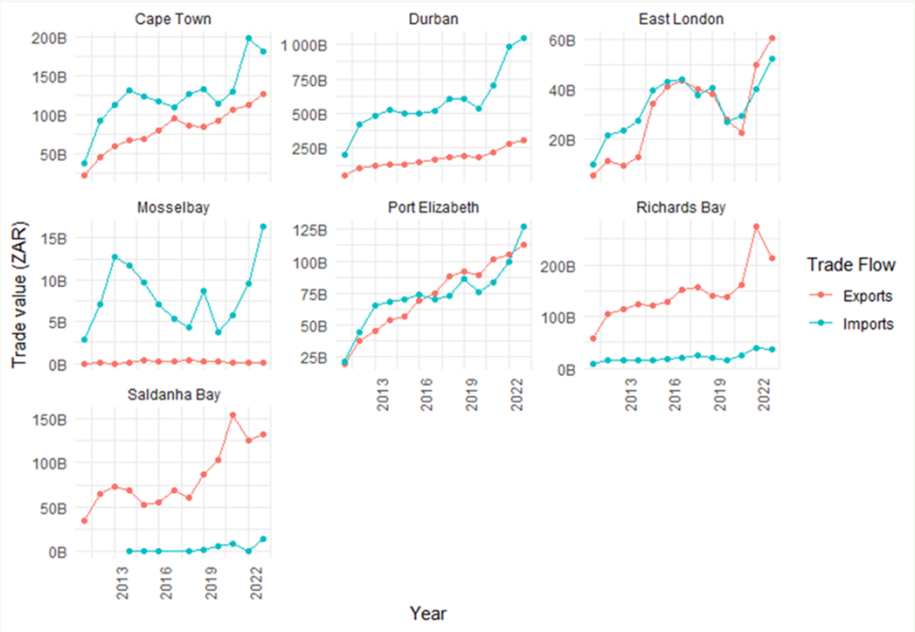

Figure 8: OEC, 2024

Total export value by port and trading partner for the year 2023

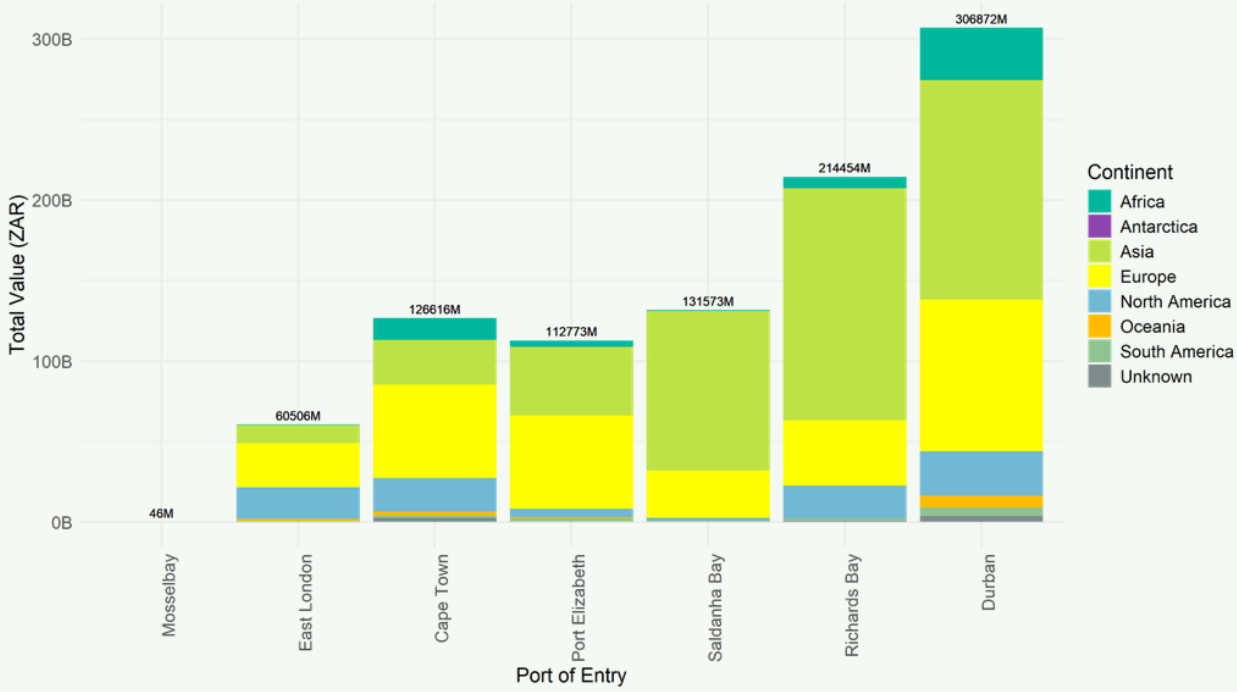

Figure 9: OEC, 2024

Commodities Under Regional Policy Regimes

Effects of Regional Policies on Maritime Trade in SA

Regional policy regimes shape the global maritime trade landscape. Within the context of maritime defossilisation, four key internationaltrade agreements, namely, the African Continental Free Trade Area (AfCFTA)(AU, 2023), amongst other recent policies adopted by the European Union (EU) including FuelEU (EU, 2023), the EU Emissions Trading System (ETS), and the Carbon Border Adjustment Mechanism (CBAM) (EU, 2021) were reviewed.

While the AfCFTA agreement, in its current form, does not directly address defossilisation instruments, it serves as an entry point to develop multi-lateral agreements across the African continent (Table 6). Whereas the EU's policies on FuelEU Maritime, the ETS, and the CBAM are interconnected in their overarching goal to reduce carbon emissions and combat climate change, though targeting different aspects of emissions through distinct mechanisms (Table 6). The FuelEU Maritime policy specifically sets fuel standards, the EU ETS uses a cap-and-trade system, and CBAM applies a carbon price on carbon-intensive imports.

With regard to national maritime trade, these regional policies pose both implications and opportunities. Based on the 2023 trade data, export value with African countries grew from 15 billion ZAR in 2011 to 58 billion ZAR in 2023, representing a total export value ranging between 8-6% respectively (OEC, 2024). Over the past decade this percentage share of export value to African countries has varied between 5-9%, with the top five commodity groups consisting of 'Mineral products', 'Metals', 'Machines', 'Foodstuffs' and 'Transportation' (OEC, 2024). The AFTCA therefore creates the opportunity to expand intra African trade between African partner countries.

Table 6: Overview of regional trade policies relevant to maritime defossilisation in South Africa

Policy	Mechanism	Scope	Impact
African Continental Free Trade Agreement	Cutting red tape, by eliminating 90% of tariffs, focusing on outstanding non-tariff barriers, and creating a single market with free movement of goods and service.	All 55 member states of the African Union, including all modes of transport, including maritime.	Expected increase in traffic through SA ports with African partners. Serve as an entry point for the development of green value chains across African member states. This can simplify custom procedures and increase port efficiency
FuelEU	This regulation sets limits on the greenhouse gas intensity of the energy used on board by ships arriving at or departing from EU ports, effectively pushing for the adoption of greener fuels and technologies.	Applies to ships above a certain gross tonnage threshold, irrespective of their national flag, covering intra-EU and international voyages involving EU ports.	***Compliance for EU-bound Ships:*** South African shipping companies must comply with FuelEU Maritime standards for their ships to operate in EU waters. This may require South African ships to adopt cleaner fuels or retrofit their vessels to meet the EU's GHG intensity limits. ***Market Influence:*** The regulations encourage the global

			maritime industry to adopt greener technologies and fuels, influencing South African shipping practices to remain competitive and comply with international standards
EU Emission Trading Scheme (ETS)	It operates on a cap-and-trade principle where a cap is set on the total amount of greenhouse gases that can be emitted by installations covered by the system. Companies receive or buy emission allowances which they can trade with one another as needed.	Covers multiple sectors including power, industry, and aviation. The system is being expanded to include maritime transport (in connection with FuelEU), with a proposal to incorporate emissions from intra-EU voyages, half of the emissions from international voyages to and from the EU, and emissions occurring at berth in EU ports.	***Intra-EU and International Voyages:*** For South African ships involved in intra-EU voyages or voyages between the EU and South Africa, the expanded ETS requires them to purchase emission allowances for their CO_2 emissions.
Carbon Border Adjustment Mechanism (CBAM)	Importers will need to buy carbon certificates corresponding to the carbon price that would have been paid if the goods had been produced under the EU's carbon pricing rules. The price of the certificates will be based on the weekly average auction price of EU ETS allowances.	Initially targets sectors that are at high risk of carbon leakage, such as cement, iron and steel, aluminium, fertilizers, and electricity. It is expected to extend to other sectors over time.	***Export Costs:*** South African exports of goods such as steel, cement, and aluminium to the EU will be subject to carbon costs under CBAM, increasing the price competitiveness. ***Compliance Pressure:*** South African industries, including those using maritime transport for exports, may need to adopt cleaner production technologies to reduce the carbon footprint of their goods to mitigate the impact of CBAM costs.

Moreover, in the context of European policy, the total export value to the EU has increased over the past decade from 51 billion ZAR in 2011 (or 27% share to total export value) to 307 billion ZAR in 2023 (32% to total export value) (Table 7). The main carbon-intensive export items currently listed under Annex 1 of the CBAM policy, and relevant to SA exports, include Cement, Aluminium, Fertilisers and Iron and Steel (European Commission, 2021). Thereby, the total export value of these goods from SA to the EU equates to approximately 50 billion ZAR (in 2023) (Table 7 and Figure 10: OEC, 2024), comprising approximately 16% of total export value to the EU.

Figure 10 shows the export value subject to CBAM regulations across other ports in SA. At an inter-regional level, this shows that export trade to the value of 25 billion ZAR will be liable to the CBAM policy from exports out of Saldanha Bay alone, mainly from Iron exports (
Figure 10). Whereas a total of ~13 billion ZAR in Aluminim exports will be liable to CBAM regulations at the Port of Richards Bay. This specifically highlights the ports with the largest potential to adapt and introduce emissions monitoring.

Potential scope expansion of the CBAM, including the proposal to include emissions associated with the production of goods, present trade implications for

South Africa due to its reliance on coal-based power generation (Monaisa, 2023). The expanded scope of the new proposal additionally includes hydrogen and emissions related to transportation modes. On-going developments in green hydrogen production within South Africa presents potential opportunitity for exports to the EU. Moreover, to remain globally competitive, South African maritime authorities, operators, and exporters must proactively adapt to evolving regulations and integrate sustainable practices into trade and shipping operations

Table 7. Table showing the differences in total export value from SA to the European Union, and the value related to the Carbon Border Adjustment Mechanism goods, with the relevant proportions. Source: OEC, 2024

Year	Exports	EU_exports	CBAM_EU_exports	EU to total	CBAM EU To EU
2011	192B	51B	8B	0.27	0.16
2012	370B	94B	14B	0.25	0.15
2013	420B	110B	17B	0.26	0.16
2014	460B	132B	17B	0.29	0.13
2015	461B	144B	16B	0.31	0.11
2016	517B	167B	20B	0.32	0.12
2017	594B	180B	25B	0.30	0.14
2018	613B	187B	23B	0.30	0.12
2019	633B	192B	30B	0.30	0.16
2020	636B	199B	35B	0.31	0.18
2021	768B	252B	53B	0.33	0.21
2022	947B	337B	53B	0.36	0.16
2023	953B	307B	50B	0.32	0.16

In terms of other EU policies, such as FuelEU Maritime, though South Africa does not have a fleet directly affected by the FuelEU Maritime regulations, vessels operating along the EU-South Africa routes will be implicated by the need to decarbonize and adopt cleaner fuels. Consequently, SA can support this agenda by fulfilling its obligations to the IMO and providing green alternative fuels, while also adapting its export products to be less carbon intensive.

Each EU policy, while distinct in focus and mechanism (Table 6), collectively imposes increased compliance costs on the South African maritime sector, necessitates the adoption of cleaner technologies, and could have significant economic implications for exports to the EU. Furthermore, propositions of the universal levy to enable monitoring and compliance to IMO fuel standards, creates additional uncertainties around the additional cost implications to the maritime sector (Box 2). Therefore, while discussions continue to be held and new policies unfold, South African maritime authorities, operators and exporters should be prepared to adapt to the evolving maritime policy landscape to maintain market access and remain competitive.

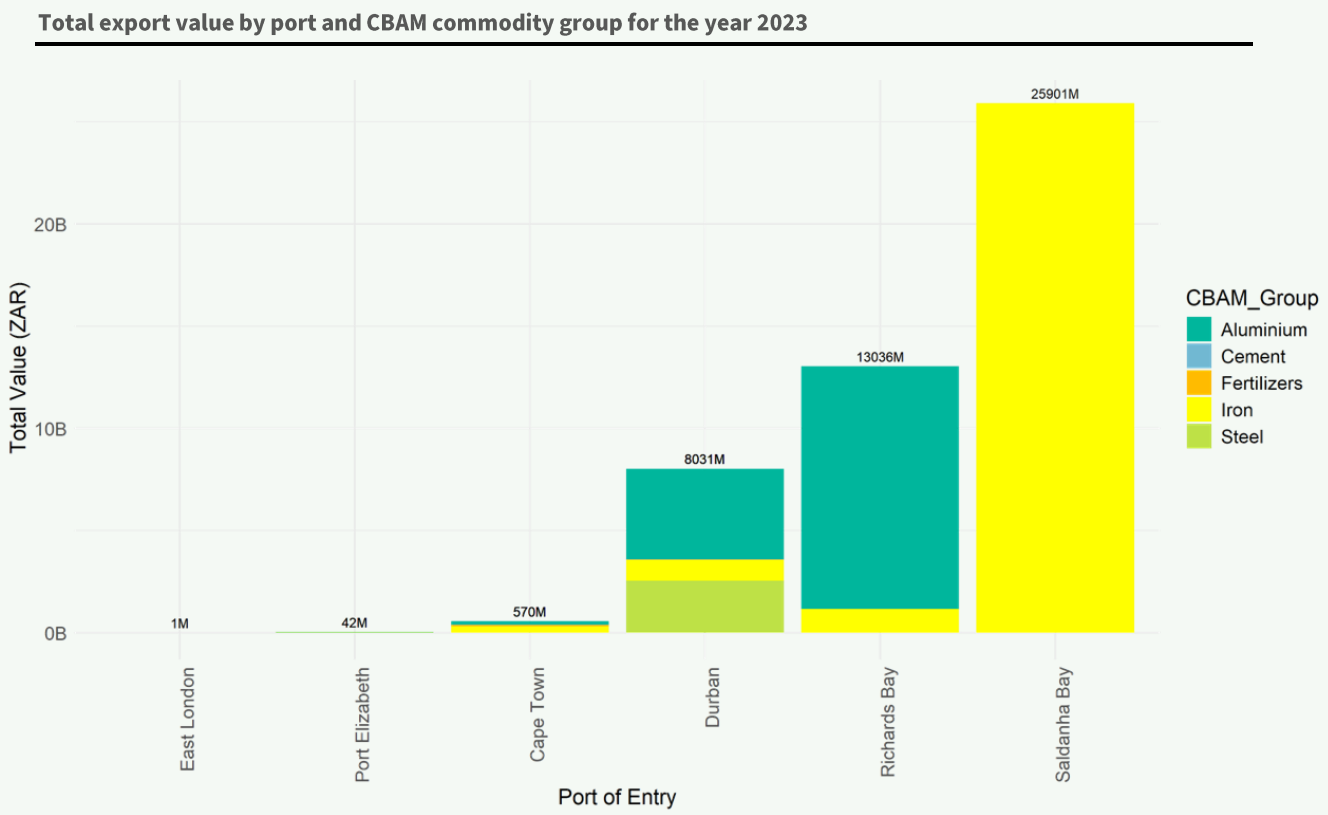

Figure 10: OEC, 2024

Key Findings and Recommendations

Table 8: Recommendations based on key findings from the analysis

Key Findings	Recommendations	Influential Stakeholders
Market		
The global defossilisation agenda necessitates proactive adaptation by South African maritime authorities and businesses to maintain competitiveness and capitalise on green hydrogen and PtX opportunities.	*Facilitate Uptake of Zero-Carbon Fuels* South Africa should work towards supplying alternative green bunker fuels, including PtX fuels for vessels visiting its ports. Developing the green hydrogen supply chain and producing PtX fuels can present opportunity for South Africa to meet future demand and establish itself as a leader in zero-carbon fuel markets.	All
Legislation and Policy		
South Africa currently has a robust legislative and maritime policy landscape, though adapting existing legislation and policy to align with global maritime policy is necessary to position South Africa in the evolving global maritime context, and to meet obligatory requirements of an IMO member state.	*Adapt existing legislation and policy to align with global maritime policy* Integrating measures, such as the environmental fuel compliance measures outlined in the Green Transport Strategy, into maritime policy. This may only apply to domestic transport, since foreign vessels are exempt from emissions control in SA (e.g. Carbon Tax Act, 2019).	DOT, DFFE, SARS
	Stricter Enforcement of Global Fuel Regulations (e.g. Sulphur Cap) South Africa needs to enforce stricter regulations to ensure compliance with global fuel standards, such as the IMO's sulphur cap, in its territorial waters. Develop effective legislation to enable enforcement for future fuels. This may include developing incentives or tax rebates for foreign vessels with IMO compliant fuel.	DOT, DFFE, SAMSA, TNPA, National Treasury, SARS
Vessel Traffic		

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South Africa plays a crucial role in African maritime trade. While its port infrastructure is vital, by addressing port inefficiencies, expanding its domestic fleet, and implementing green shipping practices, the country can unlock new growth potential.	*Prioritise investments in port infrastructure to improve port efficiency to ensure higher turnover* Investing in South Africa's port infrastructure is crucial to improving efficiencies and increase trade turnover. Key priorities include upgrading and modernising port infrastructure and strengthening multimodalism especially with rail networks whose function involve less carbon intensive operations.	Transnet, TNPA, DOT
	Digitalisation and Data Develop appropriate data infrastructure to monitor maritime traffic and related indicators at the port level to inform management and defossilisation efforts. This is in line with the IMO's call for the Maritime Single Window, which requires member states to develop and use a single, centralised digital platform to collect, exchange and store related to maritime operations.	DOT, TNPA, DSTI
Emissions		
According to current analysis, foreign vessels contribute to ~97% of total emissions within SA waters, with domestic transport only contributing ~3%. Though SA does not have jurisdiction to enforce regulations on foreign vessels directly, SA does have jurisdiction to control the compliance of lower-zero carbon fuel standards within its national waters.	*Facilitate the maritime defossilisation by accommodating low-carbon fuel requirements of incoming foreign vessels* Providing bunkering of low-zero carbon fuels can indirectly contribute to lowering emissions emitted from foreign vessels in SA waters	TNPA,SAMSA, DMRE, Fuel producers; Bunkering supplies and operators
	Monitor Emissions of International Vessels South Africa should implement effective mechanisms, potentially an IMO checkpoint or Emission control areas (ECA), to monitor emissions from international vessels in its waters.	TNPA, SAMSA, DFFE
	Regulate Emissions of Domestic Fleet For domestic fleet development and boatbuilding initiatives, new fleet developments should prioritize carbon-neutral or hybrid vessels. This will prevent the need for costly reconfigurations in the future.	TNPA; DFFE, SAMSA

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Trade		
Emerging trade regulations, such as the European Union's Carbon Border Adjustment Mechanism (CBAM) and the Fuel EU policy, will impose stricter controls on traded goods and carbon emissions, impacting trade routes and export value of goods from SA	*Production and Export of PtX Products* To mitigate potential losses from changes in regional trade policy like the EU's CBAM, South Africa should focus on producing, utilising and exporting PtX products, including green fuels, green steel, and green fertilizers. This includes exploring opportunities to develop green-value chains to unlock green trade potential. Efforts should be dedicated to ports with the largest share of trade with the EU and carbon-intensive commodities (e.g. Port of Saldanha, Richards Bay and Durban).	DTIC, ITAC, Exporters
	Establish Bi-Lateral/Multilateral Green Shipping Corridors South Africa should support defossilisation efforts by establishing green shipping corridors, which involve collaborative routes between ports. These corridors will provide zero-carbon fuel bunkering options and facilitate the testing of green solutions, enhancing South Africa's contribution to global maritime defossilisation. South Africa should become a signatory of the Clydebank Declaration to further commit to the development of green shipping corridors and international collaboration in defossilisation.	DOT, TNPA, Shipping companies
	Foster and Strengthen Partnerships with Multilateral Structures (e.g., AfCFTA) South Africa should review and potentially restructure import tariffs with African countries under the African Continental Free Trade Area (AfCFTA) to enhance partnerships and support green trade initiatives.	DTIC, AfCFTA member states

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Endnotes

1. The PMAESA Green Port Initiative is a program launched by the Port Management Association of Eastern and Southern Africa (PMAESA) to promote sustainable and environmentally friendly practices in ports across the Eastern and Southern African region. Key elements of the initiative include reducing emissions, ensuring energy efficient operations, waster and water management and implementing biodiversity conservation measures.
2. Key SEZ's with maritime alternative energy strategies, Freeport Saldanha, COEGA IDZ, Dube TradePort and Richards Bay IDZ.
3. Carbon leakage is the unintended increase in greenhouse gas emissions, due to a transfer of business and production of goods to a jurisdiction with more lenient climate policy.
4. The IMO Maritime single window referes to a mandatory call (as of 2024) for all member states to use a single, centralised digital platform to collect and exchange information with ships when they call ports.

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Appendix A. Data and Assumptions

Graphical representation of the methodology used to estimate shipping emissions

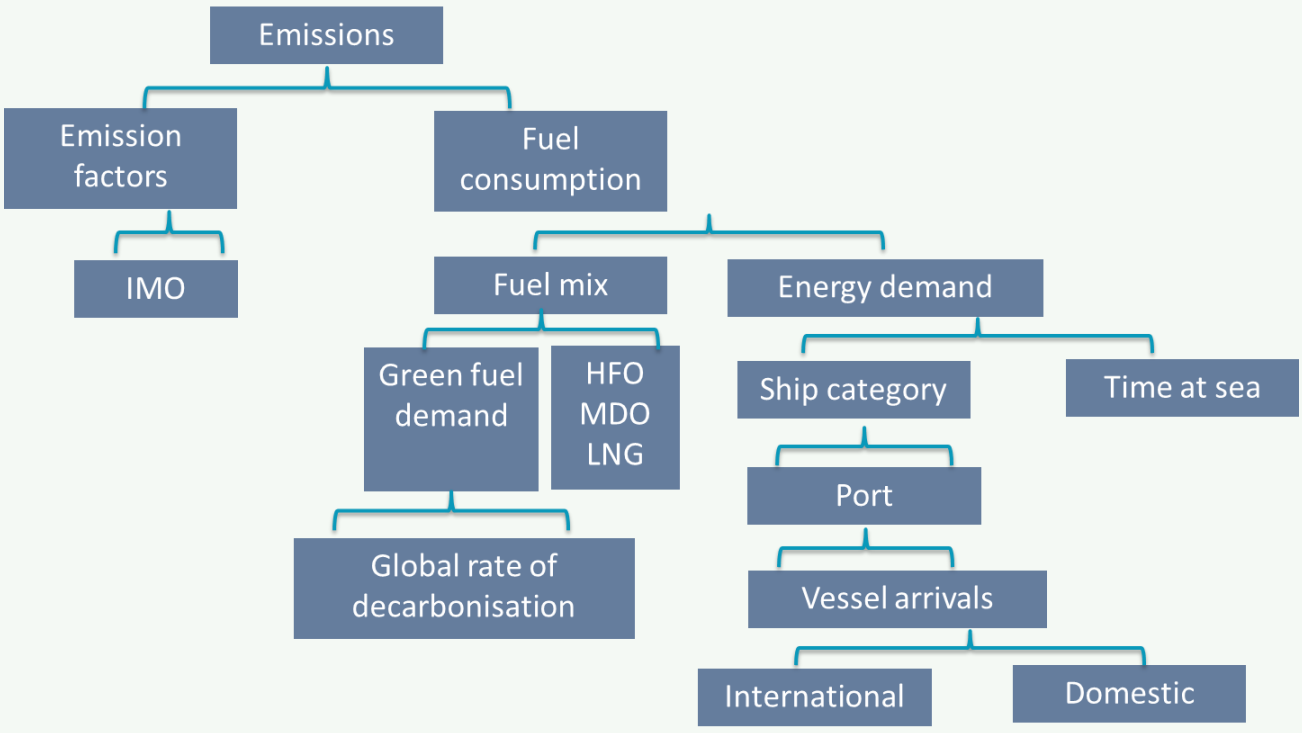


Figure 11: Adapted from IMO, 2020

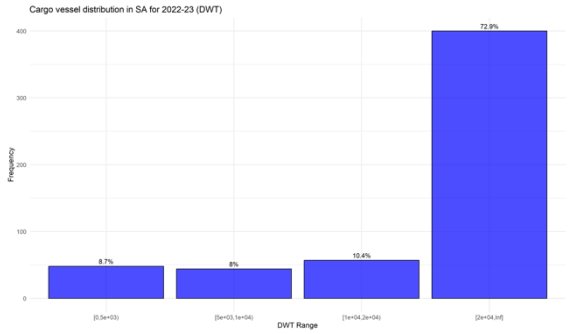
Table 9. Overview of data and assumptions for the maritime traffic analysis

Variable	Notes and Assumptions	Source(s)
Vessel arrivals by port & vessel type (vessels)	Vessel types: [General Cargo including RoRo, Car and other; Bulk; Containers; Tankers; Passenger; Domestic] Ports: [Richards Bay; Durban; East London; Ngqura; PE; Mosselbay; CPT; Saldhana]	TNPA Port statistics: https://www.transnetnationalportsauthority.net/Commercial%20and%20Marketing/Pages/Port-Statistics.aspx Data only available for 2016; 2018; 2020; 2021; 2022; 2023.
National future shipping growth rate (%/year)	1.5 % p.a (2024-2050)	Historical trends, before the advent of COVID-19, show a decline in growth between 2016-2019, hence historical future growth is estimated between 1-2% between studies. World Bank, 2024 assume 1% growth for South Africa. International growth is estimated to be 3.2% between 2011 and 2019 (UNCTAD, 2023).
Duration in transit in EEZ (days)	Richards Bay: 1 Durban: 1.5 East London: 1.5 Ngqura: 2 PE: 2 Mosselbay: 2 CPT: 1.5 Saldanha Bay: 3	Disaggregated by port and measured from each port to the nearest point of entry/exit on the EEZ based on the direction of the main shipping routes. Based on the assumption of speed 14knots. This is also based on the average time relative to all the routes. Calculated using the route calculator on https://www.myshiptracking.com/
Departure multiplier (%)	100	Ratio between arrivals and departures calculated to be ~0.99-1 based on TNPA data for the year 2022-2023 recordings, i.e. departures are approximately equivalent to arrivals.
Multiplier for emissions from vessels passing through EEZ	1.8 dmnl	Lack of data on vessels passing through EEZ - Assumptions based on Abhold and Shaw (2022), where the number of vessels bypassing the EEZ is approximate to the international departures. World Bank, 2024 states the potential

		demand for ships passing-by SA coast is approximately two times the energy demand for vessels calling in all eight ports.
Historical fuel mix (proportion)	Heavy Fuel Oil: 0.79 Marine Diesel Oil: 0.19 LNG: 0.02 Green ammonia: 0 Green methanol: 0	Share of marine fuels for vessels visiting our ports, based on approximations of global fuel mix – since this representative of the international vessels visiting SA. International Maritime Organization, I. (2020) Fourth IMO Greenhouse Gas Study, page 7.
CO2 emission factors (kg/ton)	HFO: 3114 MDO: 3206 LNG: 2750 Green Ammonia: 0	Emission factors are further disaggregated by fuel type. Tier 1 values are assumed. Based on 2018 values. Emission factors are based on WTW estimates. International Maritime Organization, I. (2020) Fourth IMO Greenhouse Gas Study. Table 27 – page 83. & Schuller 2024 and Schuller et al., 2021 for WTW emission factors for ammonia and methanol
N2O emission factors (kg/ton)	HFO: 0.18 MDO: 0.18 LNG: 0.10 Green Ammonia: 0	
CH4 emission factors (kg/ton)	HFO: 0.05 MDO: 0.05 LNG: 11.96 Green Ammonia: 0	
Global warming potential (kg/kgCO2eq)	CO2: 1 N2O: 265 CH4: 28	The GHG emissions are calculated as CO2-equivalent (CO2eq), using the global warming potential over a 100-year time-horizon (GWP100). International Maritime Organization (2024) Annex 10. IMO Resolution MEPC.391(81): 2024 Guidelines on Life Cycle GHG Intensity of Marine Fuels.
Energy content by fuel (GJ/ton)	HFO: 40.2 MDO: 42.7 LNG: 48 Green Ammonia: 18.6 Green Methanol: 19.9	Used to estimate the energy demand by port, vessel and fuel type. International Maritime Organization, I. (2020) Fourth IMO Greenhouse Gas Study, page 71: “The conversion between fuels was done using the following assumed energy densities: For HFO is 40,200 kJ/kg; MDO uses 42,700 kJ/kg; LNG uses 48,000 kJ/kg and Methanol is assigned 19,900 kJ/kg”. Second source: IEA-amf.org (Accessed on 20 September 2024)

H2 mass ratio to fuel type (proportion)	HFO: 0.15 LNG: 0.25 Ammonia: 0.17 Methanol: 0.13	The mass of hydrogen contained in ammonia and methanol, calculated as the ratio of Hydrogen to the molecular weight of the fuel compounds.
Tons to kg	1000 kg/ton	SI unit conversion
GJ to GWh	3600 GJ/GWh	
GWh to TWh	1000 GWh/TWh	

Table 10. Average fuel consumption relative to vessel size. Vessel size distribution is based on vessel arrivals across SA ports for 2022-2023. Notes. Fuel consumption ranges from ABS: American Bureau of Shipping - Guidance Notes on Monitoring Fuel Oil Consumption: ABS Guidance Notes. The International Council on Clean Transportation - Reducing Cruise Ship Air Emissions: Reducing Cruise Ship Air Emissions. The Society of Naval Architects and Marine Engineers - Guidelines for the Economic Selection of Propulsion Plants for Commercial Ships: SNAME Guidelines. Vessel size data: TNPA 2022-23 vessel movement report. Vessel size distribution was based on the 5 main vessel categories: Cargo (filtered by breakbulk, car, livestock, RoRo and general cargo), Bulk (filtered by term 'bulk', excluding breakbulk), Container (filtered by term 'container', including Reefer), Tanker (filtered by term 'tanker'), Passenger (filtered by term 'passenger'), domestic (filtered to include Barge, Cable Layer, Dredger, Hopper, Naval Vessels, Oi Rig, Search & Research, Tug, Yacht, Foreign fishing, SA trawlers, other). Based on speed assumption of 14 knots. Only for transit & does not vary between engine type.

Vessel Type	Avg. Consumption (tonnes/day)	Size distribution	Typical Fuel Type
Cargo	50 - 300		HFO/MGO

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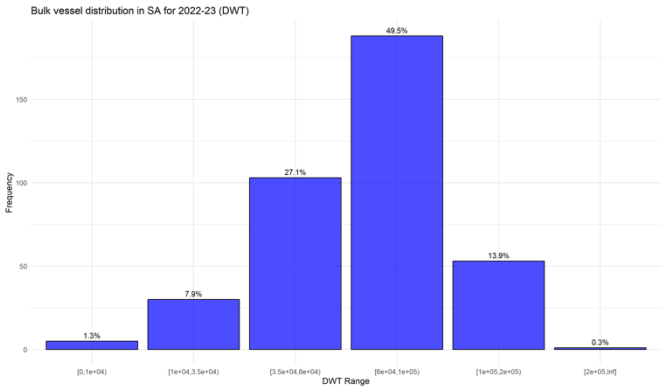
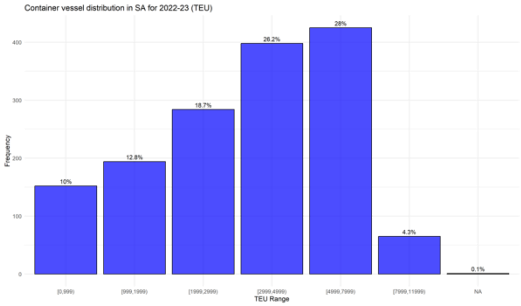
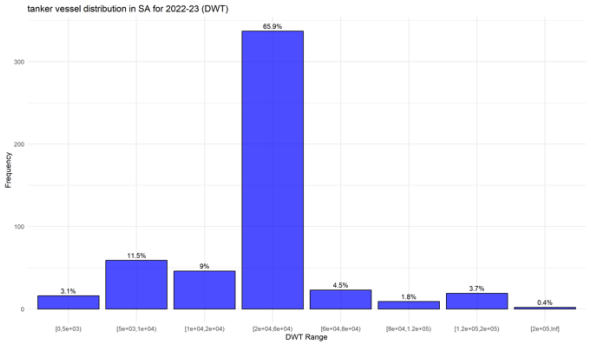
Bulk	20 -200		HFO/MGO
Container	50 - 150		HFO/MGO
Tanker	20 - 150		HFO/MGO

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IKI INTERNATIONAL CLIMATE INITIATIVE
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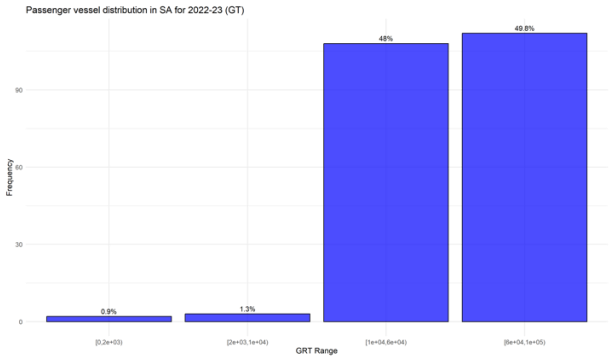
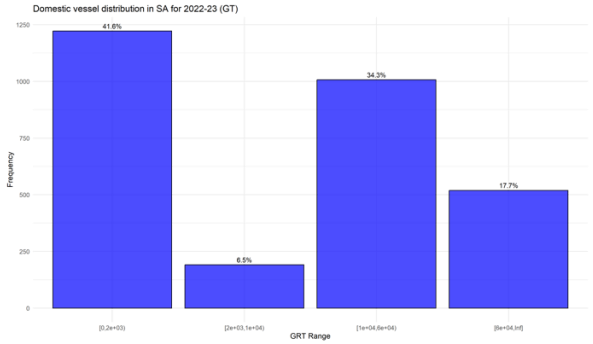
giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
HEAT

Passenger & Cruise	100-300		HFO/MGO
Domestic	10 - 30		MGO/Diesel-Electric