

WESTERN CAPE FREIGHT DEMAND MODEL

2024 Model | Report | February 2026



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In 2023, South Africa's freight logistics crisis cost the economy about R1 billion per day (which included losses of R50 million in tax revenue and 500 jobs) and added a R30 million interest charge to Transnet's debt burden daily¹. Further analysis shows that the freight logistics system's failures cost the country R40.5 billion less in 2024 compared to 2023. While this confirms that national reform and turnaround efforts are making a difference, it is clear that the crisis continues to undermine the growth and competitiveness of the South African economy. Since these economic consequences are particularly severe in the export-driven sectors of the Western Cape, it is vital that current and future efforts to improve the system in the province (and wider country) are successful. The province (especially these sectors) is extremely reliant on the Port of Cape Town as a global trade gateway, therefore, port performance improvements are particularly crucial as part of these efforts.

Successful national and regional macrologistics interventions rely heavily on a data-driven approach. Evidence-based macrologistics planning for infrastructure investment and policy direction requires an activity-based data and costing framework, similar to the precision needed in business logistics. Just as businesses analyse trade-offs between strategic alternatives and investment options through detailed evaluation of logistics activities, the same principle applies to national and regional logistics planning.

In South Africa's logistics crisis – marked by inefficiencies in Transnet and the rail sector's inability to meet industry demands – a demand-based freight flow model has emerged as an essential tool for identifying and assessing potential solutions.

Understanding the movement of goods on both national and provincial scales is crucial, and this need is effectively addressed by a demand-driven model.

The Freight Demand Model™ (FDM™) for South Africa captures freight flows across 372 districts for 83 commodities, encompassing export, import, and domestic freight movements over a 30-year forecast horizon. This model provides invaluable insights to guide decision-making and long-term planning, offering a foundation for tackling the country's logistics challenges.

The freight flow model offers valuable insights into the current freight volumes across various transport modes in a region while also assigning costs to these flows. This current demand is closely tied to the region's GDP, often referred to as "GDP in motion." By incorporating forecasts, the model can project future demand for each flow, providing a wealth of analytical opportunities for decision-makers. This enables the evaluation of policy interventions and industrialisation strategies, including their impacts on infrastructure, cost-benefit analyses of different transport modes, and assessments of congestion management and law enforcement measures.

National and provincial governments must develop comprehensive strategies to mitigate the effects of the logistics crisis and establish a foundation for a more resilient and efficient sector. In this regard, the Western Cape Provincial Government has emerged as a leader in tackling the crisis directly. The ninth iteration of the Western Cape Freight Demand Model™ (WC FDM™) plays a crucial role in shedding light on the complexities of freight movement within the region. By analysing 2024 data, the WC FDM™ report provides invaluable insights into data sources, the rigorous methodology used, and the outcomes achieved. These insights lay the groundwork for informed, strategic decision-making, ensuring that policies and interventions are targeted for maximum effectiveness.

The Western Cape's commitment to transparency and data-driven approaches highlights the provincial government's determination to address the logistics crisis and drive sustainable growth in the region's transport and logistics sector.

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¹ Aritua, B., Havenga, J.H., Simpson, Z.P., Swarts, S., Neethling, H., & de Bod, A. 2025. Chapter 14: The pathway to integrated surface transport and regulation of logistics in South Africa. In *Challenges in Transport Regulation in Europe and Beyond*. Cheltenham, UK: Edward Elgar Publishing.

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Executive summary

Amidst the ongoing logistics crisis in South Africa, successful national and regional macrologistics interventions have proven to be critically dependent on a data-driven approach. National and provincial government must develop comprehensive strategies that can mitigate the effects of the crisis and lay the foundation for a more resilient and efficient logistics sector. In this context, the Western Cape Government (WCG) has emerged as a pioneer in addressing the crisis head-on. The WCG's commitment to transparency and data-driven approaches highlights the provincial government's determination to address the logistics crisis and drive sustainable growth in the region's transport and logistics sector.

The ninth iteration of the Western Cape Freight Demand Model (WC FDM™) plays a pivotal role in shedding light on the complexities of freight movement within the Western Cape. By analysing data from the WC FDM™ for the 2024 base year, this report offers invaluable insights into the data sources, the rigorous methodology used, and the outcomes achieved. These insights lay the groundwork for informed, strategic decision-making, ensuring that policies and interventions are targeted for maximum effectiveness. The model has, for instance, been used to guide implementation of the Western Cape Freight Strategy.

This report outlines the methodology and data sources of the model, and summarises key characteristics associated with freight flows to, from, and within the Western Cape, as well as a potential scenario for modal shift and terminal networks in the province.

Methodology

The national and provincial freight demand models are comprised of econometric and flow modelling. Econometric modelling identifies and analyses causes and effects, and correlates relationships between total freight transport demand and its drivers. Flow modelling uses the supply and demand values of the econometric model to represent freight movement between supply and demand areas for all commodities and modes.

The models are based on Logistics Service Provider cost and tariff data (interview-based), Transnet Freight Rail data, Transnet National Ports Authority data, Western Cape-specific data (agriculture, crops, and mining), Western Cape-specific waste data, international air freight data for Cape Town International Airport, and publicly available industry and business data.



Overview of the National FDM™

145.3 million tonnes (18.4%) of national freight in 2024 (790.1 million tonnes) had either an origin, destination or both within the Western Cape. These freight volumes are skewed by bulk line freight, namely iron ore (50.0 million tonnes) and manganese exports (6.2 million tonnes), which are almost entirely destined for the Port of Saldanha.

With bulks removed, 84.9 million tonnes (16.4%) of all national freight in 2024 (518.7 million tonnes), known as General Freight Business (GFB) volumes moved through the Western Cape.

The Western Cape contributed R 1 041.4 billion (14.2%) and R201.4 billion (12.7%) to national GDP (R7 352.4 billion) and transportable GDP (R1 590.3 billion) in 2024, respectively. This is relatively low compared to its 112.0 billion (39.1%) and 59.7 billion (33.5%) contributions to national total (286.3 billion) and GFB (178.0 billion) tonne-kms, respectively.

Trade by mode

The total road and rail freight with an origin or destination in the Western Cape in 2024 amounted to 143.8 million tonnes, showing a slight increase from the 143.6 million tonnes in 2023. Modal share in the Western Cape (excluding air freight and pipelines) remained unchanged for total freight (61% for road and 39% for rail) in 2024. There was similarly no significant change in the market share for GFB¹ freight (99% for road and 1% for rail) since 2023.

GFB freight rail volumes decreased across the mining and manufacturing sectors in 2024, but increased in the agriculture sector. The mining sector is dominant in GFB rail freight volumes, which is primarily driven by Namakwa Sands activity. Opportunities still exist for rail transport of long-distance GFB freight in the Western Cape. Similarly, fruit on rail remains a major opportunity that has not been realised due to the lack of consolidation facilities and service levels.

As in 2023, pipeline freight in 2024 amounted to 3.98 million tonnes of crude oil transported between the City of Cape Town and the Port of Vredenburg. Air freight via Cape Town International Airport amounted to 74 888 tonnes, whereof most (61%) movements were related to exports. Overall, fresh food was the most prevalent air freight commodity (46%).

Provincial trade

A total of 147.8 million tonnes of freight touched the Western Cape in 2024 and is made up of 86.6 million mining tonnes (59%), 41.5 million manufacturing tonnes (28%), 17.0 million agricultural tonnes (12%), and 2.6 million (2%) waste tonnes. The Western Cape GFB freight (64.6 million tonnes) is split between intra-Western Cape freight (21.5 million tonnes), freight transported to other provinces (24.5 million tonnes) and freight received from other provinces (18.7 million tonnes).

Waste is an intra-provincial flow only and amounts to 2.6 million tonnes (12% of intra-Western Cape freight).

More than half (54%) of intra-Western Cape freight and 77% of freight to other provinces are manufacturing commodities, which together amount to 30.1 million tonnes. Manufacturing freight represents 58% of the Western Cape's freight from other provinces. The largest commodity group in the Western Cape's manufacturing sector is processed foods (29%), followed by beverages (11%) and diesel (8%).

KwaZulu-Natal (KZN) is the Western Cape's main GFB trading partner, followed closely by Gauteng. If it was not for port-related trade, Gauteng would have been the Western Cape's biggest trading partner, because 23.8% of trade with KZN is related to the Port of Durban.

Corridors

For total freight touching the Western Cape, the N7 is the only corridor with significant rail volumes. However, this is primarily due to the dedicated iron ore corridor (i.e. iron ore and manganese exports). Corridor GFB freight is dominated by road, with a 99.8% market share on the N1 corridor; 99.8% market share on the N2 corridor and 85.1% market share on the N7 corridor.

The average travel distance of road freight on the N1, N2, N7, Metropolitan and Core Western Cape corridor is 1 388 km, 679 km, 405 km, 28 km and 87 km, respectively. Due to the low rail market share, modal shift opportunities exist for long-distance road freight in the Western Cape.

Flow segmentation

Manufactured goods, transported over long distances on road, constitute a large volume of the Western Cape's GFB freight. This presents two opportunities for rail:

1. Siding-to-siding freight, that is, long-distance freight that is usually moved from large manufacturing plants to other plants for further beneficiation; and
2. Fast Moving Consumer Goods (FMCG) freight that can be palletised and containersied, and transported through domestic intermodal solutions.

The lack of collaborative rail-road solutions to capture long-distance FMCG freight has led to higher transport costs, undermining the competitiveness of Western Cape industries.

South Africa's logistics challenges and rail reform initiatives create opportunities for the public and private sector to establish terminal and consolidation centres, promoting the shift of palletised and containerised freight to alternative transport modes.

¹ GFB is defined as the competitive market space and consists of the total freight tonnes less iron ore exports, manganese exports, pipelines and, for the analysis that follows, stone and aggregate. The latter has been removed from the subsequent GFB analysis because it is typically a very short-distance movement of mostly construction aggregate, which is challenging to quantify and has extremely dispersed transport.

Economic forecast

Iron ore and manganese exports constitute the majority of the Western Cape's mining sector freight intensity. Manufacturing and agricultural commodities from the Western Cape are transported over significantly longer distances than the mining commodities. The manufacturing sector is forecast to generate the largest logistics demand in the absence of the ring-fenced export lines. The economic forecast suggests the development of infrastructure that will support the growing manufacturing and agriculture sectors.

Freight transport costs

In 2024, road freight transport accounted for nearly 87% of the Western Cape's total transport cost of R89.3 billion. The main road freight transport cost drivers were fuel (R38.5 billion; 43.1% of total cost), truck driver wages (R11.0 billion; 12.3% of total cost) and tyres (R7.2 billion; 8.1% of total cost). Fuel cost increased by 15.6% against 2022 and 18.2% against 2023, driven by higher fuel prices.

With its current low market share, the South African freight railway's challenge is that it needs a substantial modal shift from road to realise density benefit and further emphasises the significance of resolving the rail crisis in South Africa.

Externality costs

The total externality cost for road freight transport in the Western Cape amounts to R14.06 billion, which is 18.1% of current road freight transport costs. Road freight transport contributes 94% of the total freight transport externality cost of R14.95 billion.

The four largest road freight transport externality cost drivers, namely emissions, accidents & crashes, noise, and congestion, contribute more than 80% to total freight transport externality costs in the province, impacting the general population while not being carried by the users of the service.

The internalisation of externality costs can be induced through policy interventions, which could induce a systemic change to shift rail-friendly freight to rail.

Scenario 1: Modal shift

The modal shift scenario is for commodities that have been identified as rail-friendly, based on the density attributed to the origin and/or destination, packaging type, and distance. As rail traffic density increases, it becomes more efficient.

An estimated 9.48% of the Western Cape's total freight transport cost could have been saved in 2024 through modal shift. At current rail volumes, road is more competitive within the Core Western Cape area. The largest modal shift opportunity is for the N1 corridor freight. This could potentially reduce total transport costs by 8.73%.

Scenario 2: Worcester freight terminal

The aim of this scenario is to assess the viability of an intermodal freight terminal located in Worcester.

This viability was assessed via four operational models:

1. A stand-alone option, with the Worcester terminal operating as the sole regional intermodal hub.
2. The expanded stand-alone option, with the Worcester terminal - including fruit terminals.
3. A dual hub option, with both the Worcester and the Kraaicon terminals.
4. The expanded dual hub option, with the Worcester and Kraaicon terminals - including fruit terminals.

The viability of the terminal is inherently tied to its connectivity with major inland hubs, specifically the City Deep Terminal in Johannesburg. As one of the largest dry ports in Africa, City Deep serves as the primary destination for rail freight from the coast. A Worcester-based terminal would function as a strategic consolidation point of cargo coming into and going out from the Western Cape. Results indicate that 10.4 million tonnes of road freight can utilise the intermodal freight terminals. The national terminal network can be effective in reducing trips to and from the Port of Cape Town. Intermodal facilities (without the fruit terminals in Ceres, Elgin and Vredendal) have limited incentives from a cost structure perspective due to a low volume of trips. The fruit terminals are more effective because they focus solely on fruit exports to the port. Most long-distance freight will remain on road despite an aggressive intermodal freight pick-up.

Scenario 3: Terminal network (2024)

A terminal network for the Western Cape was considered, comprising of a central super terminal or freight village, port connectivity, and network of handling points for containers, fruit, processed food, and fuel. The terminal network scenario was first developed for the 2022 base year. This update for the 2024 base year includes another terminal, located in Worcester, to evaluate its impact on the broader terminal network. The estimated cost saving of the proposed terminal network is R2.44 billion in transport cost and R2.03 billion in externality cost. The value of this network extends beyond individual facilities and lies in the collaborative interactions and shared benefits among interconnected connections.

Scenario 4: The impact of RTMS adoption

4.3% of the Western Cape's truck population is estimated to have been RTMS certified in 2024, which grew to an estimated 4.5% in 2025. This means about 2 088 of the province's 48 566 registered truck population in 2024 were RTMS certified.

The baseline RTMS adoption rate (4.3% of 2024) saved the Western Cape road freight transport sector about 4.5 million litres in fuel, R18.5 million in accident and crash externality cost, and nearly 12 000 tonnes in CO₂ emissions. Slightly more than doubling baseline RTMS adoption in 2024 (i.e. to 10%) would have seen additional savings of almost 6 million litres of fuel, 16 000 tonnes of CO₂ emissions, and R25 million in accident and crash externality cost. An ambitious RTMS adoption rate of 50% in 2024 would have seen the sector reduce both its total fuel consumption and CO₂ emissions by 10% and its accident and crash externality cost by 30%.

There has been notable progress made regarding increasing RTMS adoption in the Western Cape, most notably with the introduction of the PBS policy and the development of the WCG digital RTMS Toolkit. More effort is, however, needed among government and industry role-players to unlock the full potential of RTMS adoption within the sector.

Waste data

Waste does not contribute to the GDP directly, but it has an indirect impact since its transportation and disposal requires resources that could have been used for activities that contribute to the GDP.

The waste forecast investigates a plausible relationship between waste landfilled and commodity demand. Waste management and the logistics behind it are complex and waste landfilled is inherent to the consumption of goods, and extraction and manufacturing processes. A portion of transportable GDP will, therefore, end up in landfills.

Municipal waste reduction initiatives have seemingly been reducing the waste landfilled cumulatively by 25 679 tonnes per year since 2010 up until 2024, given that the demand for processed foods and beverages in the CoCT explains the waste landfilled.

Municipal waste forecasts for the CoCT, based on demand for processed foods and beverages, in the absence of additional waste reduction measures such as recycling and reuse, are expected to increase to 2.67 million tonnes per year by the year 2055. Garden waste landfilled is expected to increase by 28.9% by 2055 based on the forecast of fertilizer demand in the CoCT. Construction and demolition waste is expected to grow the fastest of the three waste streams, based on the forecast of bricks and cement demand in the CoCT.

Air freight data

In 2024, 74 888 freight tonnes were transported via Cape Town International Airport (CTIA), whereof 45 381 tonnes (61%) were exported and 29 506 tonnes (39%) were imported.

This shows a growth in total trade of 24.8% (14 865 tonnes) from the 2023 volumes of 60 023 tonnes; and 42.9% (22 498 tonnes) from the 2022 volumes of 52 389 tonnes. Air trade volumes are more than the previous recorded high of 63 006 tonnes, which were transported in 2019.

CTIA predominantly imports (12.8%) and exports (67.1%) food commodities (34 258 total tonnes) in its role as a facilitator of international trade.

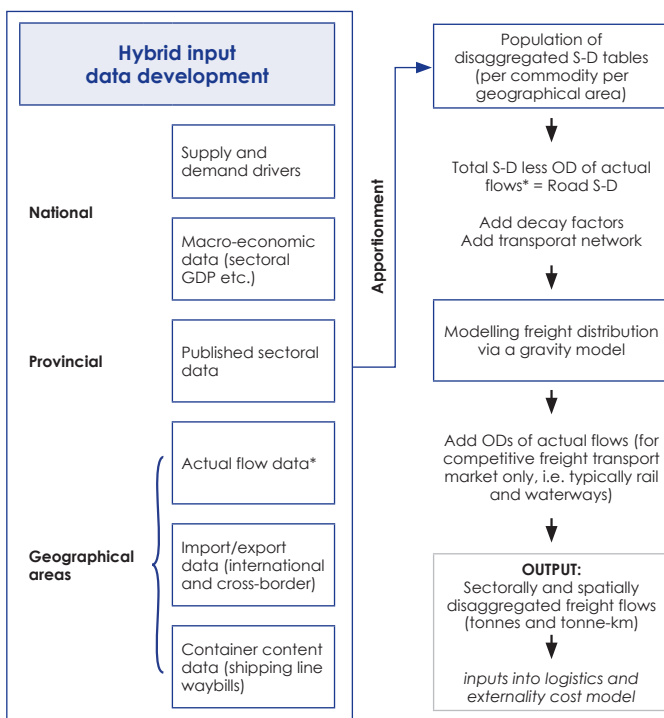
Apart from food-related commodities, the most air trade volumes in 2024 are related to:

- perishable non-foods (4 688 tonnes),
- basic industrial raw materials (1 545 tonnes),
- parts and components: power, agriculture, construction, mining, handling (1 077 tonnes),
- odours and flavours (623 tonnes), and
- and clothing and accessories (605 tonnes).





The process and key data sources that are used to develop the Western Cape Freight Demand Model¹ are indicated in Figure 1. The model produces supply and demand data which, in turn, defines freight flows in terms of origin, destination, commodity, volume and transport mode. The primary steps include: gathering and development of actual and modelled commodity-level data, disaggregation of this data to supply and demand per geographical district and modelling of the freight flows between origins (supply) and destinations (demand). Supply-and-demand tables are developed based on a hybrid approach that utilises the available datasets for each geography.



S-D = Supply and demand
OD = Origin-destination
* Rail, waterways, pipelines, conveyor belts (where applicable)

Figure 1: Adapted from key data sources and process detail of the FDM (Havenga and Simpson, 2018)²

The National Freight Demand Model (FDM™) was first developed and used in 1998. The model was improved in 2006 to become a completely repeatable model that captures freight flows between 372 districts for 83 commodities for all modes of transport on land within South Africa, for export, import and domestic freight, over a 30-year forecast horizon. The WC FDM™ was first developed in 2018 for the 2017 base year, based on the national FDM™ with the objective of providing the province with richer and more refined known data to enable the development of more refined strategies.

The methodology for developing the FDMs (both national and provincial) consists of two steps: (1) econometric modelling and (2) flow modelling.

Econometric modelling

This modelling approach is required to develop multi-commodity, multi-regional national freight demand models (Havenga and Simpson, 2018). Econometric models identify and analyse cause-and-effect and correlative relationships between the total freight demand and its drivers. Figure 2 shows the econometric modelling steps.

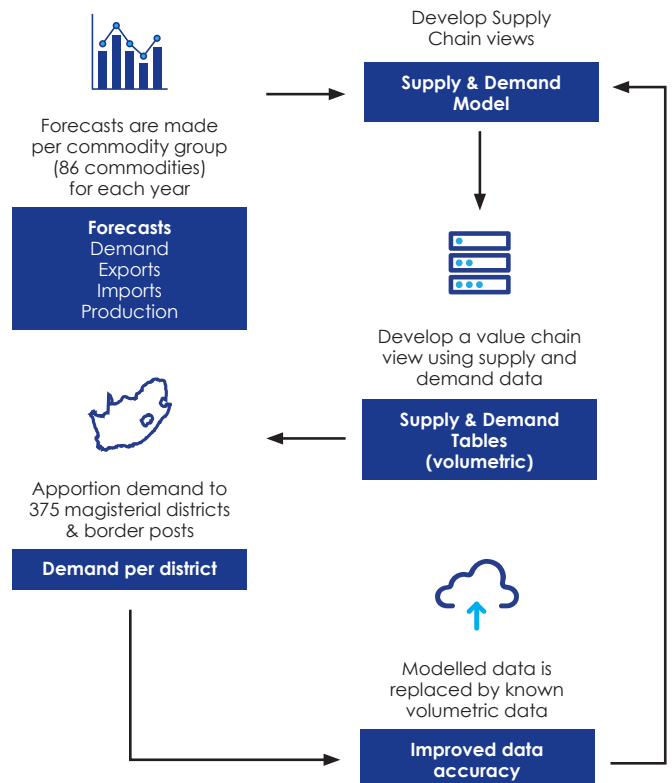


Figure 2: Econometric model

Supply and demand are forecasted 30 years into the future. This provides likely high and low growth scenarios. These forecasts are based on assumptions regarding the international economic outlook, Gross Domestic Product (GDP) growth, inflation, national capital spending, population growth, and various other forecasting factors.

Flow modelling

Flow modelling uses the supply and demand values of the econometric model to model the movement of freight between supply areas (origins) and demand areas (destinations) throughout the country, for all commodities and modes. The input data is created by subtracting the volume of known flows per geographical district (rail, pipeline, conveyor) from the total supply and demand volumes.

The balance of supply and demand is then modelled as road flows, using gravity modelling.

¹ Western Cape Freight Demand Model utilises in part the "FDM" (a registered trademark of GAIN Group (Pty) Ltd)

² Havenga, J.H. & Simpson, Z.P. 2018. National freight demand modelling: a tool for macrologistics management. *International Journal of Logistics Management*, 29(4): 1171-1195.

1. Forecasts and growth rates: Revised in line with the national FDM™ for imports, exports, production, intermediate demand and final demand/consumption in WC FDM™.
2. Waste: Verified provincial data for 2024, collected by the WCG's Department of Environmental Affairs and Development Planning (DEA&DP), is included in the model⁴. The model also includes waste data received from the City of Cape Town.
3. Participating LSPs: Company origin-destination (OD) freight movements were further interrogated and verified with more detailed cost and tariffs.
4. Liquid fuels and the imports and exports of refined petroleum products: Additional research was conducted and comparisons made between data from industry, the South African Petroleum Industry Association (SAPIA) and the Department of Energy.
5. Weighbridge data: Used to validate WC FDM™ flows. It largely confirmed the modelled WC FDM™ road flows.
6. South African National Roads Agency Limited (SANRAL) data: New SANRAL data for analysis and comparison with modelled data on the N1, N2 and N7.
7. Agricultural data: Latest data, including estimated current crops and future plantings and yields, were incorporated.
8. Air freight data: International air freight handled by Cape Town International Airport included but not yet integrated with other modes of transport in the FDM™, as the OD detail is not available.

⁴ Department of Environmental Affairs and Development Planning. 2024. *Annual state of waste management report 2024*. Western Cape Government.

Refer to Chapter 6 of Havenga *et al.* (2020), Havenga (2013) and Chapter 8 of Havenga (2007) for a more technical description of the FDM™ model:

- Havenga, J.H. 2007. *The development and application of a freight transport flow model for South Africa*. Dissertation presented for the degree of Doctor of Philosophy (Logistics Management), Stellenbosch: University of Stellenbosch.
- Havenga, J.H. 2013. The importance of disaggregated freight flow forecasts to inform transport infrastructure investments. *Journal of Transport and Supply Chain Management*, 7(1): 1-7.
- Havenga, J.H., Witthöft, I.E., de Bod, A. & Simpson, Z. 2020. *From Logistics Strategy to Macrologistics: Imperatives for a developing World*. London. Kogan Page Publishers.



While the National Freight Demand Model (FDM™) for South Africa (SA) was preliminarily updated for 2024 by GAIN Group, it is not publicly available. GAIN has, however, made some data available for a high-level national overview and comparison with the Western Cape (WC).

During 2024, 790.1 million (m) tonnes of freight were moved in SA, with 145.3m tonnes (18.4%) having either an origin, destination or both within the WC, as shown in Figure 1(a). However, as seen in Figure 1 (b), these freight volumes are skewed by the iron ore (50.0m tonnes) and manganese exports (6.2m tonnes), which are almost entirely destined for the Port of Saldanha.

The iron ore and manganese export lines account for 6.3% and 0.8% of national freight, respectively. This highlights that a large portion of freight that moves through the WC does so without contributing significantly to the province's gross domestic product (GDP)¹.

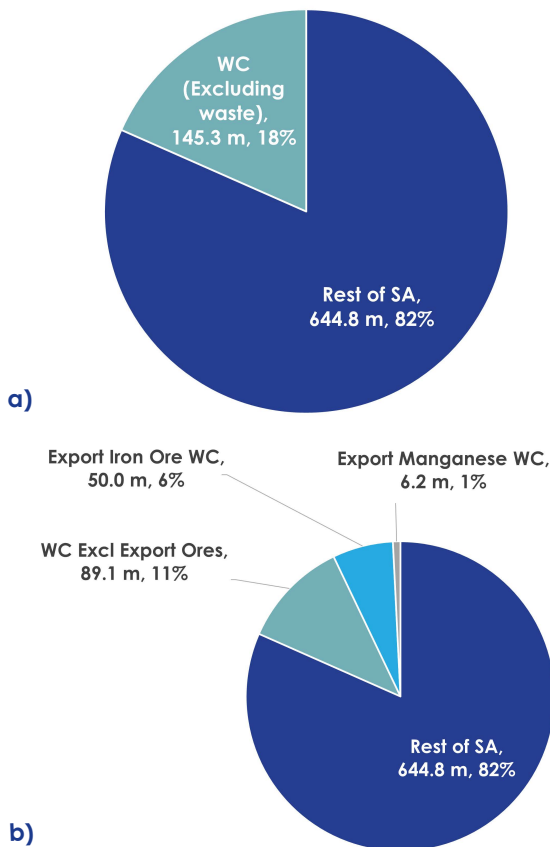


Figure 1: The WC's freight volumes as a percentage of SA's in 2024

Figure 2 shows the contribution of the WC as a percentage of national freight volumes and freight intensity. The former is measured in tonnes, while the latter is measured in tonne-kilometres (tonne-kms).

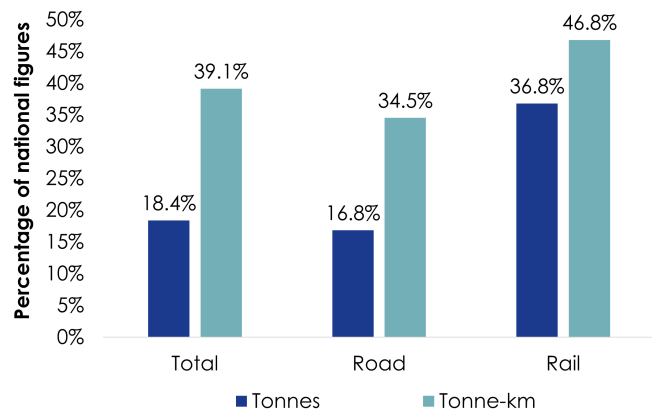


Figure 2: The WC's road and rail freight tonnes and tonne-kms as a percentage of SA's in 2024

The total freight moving in the WC indicate a very high freight transport intensity² in terms of tonne-kms, with its 18.4% contribution to national tonnes requiring 39.1% of national tonne-kms. This difference in the WC's percentage share of the national total shows how moving bulk freight over long distances can affect freight intensity measurements. Since they skew freight intensity, the bulk lines (iron ore export, manganese export and pipelines³, hereafter referred to as "the bulks" or "bulk commodities") have been excluded from the WC freight. This enables a fair analysis of the remaining non-bulk freight, known as General Freight Business (GFB) freight, to be conducted. Note that along with the bulks, export coal and conveyor belt coal are excluded to determine national GFB freight.

With the bulk commodities excluded from freight flows, Figure 3 shows that the WC's share of national freight intensity (tonne-kms) is still high compared to its contribution to national freight volumes (tonnes). The WC is one of nine provinces but contributes a third of national GFB freight tonne-kms (33.5%) and only accounts for 16.4% of the national GFB tonnes.

¹ The iron ore and manganese mining contribute to the primary sector GDP of the Northern Cape. The export of the commodities at the Port of Saldanha contributes to the tertiary sector GDP of the Western Cape.

² Freight transport intensity is the ratio of freight transport demand (measured in tonne-kms) and the economic output (measured in GDP). It is, therefore, the quantum of freight transport required to achieve the same output. This quantum for income received from gold mining versus that from coal mining is very low. Meaning much less freight activity is required to achieve the same income. Generally, high freight intensity means low returns for many tonne-kms. It can be improved by higher value economies (services and high value products - where the freight to product value ratio is low) or more efficient logistics (less kilometres for the same task, achieved through *inter alia* lower empty haul, better routing, better load factors, etc).

³ The other bulk commodities of significance to the South African economy are coal exports through Richards Bay and conveyor belt coal to power stations. The physical flows of these two bulk commodities do not interact directly with the Western Cape's economy.

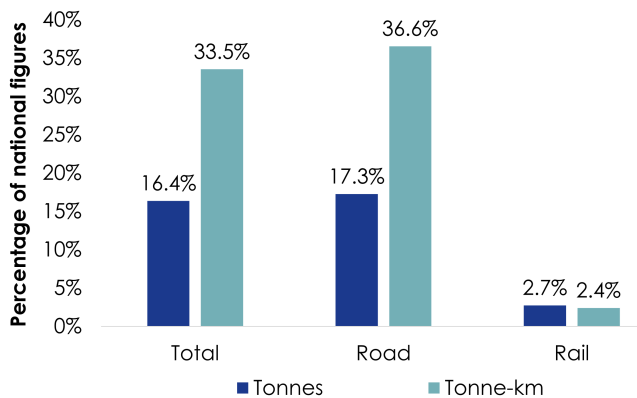


Figure 3: The WC's GFB volumes as a percentage of SA's in 2024

Furthermore, rail freight transport's GFB contribution is comparatively low against that of road, especially given the long transport distances to inland markets. The national FDM™ indicates that rail freight transport's corridor market share is the highest on the Natal corridor (next to the N3), and lowest on the Cape corridor (next to the N1). Historically, the majority of the rail freight sector's developments were concentrated along the Natal corridor, even though it is much shorter than the Cape corridor. An underdeveloped Cape corridor and long transport distances has led to the WC experiencing a lower comparative rail market share (with bulk commodities excluded). The WC is, therefore, in a position where leveraging initiatives that encourage modal optimisation and transport cost efficiencies for GFB traffic will have the greatest positive effect.

Table 1 shows the WC's overarching freight position. Due to the province's slightly larger tertiary sector⁴, its contribution to transportable GDP is lower than its contribution to total GDP. Although the WC contributed only 14.2% to national transportable GDP⁵, it contributed 39.1% and 33.5% of national's total and GFB tonne-kms, respectively.

Table 1: The WC's overarching freight position in 2024

Measure	SA	WC	%
GDP (Billion Rands current prices)	7 352.4	1 041.4	14.2%
Transportable GDP (Billion Rands current prices) ⁶	1 590.3	201.4	12.7%
Tonnes (millions)	790.1	145.3	18.4%
GFB tonnes (millions)	518.7	84.9	16.4%
Tonne-kms (billions)	286.3	112.0	39.1%
GFB tonne-kms (billions)	178.0	59.7	33.5%

The contribution of the WC's mining volumes to its total freight volumes was 59.7%, which approaches the national mining sector's 64.9% contribution to SA's total freight volumes, as shown in Figure 4. As described before, the mining sector's significant role in the WC's is due to the export gateway for iron ore through the Port of Saldanha. When the bulks are excluded, the contribution of the WC's GFB mining volumes to its total freight volumes declines to 31.1%, with manufacturing (mostly consisting of agro-processing) and agriculture increasing to 48.9% and 20.0%, respectively (when compared to each sectors' contribution to total tonnes).

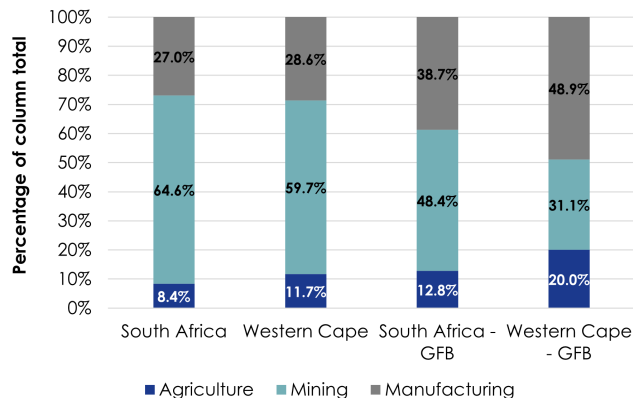


Figure 4: Total and GFB tonnes per sector as percentage of total tonnes for SA and the WC in 2024

Figure 5 shows the percentage contribution of total (including the bulks) and GFB (excluding the bulks) tonne-kms per sector for SA and the WC.

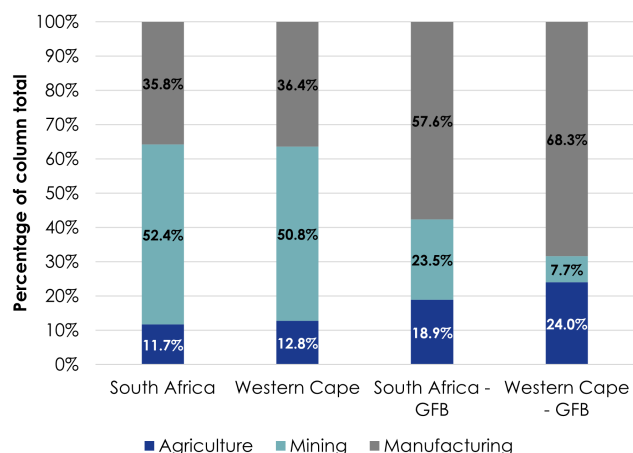


Figure 5: Tonne-kms per sector as percentage of total tonne-kms for South Africa and the Western Cape (2024)

The mining sector contributed near two thirds of SA's and the WC's respective freight volumes - while accounting for 52.4% and 50.8% of their total tonne-kms in 2024, respectively. The relatively lower tonne-km contribution is due to the WC's mining activities having relatively shorter hauls (mostly Namaqua Sands projects) than mining activities in the rest of the country. Meanwhile, the manufacturing sector contributed 27.0% and 28.6% of SA's and the WC's respective freight volumes - while accounting for 35.8% and 36.4% of their total tonne-kms in 2024, respectively. In comparison, the agricultural sector only represented 8.4% and 11.7% of SA and the WC's respective freight volumes; while accounting a mere 11.7% and 12.8% of their total tonne-kms in 2024, respectively.

⁴ The primary sector refers to economic activity pertaining to the extraction of raw materials/ goods from the earth (mining and agricultural commodities). The secondary sector receives products from the primary sector (either from the domestic economy or imported) for economic activities related to construction, the manufacturing of intermediate demand goods for further manufacturing processes, and the manufacturing of final consumer products. The tertiary sector consists of the production of services such as banking, insurance and telecommunications.

⁵ STATSSA, P0441.2 - Provincial Gross Domestic Product, 2024

⁶ While national economies are segmented into the primary, secondary and tertiary sectors, the FDM™ only accounts for transportable GDP, that is, the primary (agriculture and mining) and secondary sectors. The tertiary (economic) sector is not transportable and, therefore, not accounted for in the FDM™.

The discrepancy between the WC's contribution to national tonnes and tonne-kms (especially in the manufacturing sector) results from the province's longer inter-provincial trading distances compared to other provinces in SA. This requires longer trips for exporting and importing finished goods and processed and unprocessed food.

A comparison between the total tonnes and tonne-kms per sector shows that, manufacturing and agricultural commodities are being moved over longer distances than mining commodities, on average. This becomes more evident when excluding the bulks. The manufacturing sector contributed 57.6% and 68.3% of SA's and the WC's GFB tonne-kms, respectively. In comparison, the agriculture sector contributed 18.9% and 24.0% of their GFB tonne-kms, respectively.

Highlights

- 145.3 million tonnes (18.4%) of national freight in 2024 (790.1 million tonnes) had either an origin, destination or both within the Western Cape.
- These freight volumes are skewed by bulk line freight, namely iron ore (50.0 million tonnes) and manganese exports (6.2 million tonnes), which are almost entirely destined for the Port of Saldanha.
- With bulks removed, 84.9 million tonnes (16.4%) of all national freight in 2024 (518.7 million tonnes), known as General Freight Business (GFB) volumes moved through the Western Cape.
- The Western Cape contributed R 1 041.4 billion (14.2%) and R201.4 billion (12.7%) to national GDP (R7 352.4 billion) and transportable GDP (R1 590.3 billion) in 2024, respectively. This is relatively low compared to its 112.0 billion (39.1%) and 59.7 billion (33.5%) contributions to national total (286.3 billion) and GFB (178.0 billion) tonne-kms, respectively.



In this chapter, Western Cape freight is discussed from two perspectives, namely, total freight and general freight business (GFB). GFB is defined as the competitive market space and consists of the total freight tonnes less coal-, iron ore-, and manganese exports, pipelines and (for the subsequent analysis) stone and aggregate. The latter has been removed from the GFB analysis because it is typically a very short-distance movement of mostly construction aggregate, which is challenging to quantify and has extremely dispersed transport. Previously iron ore on the export line, which was used for Saldanha Steel, was included in GFB. This iron ore, however, uses the same dedicated line and station infrastructure as the export iron ore and was revised to be non-GFB freight, as it was not mode competitive.

Trade by mode

Total road and rail freight with an origin or destination in the Western Cape in 2024 is shown in Figure 1 and amounted to 143.8 million (m) tonnes, representing a slight increase from the 143.6m tonnes in 2023.

The total tonnes per sector for road and rail are given in Figure 2. The waste data¹, consists of municipal waste, organic waste, and construction and demolition waste. The largest concentration of waste generation and transportation occurs within the CoCT, which has a substantial impact on local flows.

GFB volumes are shown in Figure 3, with the dominance of manufacturing being evident. The 2024 data shows a decrease for road tonnes from 2023 for the mining (12%) sector, but an increase for the agriculture (2%) and manufacturing (0.4%) sectors. Agriculture freight by rail increased by 16%, while mining and manufacturing decreased by 3% and 31%, respectively. Rail lost 0.6% of its market share of GFB volumes in 2024 compared to 2023, which is significantly less than the 25% loss in 2023 compared to 2022.

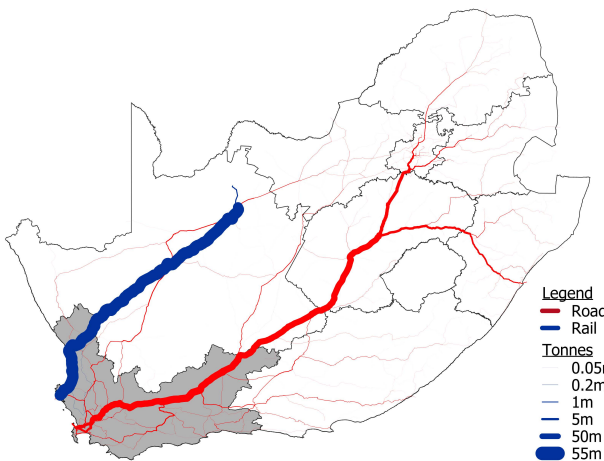


Figure 1: Total freight with an origin or destination in the Western Cape scaled to iron ore export line (2024)

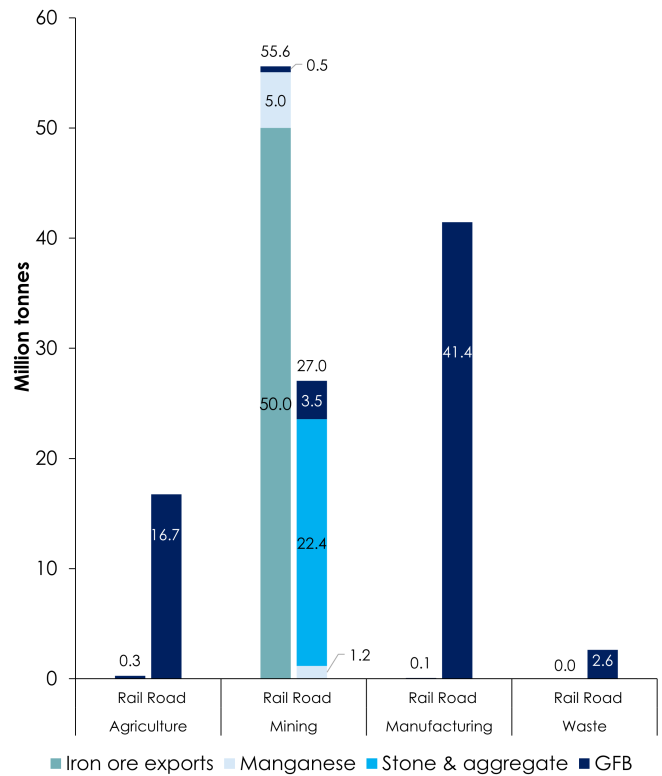


Figure 2: Total road and rail tonnes per sector in the Western Cape (2024)

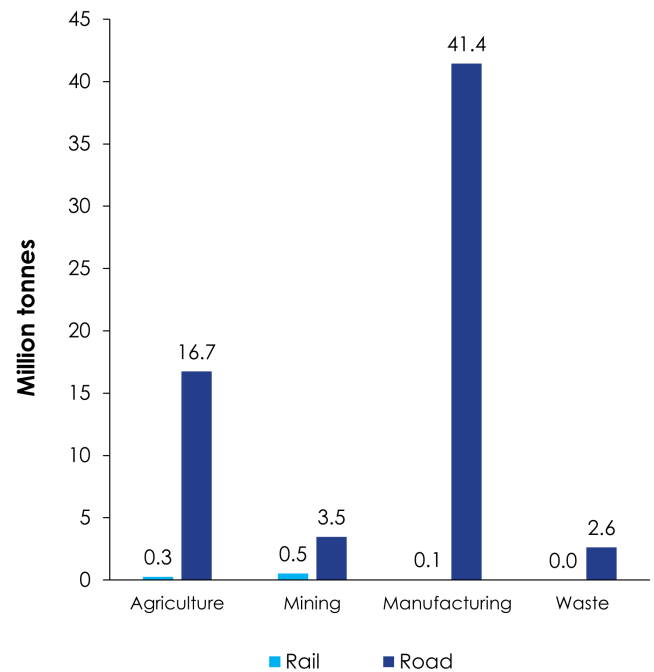


Figure 3: GFB road and rail tonnes per sector (2024)

¹ Available waste data has been integrated, despite not fully visible in terms of all routing and movements, as well as limited detail on other waste categories such as hazardous waste.

Figure 4 (to its own scale) shows GFB rail freight movements that touch the Western Cape.

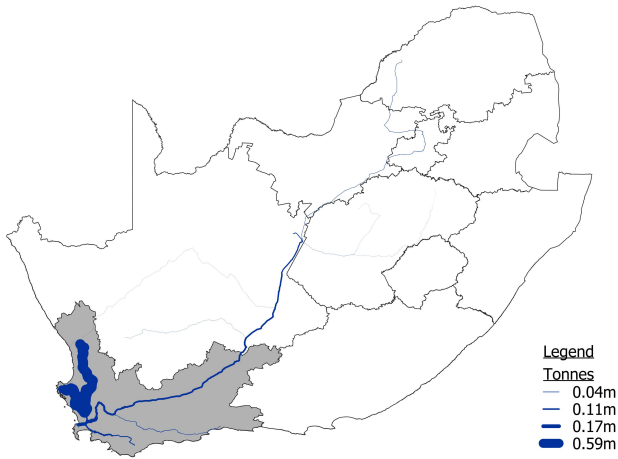


Figure 4: GFB rail freight that touches the Western Cape (2024)

Despite a historical decline in agricultural dry bulk freight transported by rail, the sector saw a recovery in 2024, compared to 2023, with a total volume increase of 37 422 tonnes (16%). Continuing the trend from 2023, barley and maize remain the only agricultural dry bulk commodities utilising rail transport.

The growth in 2024 was driven exclusively by maize, which increased by 44 223 tonnes (41%), effectively offsetting the decline in barley, which decreased by 6 801 tonnes (5%).

All chemicals (4 211 tonnes, i.e. 0.3% market share) and fertilizer (7 828 tonnes, i.e. 1.5% market share) previously transported by rail were lost between 2023 and 2024.

Apart from coal and iron ore needed for the plant, rail is basically only used at Namakwa Sands (Tronox), at a stable rate of half a million tonne per annum. Ilmenite (titanium ore), rutile, and zircon transported by rail each decreased by 5% compared to 2023. Figure 4's contrast with Figure 1 highlights the limited role of rail, once the bulk coal and iron ore exports have been removed.

Fruit on rail remains a major opportunity that has not been realised due to the lack of consolidation facilities, rail service levels and capacity.

Apart from road and rail freight, there is one movement of crude oil in pipelines between the City of Cape Town and the Port of Vredenburg amounting to 3.98m tonnes, the same as in 2023.

Commodity splits by road and rail

Freight volumes per commodity per mode (road and rail) for Western Cape-related GFB freight can be seen in Figure 5.

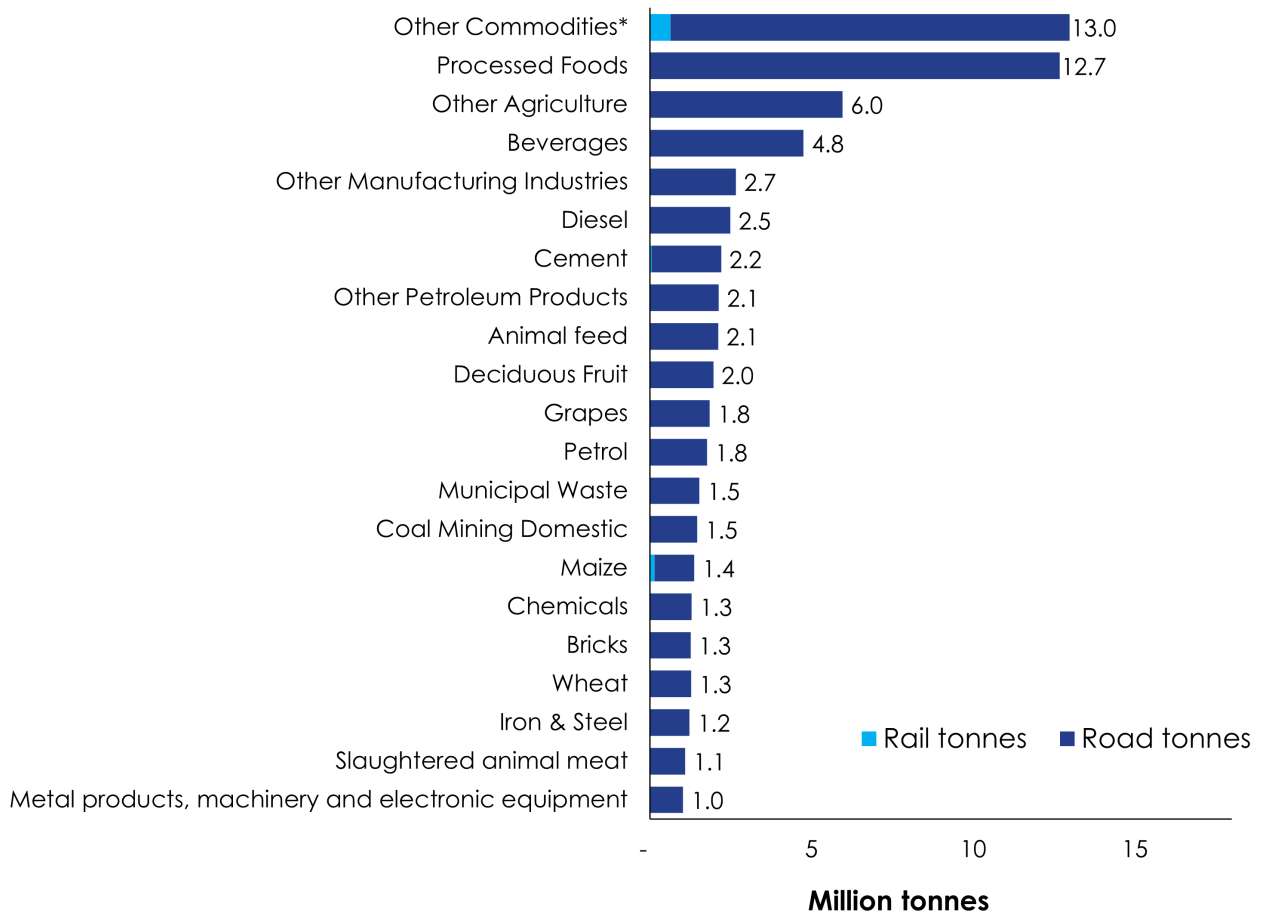


Figure 5: Western Cape related GFB freight volumes per commodity per mode (2024)

* See 15-1 'Other manufacturing commodities' for more detail on the commodities included in this grouping. Figure 5 only highlights twenty separate commodities with the highest total GFB freight volumes in 2024.

Table 1 provides the Western Cape rail volumes and market share for commodities that have rail market share.

Table 1: Rail volumes and market share (2024 and 2023)

Commodity on rail	Rail volumes (thousand tonnes)		Rail market share	
	2024	2023	2024	2023
Ilmenite (Titanium ore)	399.4	403.3	100%	100%
Maize	152.1	107.9	11%	9%
Barley	122.8	129.6	30%	33%
Zircon	84.7	88.9	82%	77%
Cement	52.3	57.9	2%	3%
Rutile	26.7	28.0	94%	94%
Coal Mining Domestic	15.4	19.5	1%	1%
Beverages	9.8	19.8	0.2%	0.4%
Gypsum	6.3	8.0	6%	6%
Fertilizer	-	7.8	0%	2%
Chemicals	-	4.2	0%	0.3%
Metal products, machinery and electronic equipment	-	0.1	0%	0.01%

Globally, the largest rail market share has historically been in low-value, bulk commodities with large parcel sizes (i.e., consignments). The traditional belief was that these freight categories serve rail economics better; the bulk mining and agricultural commodity market share was usually the highest. However, intermodal traffic, and especially domestic intermodal, has grown faster in most developed countries' railways over the last decade.

Rail has a captive market in bulk mining exports; the current success of their business, therefore, depends largely on exogenous factors, such as global economic growth, strong commodity prices, and proximity to transport facilities. Globally, rail service providers have realised that the most stable growth opportunity is fast-moving consumer goods (FMCG), which can be palletised, containerised, and moved through a domestic intermodal solution. This should also be the case for South Africa, especially for the Natal and Cape corridors. Rail transport becomes more efficient than road over long distances, given a sufficient level of density. Therefore, based on the long average distance freight travels on the Cape Corridor, it presents the biggest opportunity.

Despite rail tonnes in the Western Cape growing faster than national rail tonnes since 2010, it was not resilient to the drop in rail freight in 2020. After recovering some freight in 2023 (like it did during 2021), rail tonnes declined slightly in 2024 (see Figure 6).

While national rail tonnes and tonne-kms have increased in the same period, it should be noted that this is largely due to improvements related to dedicated bulk exports like coal and iron ore, along with other bulk mining commodities like chrome, manganese, and magnetite. Excluding these commodities, national rail tonnes and tonne-kms would likely show a similar trajectory to that of the Western Cape.

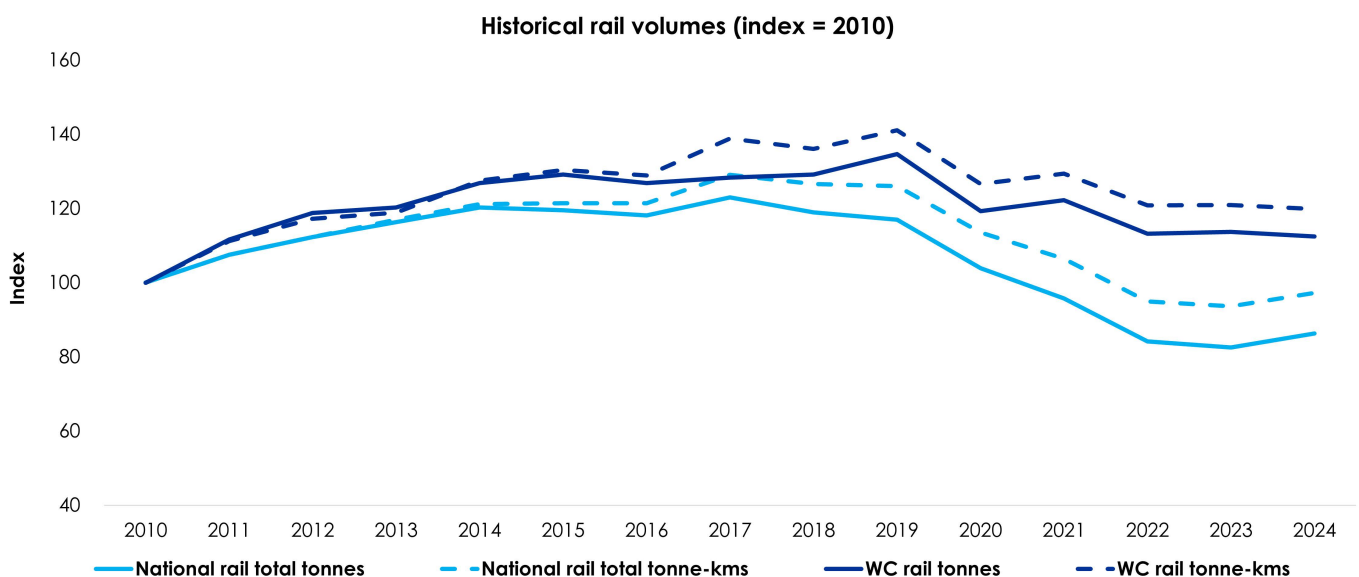


Figure 6: Time series of indexed national and Western Cape rail tonnes and tonne-kms from 2010 to 2024 (index = 2010)

Highlights

- Total road and rail freight (2024) with an origin or destination in the Western Cape amounted to 143.8m tonnes, showing a slight increase from the 143.6m tonnes in 2023. When considering total freight, the mining sector is dominant due to 50.0m tonnes of export iron ore freight.
 - Modal share in the Western Cape (excluding air freight and pipelines) remained unchanged for total freight (61% for road and 39% for rail) in 2024. There was similarly, no significant change in the market share for GFB freight (99% for road and 1% for rail) since 2023.
 - As in 2023, pipeline freight amounted to 3.98m tonnes in 2024, whereof everything was crude oil being moved between the City of Cape Town and the Port of Vredenburg.
 - Air freight via Cape Town International Airport amounted to 74 888 tonnes, whereof most (61%) movements were related to exports. Overall, fresh food was the most prevalent air freight commodity (46%). See 16-1 'Air data' for more information.
 - GFB freight rail volumes decreased across the mining and manufacturing sectors in 2024, but increased in the agriculture sector. The mining sector is dominant in GFB rail freight volumes, which is primarily driven by Namakwa Sands activity.
 - Opportunities still exist for rail transport of long-distance GFB freight in the Western Cape. Similarly, fruit on rail remains a major opportunity that has not been realised due to the lack of consolidation facilities and service levels.
-



The total 147.8m tonnes of freight touching the Western Cape is made up of 86.6m mining tonnes (59%), 41.5m manufacturing tonnes (28%), 17.0m agricultural tonnes (12%), and 2.6m waste tonnes (2%) (refer to Figure 1).

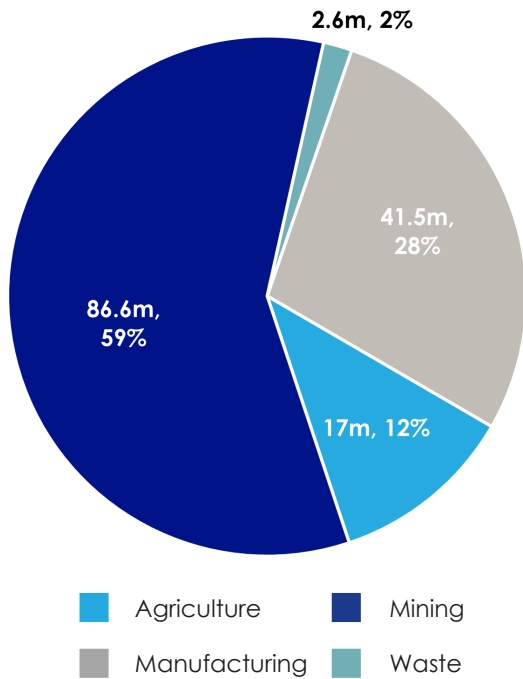


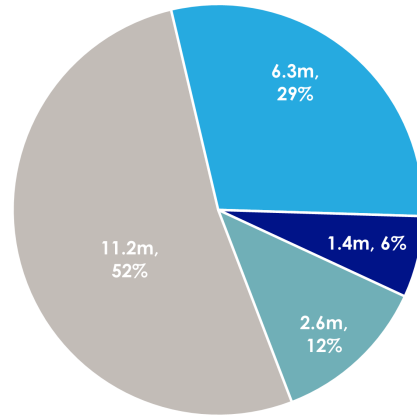
Figure 1: Total freight-flows per sector (tonnes 2024)

The Western Cape's total General Freight Business (GFB)¹ of 64.6m tonnes consists of 21.5m tonnes intra-Western Cape freight, 24.5m tonnes transported to other provinces and 18.7m tonnes received from other provinces.

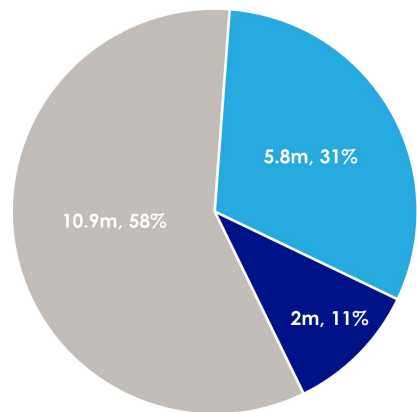
Intra-Western Cape freight shows an increase of 0.3m tonnes for 2024 compared to 21.2m tonnes in 2023. The tonnes transported to other provinces decreased by 0.3m tonnes (24.8m tonnes in 2023) and freight received from other provinces decreased by 0.3m (18.9m tonnes in 2023). These flows are shown per sector in Figure 2. Waste was modelled as a separate sector to determine its impact on the Western Cape's freight flow economy. Waste is not moved to or from other provinces, therefore, it is only an intra-provincial flow. While 2.6m tonnes of waste were transported in both 2023 and 2024, these volumes represented 10% and 12% of the intra-Western Cape freight in those years, respectively.

In 2024, the Western Cape received 0.22m less tonnes of mining commodities from other provinces than in 2023. Similarly, 0.1m less tonnes of mining commodities were sent to other provinces. The manufacturing freight sent to other provinces in 2024 saw a decrease of 0.4m tonnes compared to 2023, with manufacturing freight received from other provinces increasing by 0.1m tonnes. The volumes of agriculture commodities sent increased by 0.2m tonnes and received decreased by 0.1m tonnes.

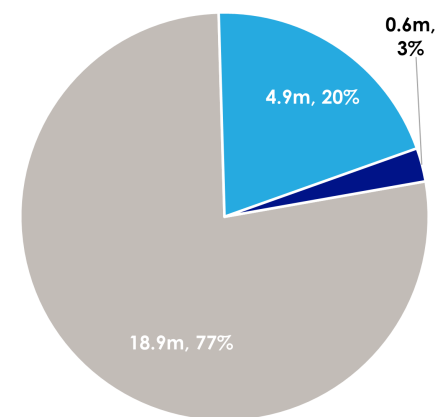
Intra-Western Cape freight (tonnes)



Freight from other provinces (tonnes)



Freight to other provinces (tonnes)



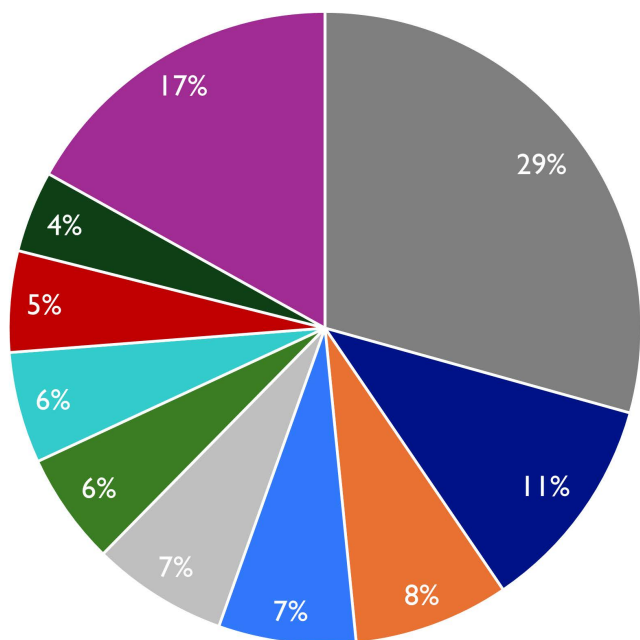
Agriculture Mining Manufacturing

Figure 2: Provincial GFB freight-flows per sector (tonnes 2024)

¹ GFB is defined as the competitive market consists of the total freight tonnes less iron ore exports, manganese exports, pipelines and, for the analysis that follows, stone and aggregate. The latter has been removed from the subsequent GFB analysis because it is typically a very short-distance movement of mostly construction aggregate, which is challenging to quantify and has extremely dispersed transport.

An industry breakdown of the Western Cape manufacturing sector is shown in Figure 3. It shows the intra-Western Cape manufacturing tonnes, as well as the manufacturing tonnes flowing to other provinces, to depict the manufacturing base of the province. Of the total 30.1m tonnes of manufacturing commodities that originate from the Western Cape, only 11.2m tonnes are distributed inside the province while 18.9m tonnes are sent to the rest of the country. The largest commodity group is processed foods which contributes 29% (a decrease of 124 364 tonnes from 2023), followed by beverages (11%) and diesel (8%). Provided that there is no structural change to the South African economy, processed foods should continue to be the mainstay of the Western Cape's manufacturing sector.

KwaZulu-Natal (KZN) again dominates as the Western Cape's main GFB trading partner, followed by Gauteng as shown in Figure 4. The Western Cape receives 5.4m tonnes (29.1%) of its GFB freight from KZN and 2.8m tonnes (15.0%) from Gauteng. Of all the GFB freight originating from the Western Cape, 5.1m tonnes (20.9%) are destined for Gauteng and 4.6m tonnes (18.7%) for KZN. If it was not for the Port-related trade with KZN, Gauteng would have been the Western Cape's biggest trading partner, because 23.8% of trade with KZN is related to the Port of Durban.



- Processed foods
- Beverages
- Diesel
- Other petroleum products
- Cement
- Petrol
- Animal feed
- Other manufacturing industries
- Bricks
- Other commodities²

Figure 3: Manufacturing commodities with origin Western Cape (intra-provincial and outgoing, 2024)

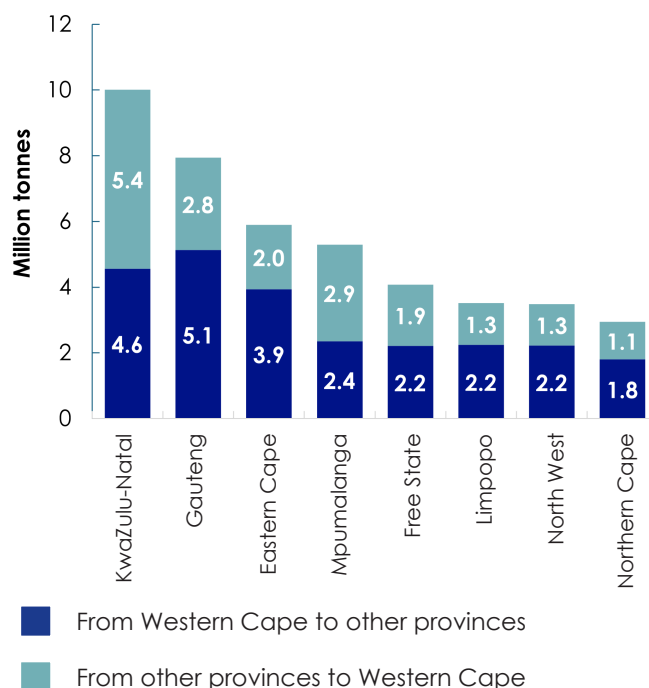


Figure 4: Western Cape inter-provincial GFB freight (2024)

Highlights

- A total of 147.8m tonnes of freight touched the Western Cape in 2024 and is made up of 86.6m mining tonnes (59%), 41.5m manufacturing tonnes (28%), 17.0m agricultural tonnes (12%), and 2.6m (2%) waste tonnes.
- The Western Cape GFB freight (64.6m tonnes) is split between intra-Western Cape freight (21.5m tonnes), freight transported to other provinces (24.5m tonnes) and freight received from other provinces (18.7m tonnes).
- Waste is an intra-provincial flow only and amounts to 2.6m tonnes (12% of intra-Western Cape freight).
- More than half (54%) of intra-Western Cape freight and 77% of freight to other provinces are manufacturing commodities, which together amount to 30.1m tonnes. Manufacturing freight represents 58% of the Western Cape's freight from other provinces.
- The largest commodity group in the Western Cape's manufacturing sector is processed foods (29%), followed by beverages (11%) and diesel (8%).
- KwaZulu-Natal (KZN) is the Western Cape's main GFB trading partner, followed closely by Gauteng. If it was not for the Port related trade, Gauteng would have been the Western Cape's biggest trading partner, because 23.8% of trade with KZN is related to the Port of Durban.

² Please refer to 15-1 'Other manufacturing commodities' for more detail on the commodities included in this 'Other commodities' grouping. Figure 3 only highlights specific manufacturing commodities with an origin in the Western Cape (intra-provincial and outgoing) since their volumes exceeded one million tonnes in 2024. These other commodities are, therefore, comprised of various manufacturing commodities which had volumes of less than one million tonnes in 2024.



To determine corridor freight for the N1, N2 and N7, the districts of South Africa are divided into five (5) zones, of which the first four are illustrated in Figure 1:

1. N1 Corridor;
2. N2 Corridor;
3. N7 Corridor;
4. Core Western Cape (districts within which freight movements are not considered to be on any of the national corridors);
5. Metropolitan (a combination of the Cape Town Metropolitan area and its peripheral areas); and
6. Non-corridor (any freight movement not clustered according to the cluster rules)

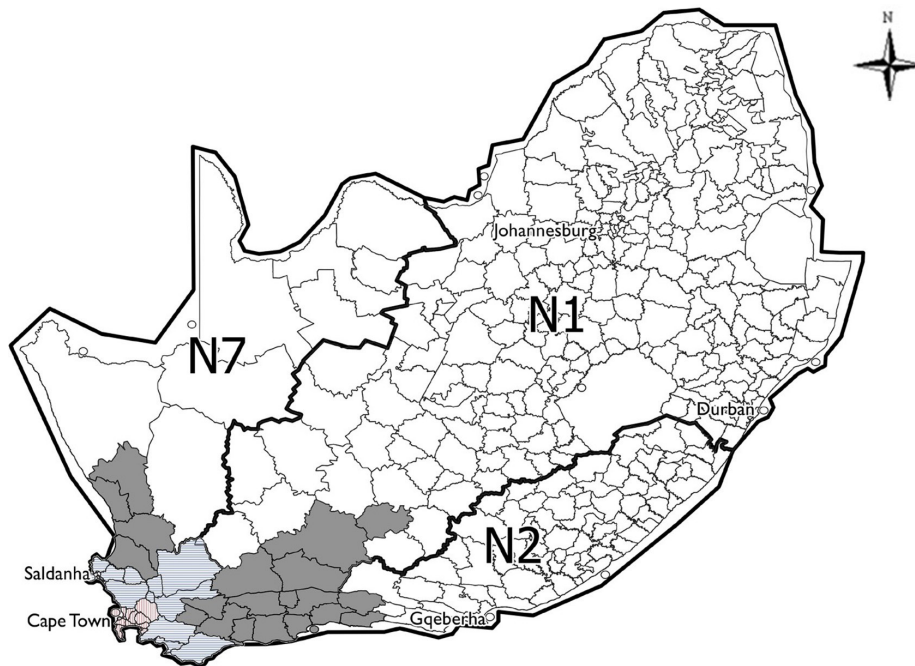


Figure 1: Corridor definitions for Western Cape freight

As shown in Figure 2, freight in the Core Western Cape zone is further sub-divided into Cape Town Metropolitan freight.

The Cape Town Metropolitan (Zone 5) freight is defined as freight that has its origin and destination inside the metropolitan areas.

The Origin-Destination (OD) pairs are clustered into corridors by applying the following rules:

Cluster rules

- If the origin and destination are both within either the N1, N2 or N7 zones, the OD pair is assigned to that corridor.
- If the origin and destination are within different corridor zones, the OD pair is not assigned to a corridor.
- If the origin and destination are both within the core Western Cape zone, the OD pair is not assigned to a corridor.
- If either the origin or destination is within the core Western Cape zone, the OD pair is assigned to the corridor zone in which the non-core Western Cape origin or destination is.

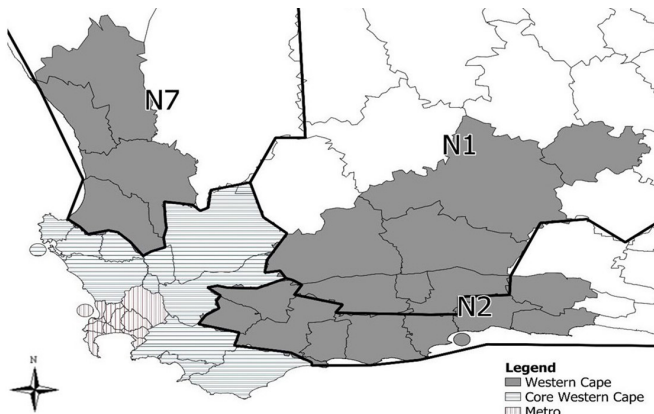


Figure 2: OD pairs for Cape Town Metropolitan freight

Table 1 provides total road and rail freight in tonnes and tonne-kms, with the percentage split for each, per zonal grouping.

Table 1: Total road and rail freight in tonnes and tonne-kms per zone (2024)

Zonal Grouping	Total tonnes			Total tonne-kms		
	Road tonnes (million) (% of zone freight)	Rail tonnes (million) (% of zone freight)	Total (million)	Road tonne-kms (billion) (% of zone freight)	Rail tonne-kms (billion) (% of zone freight)	Total (billion)
N1 Corridor traffic	29.9 (99.8%)	0.1 (0.2%)	30.0	41.4 (99.8%)	0.1 (0.2%)	41.4
N2 Corridor traffic	9.0 (99.8%)	0.02 (0.2%)	9.1	5.6 (99.8%)	0.01 (0.2%)	5.6
N7 Corridor traffic	4.2 (7.0%)	55.6 (93.0%)	59.8	2.4 (4.4%)	51.3 (95.6%)	53.7
Metropolitan traffic	27.1 (99.7%)	0.1 (0.3%)	27.2	0.6 (99.1%)	0.01 (0.9%)	0.6
Core Western Cape	8.9 (98.2%)	0.2 (1.8%)	9.0	0.6 (97.4%)	0.02 (2.6%)	0.7
Non-corridor traffic	9.1 (99.7%)	0.02 (0.3%)	9.2	10.3 (99.7%)	0.04 (0.3%)	10.4
Total	88.3 (61.2%)	55.9 (38.8%)	144.2	60.8 (54.2%)	51.5 (45.8%)	112.3

Table 2 provides total GFB¹ road and rail freight in tonnes and tonne-kms, with the percentage split for each, per zonal grouping.

Table 2: GFB road and rail freight in tonnes and tonne-kms per zone (2024)

Zonal Grouping	GFB tonnes			GFB tonne-kms		
	Road tonnes (million) (% of zone freight)	Rail tonnes (million) (% of zone freight)	Total (million)	Road tonne-kms (billion) (% of zone freight)	Rail tonne-kms (billion) (% of zone freight)	Total (billion)
N1 Corridor traffic	29.7 (99.8%)	0.1 (0.2%)	29.8	41.4 (99.8%)	0.1 (0.2%)	41.4
N2 Corridor traffic	8.1 (99.8%)	0.02 (0.2%)	8.2	5.5 (99.8%)	0.01 (0.2%)	5.5
N7 Corridor traffic	2.9 (85.1%)	0.5 (14.9%)	3.5	1.2 (83.0%)	0.2 (17.0%)	1.4
Metropolitan traffic	8.2 (99.1%)	0.1 (0.9%)	8.3	0.2 (97.8%)	0.01 (2.2%)	0.2
Core Western Cape	6.5 (97.5%)	0.2 (2.5%)	6.7	0.5 (96.6%)	0.02 (3.2%)	0.5
Non-corridor traffic	8.7 (99.7%)	0.02 (0.3%)	8.7	10.3 (99.6%)	0.04 (0.4%)	10.3
Total	64.2 (98.7%)	0.9 (1.3%)	65.1	59.1 (99.4%)	0.4 (0.6%)	59.5

Table 3 displays the GFB freight, excluding domestic iron ore and coal.

Table 3: GFB (also excluding domestic iron ore and coal) road and rail freight in tonnes and tonne-kms per zone (2024)

Zonal Grouping	GFB (also excluding domestic iron ore and coal) tonnes			GFB (also excluding domestic iron ore and coal) tonne-kms		
	Road tonnes (million) (% of zone freight)	Rail tonnes (million) (% of zone freight)	Total (million)	Road tonne-kms (billion) (% of zone freight)	Rail tonne-kms (billion) (% of zone freight)	Total (billion)
N1 Corridor traffic	28.8 (99.8%)	0.1 (0.2%)	28.9	40.0 (99.8%)	0.1 (0.2%)	40.1
N2 Corridor traffic	8.1 (99.8%)	0.02 (0.2%)	8.1	5.5 (99.8%)	0.01 (0.2%)	5.5
N7 Corridor traffic	2.8 (84.5%)	0.5 (15.5%)	3.3	1.1 (82.8%)	0.2 (17.2%)	1.4
Metropolitan traffic	8.2 (99.1%)	0.1 (0.9%)	8.3	0.2 (97.8%)	0.01 (2.2%)	0.2
Core Western Cape	5.8 (97.2%)	0.2 (2.8%)	6.0	0.5 (96.7%)	0.02 (3.3%)	0.5
Non-corridor traffic	7.8 (99.9%)	0.01 (0.1%)	7.8	9.2 (99.9%)	0.005 (0.1%)	9.2
Total	61.5 (98.6%)	0.9 (1.4%)	62.4	56.6 (99.4%)	0.3 (0.6%)	56.9

¹ GFB is defined as the competitive market consists of the total freight tonnes less iron ore exports, manganese exports, pipelines and, for the analysis that follows, stone and aggregate. The latter has been removed from the subsequent GFB analysis because it is typically a very short-distance movement of mostly construction aggregate, which is challenging to quantify and has extremely dispersed transport.

When compared to volumes of previous years, the rail tonnages on the N1 and N7 corridors show a general decrease - with the exception being maize, which saw an increase of 4 816 tonnes within the N7 zonal grouping. GFB freight has also seen a general decline in rail tonnages with the N1, N2 and N7 decreasing by 1.5%, 1.1% and 9.9% respectively. The Metropolitan and Core corridors saw a decline of 0.3% and 3.3% in rail tonnages compared to 2023 figures, respectively. The tonne-km view confirms a smaller rail market share, indicating that longer distance freight is increasingly being transported by road. This indicates that a long-distance market exists that could potentially benefit from rail's economies of scale, provided that rail operators can offer a competitive service.

Table 4 shows the breakdown of GFB (excluding road domestic iron ore and coal) road freight per zone. Note that 46.8% of this freight travels on the N1 road corridor, with an average distance travelled of 1 388 km.

Table 4: GFB (excluding road domestic iron ore and coal) road freight per zone (2024)

Zonal Grouping	Road tonnes (million)	Percentage of road traffic	Average Travel Distance (km)
N1 Corridor traffic	28.8	46.8%	1 388
N2 Corridor traffic	8.1	13.2%	679
N7 Corridor traffic	2.8	4.6%	405
Metropolitan traffic	8.2	13.3%	28
Core Western Cape	5.8	9.5%	87
Non-corridor traffic	7.8	12.7%	1 176
Total	61.5	100.0%	

Highlights

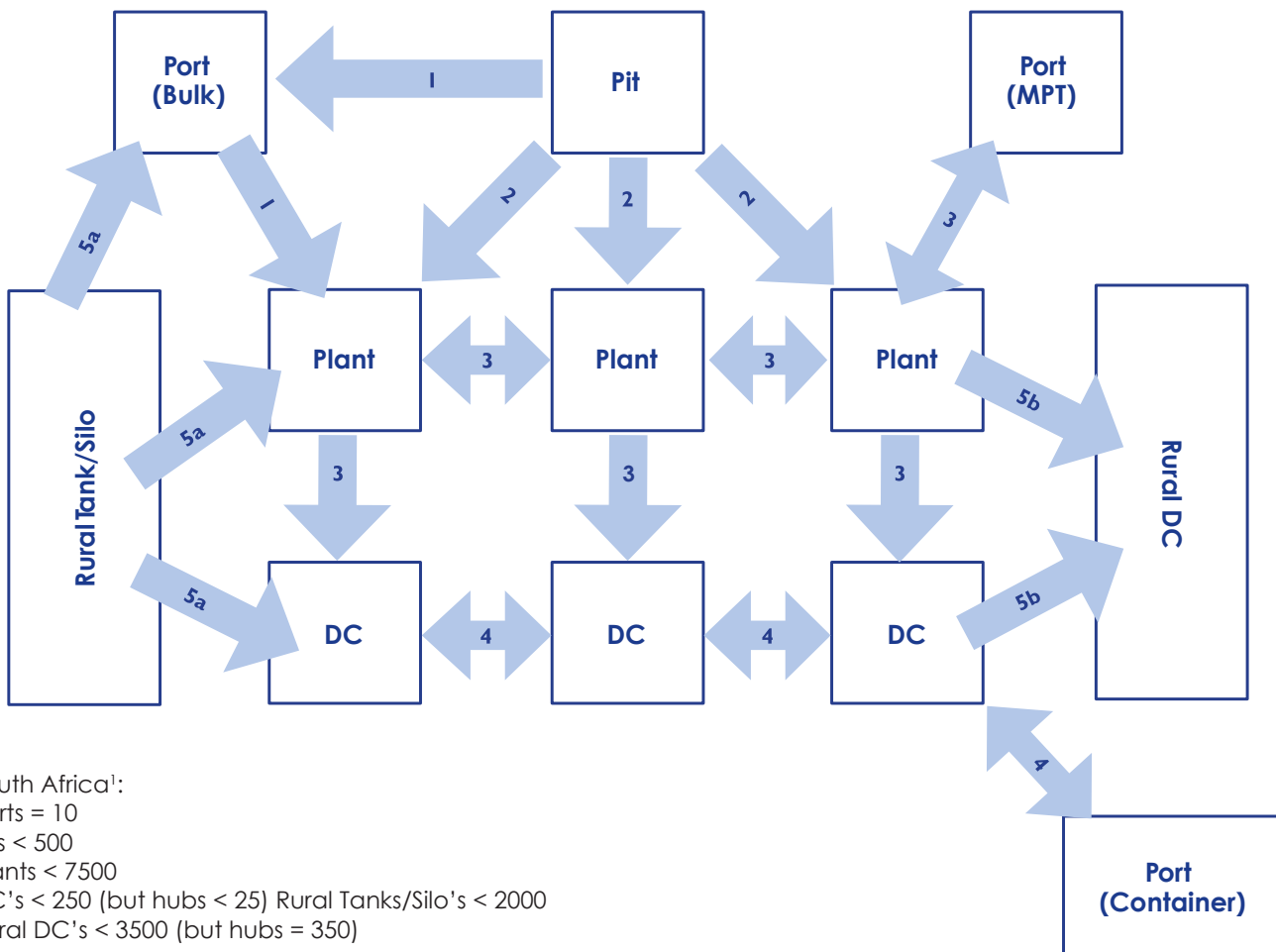
- For total freight touching the Western Cape, the N7 is the only corridor with significant rail volumes. However, this is primarily due to the dedicated iron ore corridor (i.e. iron ore and manganese exports).
- Corridor GFB freight is dominated by road, with: 99.8% market share on the N1 corridor; 99.8% market share on the N2 corridor and 85.1% market share on the N7 corridor.
- The average travel distance of road freight on the N1, N2, N7, Metropolitan and Core Western Cape corridor is 1 388 km, 679 km, 405 km, 28 km and 87 km respectively.
- Due to the low rail market share, modal shift opportunities exist for long-distance road freight in the Western Cape (more detail in Scenario 1: Modal shift).



Background to the segmentation of freight flows based on economic structure

The segmentation definitions are illustrated in Figure 1. A pit refers to a source where raw materials are extracted from the earth. Ore from the pit can be transported to a bulk terminal, port or directly to a plant for beneficiation. Beneficiated ore can be transported to another plant (intermediate demand), directly to metropolitan or rural areas, to distribution centres (DC) for consolidation before it is transported to a metropolitan or rural area, or it can be exported. Based on this view of freight flow segmentation:

- Class 1 (T1) represents freight flow from a pit to a bulk port (exports) and from a bulk port to a plant (imports).
- T2 refers to direct flows from pit to plant.
- T3 are flows from one plant to another for beneficiation, to a distribution centre for final consumption, or between plants and Multi-Purpose Terminals (MPTs) for exports and imports.
- T4 represents commodity flows between distribution centres (typically over long distances between metropolitan areas) for final domestic consumption, or between DCs and port container terminals for exports and imports.
- T5 represents all flows to and from rural areas; T5a flows originate at a rural tank or silo, while T5b are all flows destined for a rural DC.



South Africa¹:
 Ports = 10
 Pits < 500
 Plants < 7500
 DC's < 250 (but hubs < 25) Rural Tanks/Silo's < 2000
 Rural DC's < 3500 (but hubs = 350)

Figure 1: The different typologies of freight flows²

As depicted in Figure 2, these segments can be summarised in terms of extraction, intermediate manufacturing, final manufacturing and consumption, and can be divided into imports, domestic flows, and exports. The transportation of domestic consumer goods from points of final manufacturing to points of consumption account for 38% of the Western Cape's total transportation cost. Seventy-five percent (75%) of the 17% of extraction to exports refers to the handling of iron ore and manganese exports in Saldanha.

¹ Indication of the number of nodes, terminals and distribution centres in South Africa.

² Havenga, J.H. 2012. Rail renaissance based on strategic market segmentation principles. Southern African Business Review, 16(1)1: 1-21.

Beneficiation therefore represents a significant growth opportunity, changing the Western Cape's status from a "handler" of cargo to an industrial centre. If not for these minerals, the province's beneficiated exports and long-distance imports of final products would exceed the national average, indicating a pressing need to solve the cost concerns of this freight flow segment.

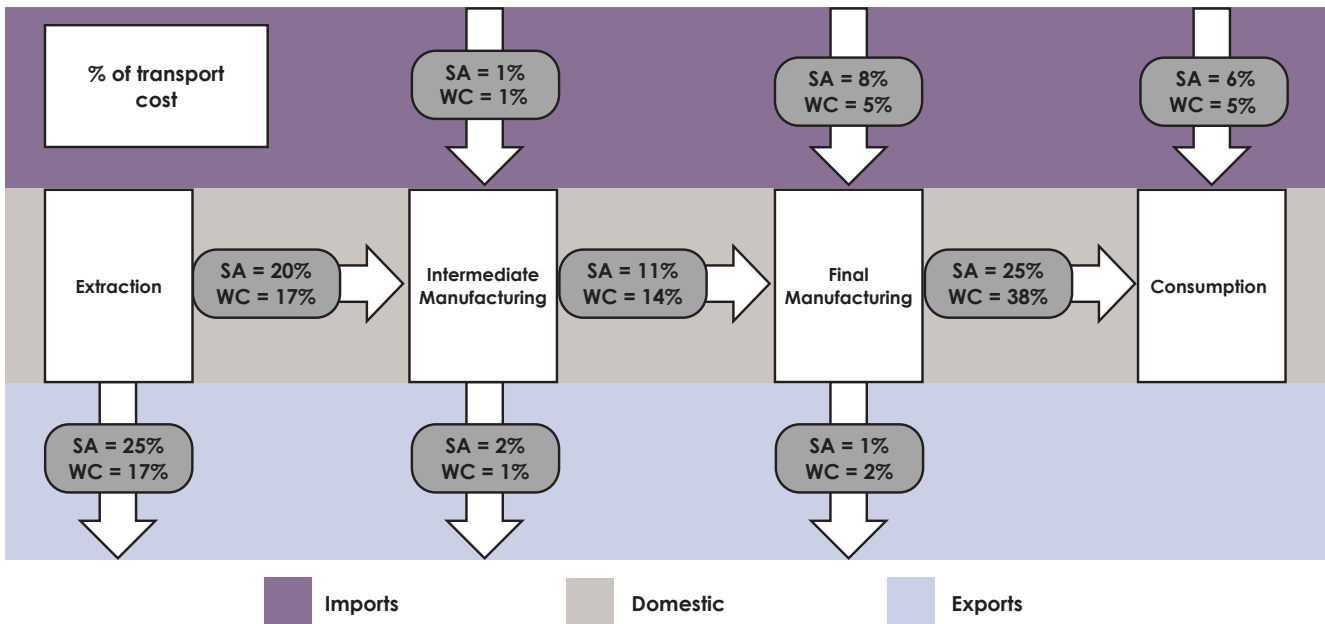


Figure 2: National and Western Cape transport cost per freight flow segment (2024)²

Western Cape freight flows informed by economic structure

An analysis of the 2024 modal split in tonnes for General Freight Business (GFB)³ in the Western Cape confirms that the province transports relatively more manufactured goods, over long distances on road (refer to Figure 3). The data highlights two specific opportunities for rail:

1. Moving long-distance freight between manufacturing plants.
2. Moving fast-moving consumer goods (FMCG) freight by intermodal transport.

The "siding-to-siding" market defines long distance freight that is usually moved from large manufacturing plants to other plants for further beneficiation. In these cases, dedicated sidings are usually the best rail solution. Rail sidings are in place in South Africa, but many have fallen dormant and have large maintenance backlogs. The potential devolution of low-density rail lines in the near future can offer opportunities for the province as these lines often serve rural areas and improving them can contribute to economic development in the province⁴.

Palletisable and containerisable FMCG freight can be transported from private distribution centres through public intermodal terminals. This domestic intermodal opportunity is still absent in South Africa's rail/road service offering, due to management and resource challenges within Transnet, as well as caution from road hauliers owing to the impact on their traditional business models. The inability of the railway to develop these solutions collaboratively with road to capture long-distance FMCG freight is hampering the competitiveness of the Western Cape's industries due to the resulting impact on transport costs. The modal shift scenario identifies cost savings, should rail be able to realise these opportunities (see section 11-1 on Scenario 1: Modal Shift).

The logistics challenges currently facing South Africa and efforts to revitalise Transnet, present opportunities for the public and the private sector to proactively establish terminal and consolidation centres to facilitate the modal shift of palletised and containerised freight.

³ GFB is defined as the competitive market space, and consists of the total freight tonnes less iron ore export line, manganese exports, pipelines and, for the analysis that follows, stone and aggregate. The latter has been removed from the subsequent GFB analysis because it is typically a very short-distance movement of mostly construction aggregate, which is challenging to quantify and has extremely dispersed transport.

⁴ South African Freight Logistics Roadmap, 2023

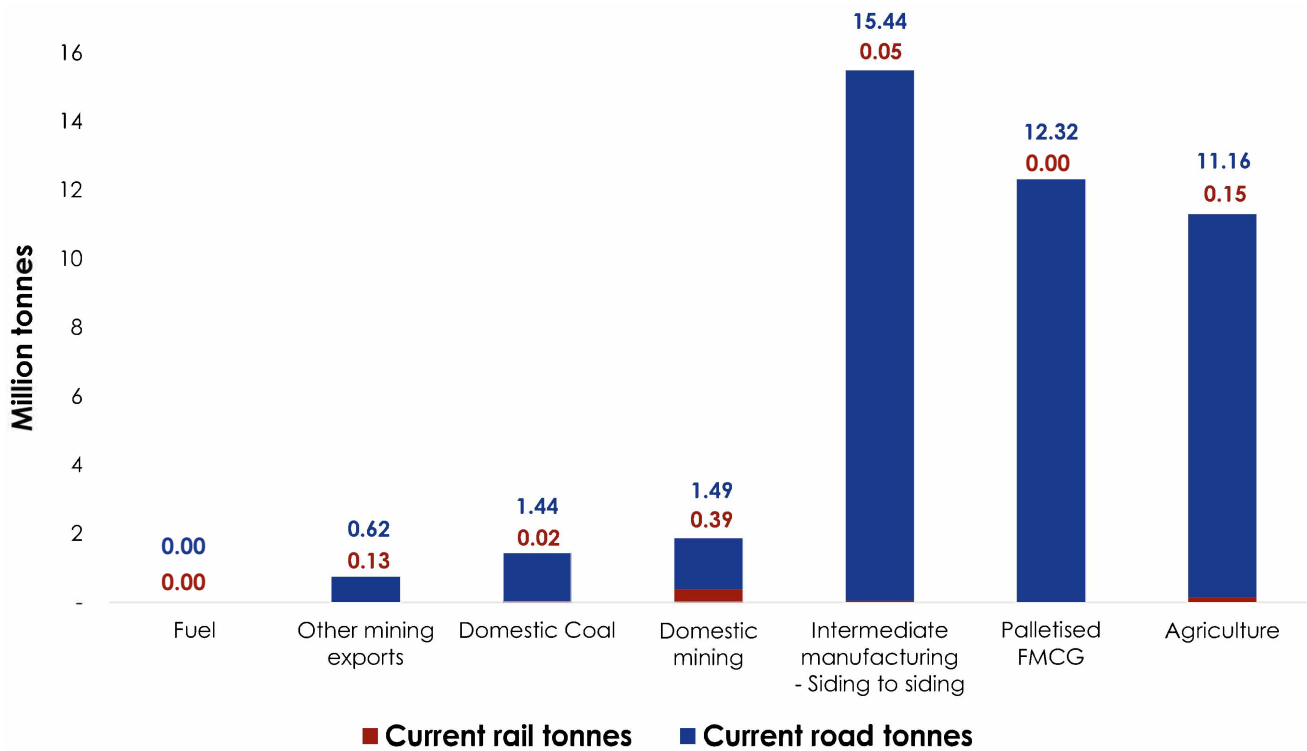


Figure 3: GFB road and rail tonnes per market segment in the Western Cape for 2024

Highlights

- Manufactured goods, transported over long distances on road, constitute a large volume of the Western Cape GFB freight.
- This presents two opportunities for rail:
 1. Siding-to-siding freight, that is, long-distance freight that is usually moved from large manufacturing plants to other plants for further beneficiation; and
 2. FMCG freight that can be palletised and containerised, and transported through domestic intermodal solutions.
- The inability of the rail sector to develop these solutions collaboratively with the road sector to capture the long-distance FMCG freight impacts transport costs, and hence hampers the competitiveness of industries in the Western Cape.
- South Africa's logistics challenges and rail reform initiatives create opportunities for the public and private sector to establish terminal and consolidation centres, promoting the shift of palletised and containerised freight to alternative transport modes.



Economic forecast

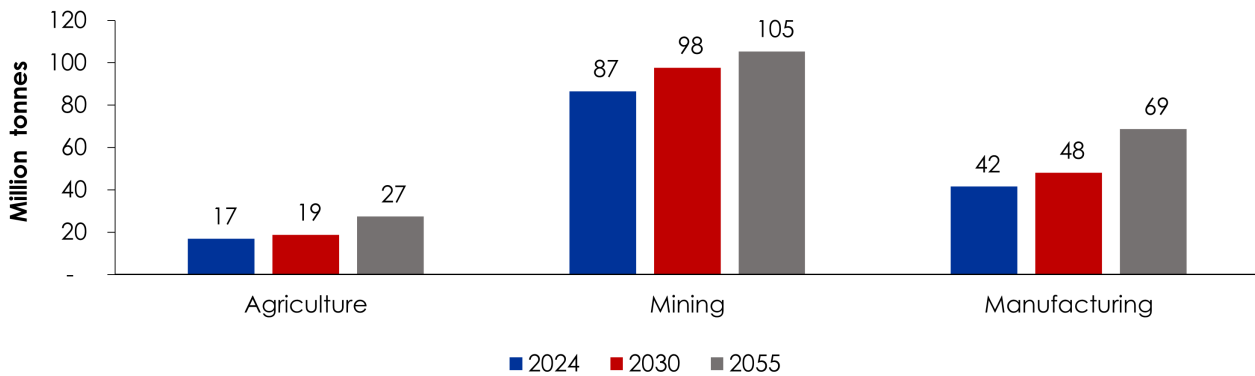
The WC FDM™ considered 2030 and 2055 as the forecast years in the analysis. The total tonnes forecast per sector for 2030 and 2055 are given in Figure 1, both (a) with and (b) without the iron ore and manganese exports, crude oil in pipes, and stone.

While COVID-19's economic impact was considered in previous economic forecasts, this forecast did not consider the potential for continued economic volatility and disruptions to the supply chains. This forecast did, however, consider global climate change perspectives, as well as the short to medium term impact of climate phenomena such as El Niño¹.

The forecast for mining, when considering GFB, is predominantly driven by titanium minerals mining on the West Coast, which is very short-haul and specific. This is evident from Figure 2, which shows the forecasted Western Cape freight flow tonne-kms by sector both (a) with and (b) excluding iron ore and manganese exports, crude oil in pipes, and stone. Evidently, manufacturing tonne-kms currently far exceed the mining tonne-kms when GFB freight is considered.

As shown by Figure 2, manufacturing commodities for the Western Cape are transported over long distances. The forecast also indicates the presence of a ceiling on the export lines². This highlights a systemic problem with the long-term sustainability of the railway lines: their profitability depends on the global demand for South African minerals, despite their high economies of scale. The investment into the export lines was necessary, for both medium-term rail growth and the South African economy; however, it is not a long-term sustainable strategy, for either the railway or South Africa. The economic forecast suggests that the long-term strategy for the Western Cape should focus on developing and supporting efficient logistics solutions to support the growing manufacturing and agriculture sectors, which supply freight to the rest of the country over long distances.

(a) Total Western Cape



(b) GFB Western Cape

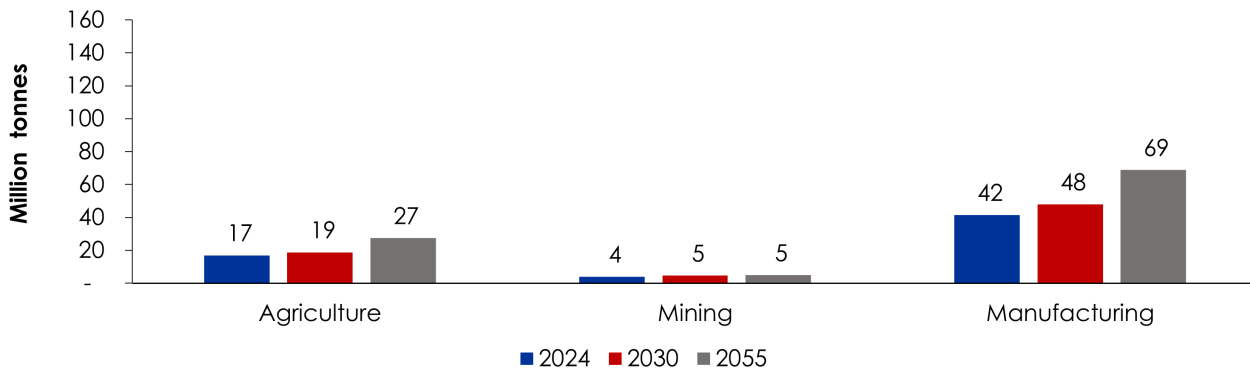
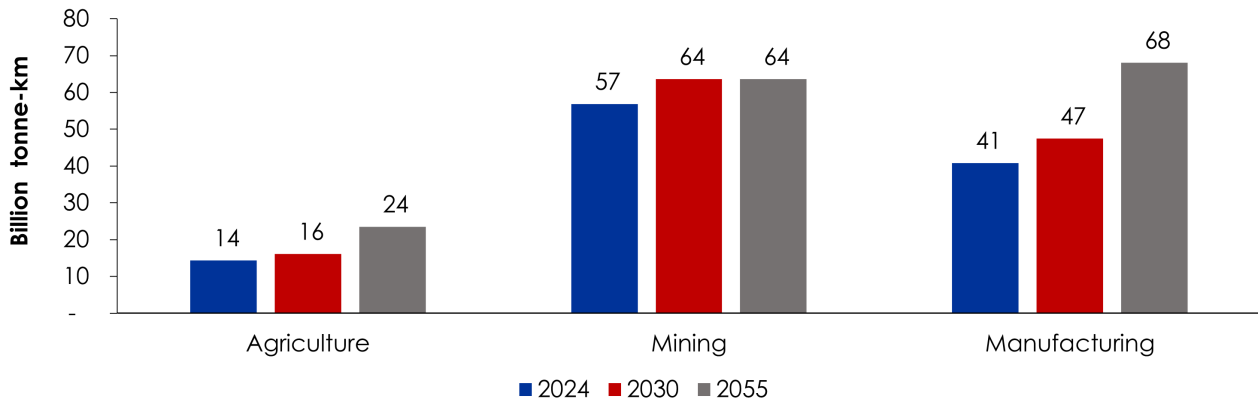


Figure 1: Total Western Cape freight flow forecast per sector (tonnes 2024)

¹ The term El Niño (Spanish for 'the Christ Child') refers to a warming of the ocean surface, or above-average sea surface temperatures, in the central and eastern tropical Pacific Ocean (United States Geological Survey, n.d.). From more information, see: <https://www.usgs.gov/faqs/what-el-nino-and-what-are-its-effects>

² Anglo American estimated a reserve life for Sishen till 2035 in its 2021 Kumba Ore Reserves and Mineral resources report (Anglo American, 2021).

(a) Total Western Cape



(b) GFB Western Cape

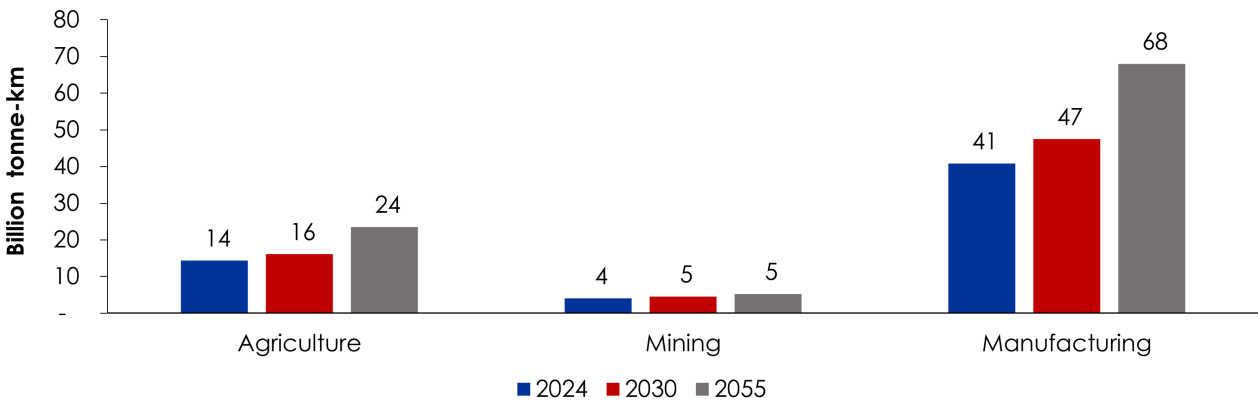


Figure 2: Total Western Cape freight flow forecast per sector (tonne-km 2024)

Highlights

- Iron ore and manganese exports constitute the majority of the Western Cape's mining sector freight intensity.
- Manufacturing and agricultural commodities from the Western Cape are transported over significantly longer distances than the mining commodities.
- The manufacturing sector is forecast to generate the largest logistics demand in the absence of the ring-fenced export lines.
- The economic forecast suggests the development of infrastructure that will support the growing manufacturing and agriculture sectors.



Freight transport costs

The freight transport cost model forms part of the national logistics cost model, which was developed by the research team to quantify the direct¹ national logistics costs. The freight transport costs are available on a district- to-district basis per commodity, and can be used to measure the impact of modal changes; they therefore indicate what the impact of certain macro- economic infrastructure-related decisions would be on the economy². For the refinement of the WC FDM™, actual road freight transport rates were confidentially received from Logistics Service Providers (LSPs) and used to refine the fixed and variable road freight transport cost elements.

The different road transport cost elements are determined by vehicle type which, in turn, is determined by commodity type, typology, and route of travel. A commodity's "preferred" vehicle type will change as each of these variables changes. Once the vehicle type and volume are assumed, the cost elements can be assigned. The approach is based on the core freight transport cost drivers, namely weight and distance travelled. Each movement can also be attributed to one of 41 possible vehicle combinations, based on the commodity's destination and distance travelled. A separate rate per tonne-kilometre for each of the 41 vehicle types is applied. Other costs that are determined by the typology, such as fuel costs and toll fees, are defined and calculated separately.

Average annual distances and working days are applied to the various combinations, based on current practice, including waiting time for loading and unloading or any other relevant factors. As examples, the sources of information include logistics and supply chain service providers, FMCG manufacturers, retail groups, agricultural food producers, processors, timber plantations, the furniture industry, car carriers, the construction industry, mining (for transport of mined commodities, but excluding transport for mining activities). Payloads for each category are based on transport regulations. Where return loads are not possible or practical, the load factor is set at 50% (e.g., raw milk and liquid petroleum). In other cases, inputs from transporters and suppliers provide an acceptable average load factor. Emerging changes, such as making use of larger pallet footprints in secondary distribution, are taken into account. Few transporters and fleet owners can actually afford to operate without a return leg, which means that load factors increase with distance where commodities and return volumes (as determined in the FDM™) allow.

Within these cost measurement combinations, different cost drivers exist for fuel, wages, repairs and maintenance, depreciation, capital cost, insurance, tyres, tolls roads and licence fees.

It is necessary to distinguish between costs and tariffs.

Costs refer to the actual costs that are directly incurred by the freight movement. That will be the total cost for in-house transport as well as outsourced transport. In the case of outsourced transport, a margin is added to the cost, in order to charge a tariff.

Tariffs reflect both the margins and strategic pricing decisions of a transport company, in addition to cost recovery. A transport company, for example, could decide to fund return legs by only recovering variable cost, thus transporting freight below total cost. For the purposes of informing policy and investment decision- making, actual costs are used in modelling national and provincial logistics costs; the impact of margins and of strategic decision- making on costs can then be modelled in scenarios.

Road costs and rail tariffs are typically used (refer to Table 1).

Table 1: Overview of underlying aspects of costs and tariffs for road and rail transport

	Road	Rail
Costs	Can be calculated with a fixed and publicly available schedule ³ .	Estimated using a well- researched algorithm. (Even the railway service providers find it difficult to apply activity- based rail costing. This is a global phenomenon, due to the very high fixed cost nature of rail business).
	The freight owner incurs road cost by utilising in-house road transport.	In-house rail transport is not possible.
Tariffs	Estimated through fieldwork and interviews in order to add margins to costs.	Precisely available for all consignments in South Africa, but confidential at the detail level.
	The freight owner incurs road tariffs by outsourcing road transport.	The freight owner incurs rail tariffs by utilising Transnet.

¹ Direct costs are internal, monetised costs of inputs and labour that are used in the provision of freight transport. These differ from externality costs that affect third parties who may not be direct users of freight transport services.










² For further detail on the methodology and macroeconomic application, refer to: Havenga, J.H. 2010. Logistics costs in South Africa: The case for macro-economic measurement. *South African Journal of Economics*, 78(4): 460 - 478.

³ Data from the Road Freight Association provides detailed fixed and variable cost drivers for the different vehicle classes used in the WC FDM™.

Rail tariffs are used due to the complexity of calculating actual rail costs. Furthermore, freight owners cannot incur actual rail costs since freight rail transport cannot be provided “in-house” (freight owners in South Africa do not own their own railway). Actual rail tariffs are confidential and cannot be disclosed, but were used in an aggregated way. In cases where rail costs are required for scenario analysis, costs are estimated based on an algorithm developed in conjunction with Transnet⁴. Road cost and tariffs are both possible for freight owners as only about 51% of freight transport in South Africa is outsourced. Where freight transport is provided in-house, the actual cost is all that is incurred by the freight owner. Where it is outsourced, the tariff incurred is made up of the transport supplier's cost and mark-up. For the purposes of comparison, an 8%⁵ profit margin was assumed for road transport costs in 2024 (see Figure 2). One of the major drivers of efficiency in road freight is outsourcing, which also contributes to South Africa being more efficient than most BRICS partners⁶ in comparisons such as the World Bank Group's Logistics Performance Index (LPI).

The drivers for road freight transport costs are described in Table 2.

Table 2: Cost drivers for road freight transport for 2024

	Cost driver	Description
	Fuel	The price of fuel is based on the weighted average annual price for 2024, taking cognisance of the different inland and coastal prices, for 500 parts per million (ppm) diesel. Bulk rebates are ignored.
	Truck driver wages	Truck driver and assistant wages vary considerably across the country based on vehicle size, primary and secondary distribution tasks, region, operators, and the structure of remuneration packages. All assumptions, in line with wage agreements between the Road Freight Employers' Association and the National Bargaining Council for the Road Freight and Logistics Industry, include an allowance for company contributions, but exclude overtime and bonuses.
	Maintenance & Repairs	The assumed cost of maintenance is based on current vehicle manufacturer maintenance contract rates, expected economic component life and industry experience. The assumptions consider the complexity of each task, including typical operating conditions such as roads, topography, and traffic density. Repair and maintenance costs for refrigeration operations are calculated in hours.
	Depreciation	An annual depreciation percentage is considered per vehicle combination, as well as a residual value per vehicle.
	Cost of capital	All estimates are based on a cost estimate for new vehicles and trailing equipment. The initial cost of vehicles, trailers, bodies, and auxiliary equipment (such as refrigeration units) is based on the average of published selling prices of such items in the modelled year in question, less known fleet discounts.
	Insurance	Insurance cost assumes that the operator has a low risk rating. Just like in 2023, premiums are set at 7% of the purchase price for vehicles, equipment, and trailers in 2024 ⁷ .
	Tyres	Tyre life is based on the typical casing life that is obtained in the various operations.
	Toll fees	Assumed route-incurred toll fees are applied proportionally to the number of trips that each movement accounts for, according to the size structure of the vehicle used for its toll fee class.
	Vehicle licence fees	Licence fees for vehicles and trailers are based on the average license fees of each province, as the licensing province of trucks is unknown, and nationally distributed ⁸ .

⁴ Note that actual rail costs at a consignment level are very difficult to calculate, even for the railways.

⁵ This is based on confidential interviews.

⁶ BRICS is an intergovernmental organisation comprising ten countries: Brazil, China, Egypt, Ethiopia, India, Indonesia, Iran, Russia, South Africa and the United Arab Emirates. Its name is derived from its original members, namely Brazil, Russia, India, China and South Africa - which are the partners specifically referred to here. Comparing South Africa's performance against these (and the other) BRICS partners is valuable to highlight shifting dynamics of global power and identify opportunities for economic integration among emerging markets. As a group that represents about 40% of the global economy and nearly half of the world's population, BRICS comparisons reveal unique insights into development models outside the traditional G7 framework, which is established by the intergovernmental forum of Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States (including the European Union).

⁷ This is aligned to Road Freight Association (RFA) data on insurance, which varies slightly from vehicle to vehicle, depending on the configuration, which is calculated as 7.5% of the total capital for prime mover or rigid vehicles and 5.0% of the total capital for trailers or semi-trailers.

⁸ This average assumption is deemed sufficient, given the current status of road freight user-pay charges.

In 2024, road freight transport accounted for nearly 87% of the total estimated freight transport cost of R89.3 billion (bn). The main cost drivers were fuel (R38.5bn; 43.1% of total cost), truck driver wages (R11.0bn; 12.3% of total cost), and tyres (R7.2bn; 8.1% of total cost). Notably, maintenance and repairs was a less significant transport cost driver in 2024 compared to previous years. These costs are shown in Figure 1 and Table 3.

After decreasing slightly between 2022 and 2023, the fuel cost increased by 18.2% between 2023 and 2024 (driven by higher fuel prices). In fact, the 2024 fuel cost is 15.6% higher than its previous high (2022) and nearly 2.5 times higher than the 2020 fuel cost.

Figure 2 outlines the cents per tonne-km (c/tonne-km) for road and rail. The impact of the export lines on rail rates is evident. Given rail's high fixed cost, higher density means that the mode's c/tonne-km cost will decrease with each additional tonne-km of activity over the same track length. With its current low market share, the South African freight railway's challenge is that it needs a substantial modal shift from road to realise these density benefits and further emphasises the significance of resolving the rail crisis in South Africa (see section 10-1 on Externality costs).

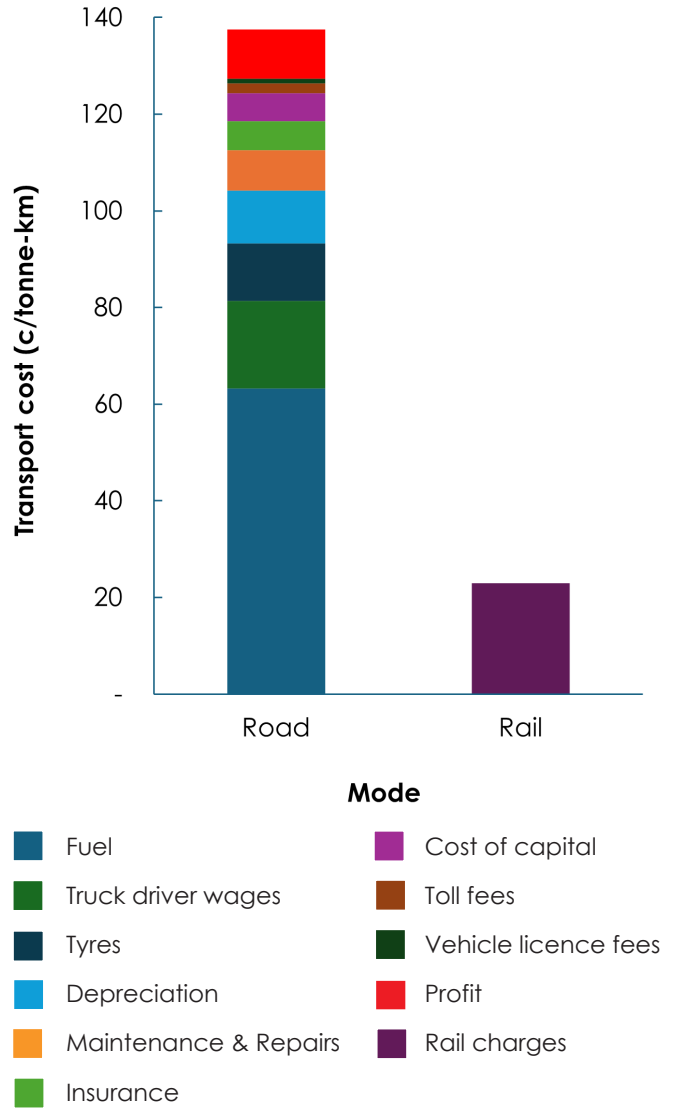


Figure 2: Transport cost in c/tonne-km per mode for Western Cape freight (2024)

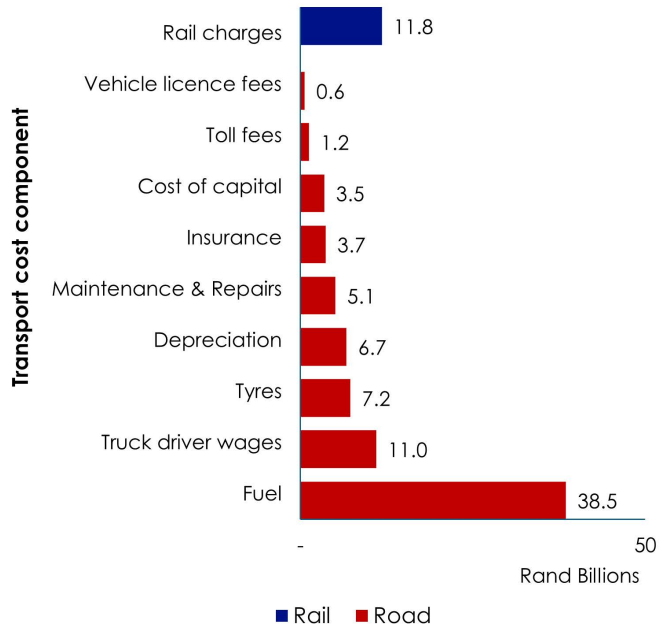


Figure 1: Transport cost components per mode for Western Cape freight (2024)

Table 3: Transport costs drivers in 2024

Cost driver	Cost (R bn)	% of total
Fuel	38.5	43.1%
Truck driver wages	11.0	12.3%
Tyres	7.2	8.1%
Depreciation	6.7	7.5%
Maintenance & Repairs	5.1	5.7%
Insurance	3.7	4.1%
Cost of capital	3.5	3.9%
Toll fees	1.2	1.4%
Vehicle licence fees	0.6	0.7%
Rail charges	11.8	13.2%
Total	89.3	100%

Highlights

- In 2024, road freight transport accounted for nearly 87% of the Western Cape's total transport cost of R89.3bn.
- The main road freight transport cost drivers were fuel (R38.5bn; 43.1% of total cost), truck driver wages (R11.0bn; 12.3% of total cost), and tyres (R7.2bn; 8.1% of total cost).
- Fuel cost increased by 15.6% against 2022 and 18.2% against 2023, driven by higher fuel prices.
- With its current low market share, the South African freight railway's challenge is that it needs a substantial modal shift from road to realise density benefit and further emphasises the significance of resolving the rail crisis in South Africa.



Externality costs

The total estimated CO₂ emissions for South Africa in 2024 are 436.6 million tonnes¹, of which approximately 14.0% (i.e. 61.1 million tonnes) are attributed to overall transport² (with an estimated 12.1%, i.e. 52.8 million tonnes, stemming from freight transport specifically³). To ensure a holistic view of transportation cost, externalities such as emissions need to be considered. Externality components are the costs associated with accidents & crashes, congestion, emissions, land use, noise and policing. These components are calculated as a relative cost per tonne-km per mode and can be applied to any subset of freight movements, such as the Western Cape. South Africa has an established national externality cost model⁴ that can be used to estimate these costs. The rates are summarised in Table 1 and are the latest available 2017 values (no other, more recent rates are available).

Table 1: National externality cost rates per component, 2017 (cent per tonne-km)

Externality cost rate components	Road	Rail
Accidents & crashes	4.79	0.41
Congestion	2.95	N/A
Emissions	8.97	1.21
Landway	0.87	0.08
Noise	3.24	0.03
Policing	2.29	N/A

Emissions costs include not only CO₂ gasses, but also all other emissions produced by burning fuel during the engine's combustion process. The emissions produced per litre of burnt diesel are given in Table 2.

Table 2: Grams produced per litre and estimated costs, per component of emissions

Acronyms ⁵	NO _x	PM metro	PM rural*	HC	CO	CO ₂ **	SO ₂
Grams produced, per litre (g/l) of fuel burnt	26.5	1.19	1.19	0.70	4.00	2 688	12.56
Assumed cost per ton, based on international perceived values (Rand)	27 721	612 906	180 525	8 113	8 113	334	54 090

Considering the average fuel usage per tonne-km of all freight vehicles, the resultant emissions in grams per tonne-km are given in Table 3, which can be used to compare emissions per modes.

Table 3: Grams of emissions produced per mode per tonne-km

Tonne-km by transport type	NO _x	PM metro	PM rural*	HC	CO	CO ₂ **	SO ₂
Road	0.71	0.03	0.03	0.02	0.11	72.41	0.34
Rail (electric)						28.34	
Rail (diesel)	0.42	0.02	0.02	0.01	0.06	42.96	0.2
Rail (weighted average of electric and diesel)	0.04	0.002	0.002	0.001	0.005	29.58	0.02

* While particulate matter (PM) is produced equally in metropolitan and rural areas per litre of fuel burnt, its perceived cost is higher in more densely populated areas.

** To calculate the cost of CO₂ emissions for South Africa, a cost of R225 per tonne of CO₂ is assumed for 2010, in line with the proposals of the South African National Treasury (2010)⁶ and McCarl and Sands (2007)⁷.

¹ <https://ourworldindata.org/profile/co2/south-africa#what-are-the-country-s-annual-co2-emissions>

² <https://www.zutari.com/how-you-get-to-work-matters-understanding-south-africans-carbon-footprint-from-workers-commutes/>

³ <https://www.iea.org/countries/south-africa/emissions>

⁴ For a detailed methodology of the externality costs model, please refer to:

- Swarts, S., King, D., Simpson, Z., Havenga, J. & Goedhals-Gerber, L. 2012. Calculation of freight externality costs for South Africa. *Journal of Transport and Supply Chain Management*, 4(1): 207 - 222
- Havenga, J.H. 2015. Macro-logistics and externality cost trends in South Africa – Underscoring the sustainability imperative. *International Journal of Logistics Research and Applications*, 18(2): 118 - 139.

⁵ Acronyms: NO_x = Nitrogen oxides; PM metro = Particulate matter metro; PM rural = Particulate matter rural; HC = Hydro Carbons; CO = Carbon Monoxide; CO₂ = Carbon dioxide; SO₂ = Sulphur dioxide

⁶ Department of National Treasury (Republic of South Africa). 2010. *Reducing Greenhouse Gas Emissions: The Carbon Tax Option*. [Pretoria]: Department of National Treasury.

⁷ McCarl, B.A. & Sands, R.D. 2007. Competitiveness of terrestrial greenhouse gas offsets: are they a bridge to the future?. *Climatic Change*, 80: 109 - 126.

The costs of accidents & crashes exceed the cost of damage to the involved vehicles, which is internalised through insurance policies. Apart from the direct cost of replacing or repairing a vehicle there are additional economic costs due to loss of life and productivity which can be quantified through value of statistical life tables. In South Africa, the Road Accident Fund levy directly internalises some, but not all of this externality cost.

Noise externality cost is based on the willingness to pay to avoid the proximity of living near noisy road or rail infrastructure. A small percentage of national GDP is used based on international benchmarks to estimate the total willingness to pay for South Africa and is then disaggregated across road and rail.

Congestion is the increase in travel time road users experience due to travel demand exceeding road capacity constraints. Large trucks take up the equivalent of roughly 3.5 passenger car equivalents on the road. It is calculated by taking the difference between average vehicle speeds and expected free flow speed across counted sections where the number of vehicles per hour per lane exceeds the free flow limit. As all vehicles are traffic and contribute toward congestion, different vehicle types' contribution are normalised to passenger car equivalents. This gives a split of the total time lost due to congestion to each vehicle use (passenger and freight) which is monetarily quantified based on a cost per hour.

Policing externality cost is based on the national estimated budget per person spent on traffic policing. This cost is attributed to freight activity based on the live vehicle population composition.

Apart from the necessity of initially connecting different areas of the country, there is an external cost associated with the expanded land use of transport infrastructure that could have been used for other economic activities. Roads are expanded to alleviate congestion, rather than finding more space-efficient means of transportation. This cost is attributed to freight according to an estimate of annual distance travelled per vehicle type and the live vehicle population.

The resultant total externality costs for Western Cape freight are given in Figure 1 and Table 4. Rail externality costs are negligible relative to road externality costs.

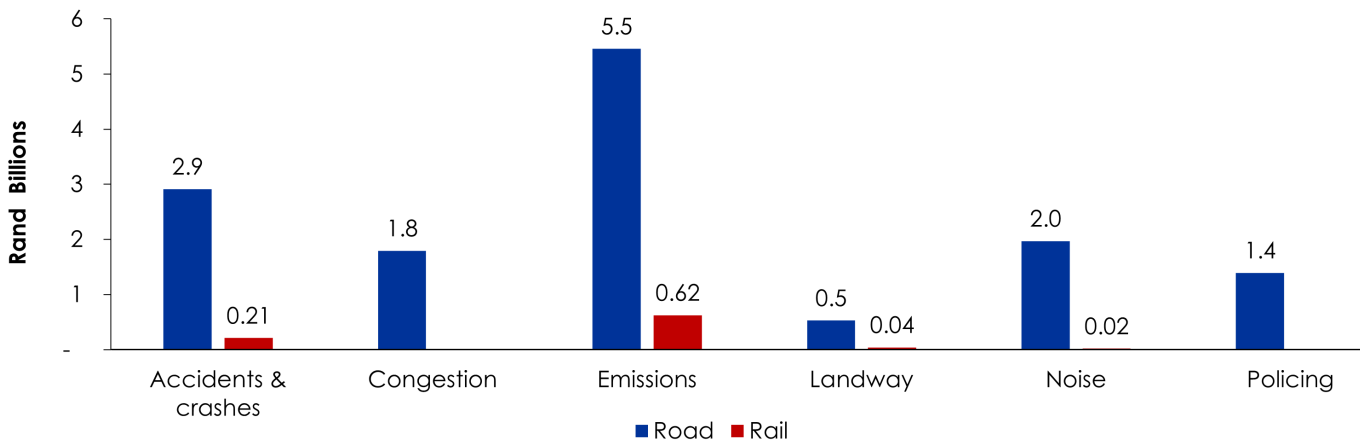


Figure 1: Externality costs for Western Cape freight (2024)

Table 4: Externality costs for Western Cape freight (2024)

Externality cost driver	Road Cost Rbn (% of driver cost)	Rail Cost Rbn (% of driver cost)	Total Cost Rbn (% of total)
Emissions	5.46 (90%)	0.62 (10%)	6.08 (41%)
Accidents & crashes	2.91 (93%)	0.21 (7%)	3.12 (21%)
Noise	1.97 (99%)	0.02 (1%)	1.99 (13%)
Congestion	1.79 (100%)	-	1.79 (12%)
Policing	1.39 (100%)	-	1.39 (9%)
Landway	0.53 (93%)	0.04 (7%)	0.57 (4%)
Total	14.06 (94%)	0.89 (6%)	14.95 (100%)

The total externality costs for road freight transport in the Western Cape for 2024 amount to R14.06 billion, which is 18.1% of direct road freight transport costs for the same period. Road freight transport contributes 94% of the total land freight transport externality costs of R14.95 billion.

The total direct road cost for 2024 is R77.49 billion (see section 8 on Freight transport costs). If the road externality cost of R14.06 billion is internalised, the total road transport cost will increase by 18.1% to R91.54 billion.

The four largest road freight transport externality cost drivers, namely, emissions, accidents & crashes, noise and congestion, contribute more than 80% to total freight transport externality costs in the province, impacting the general population while not being carried by the users of the service. When externality costs are not internalised, road freight operators are effectively cross subsidised by individuals living in polluted air (emissions) or next to noisy roads, or commuters travelling on congested routes. Furthermore, taxpayers fund the clearing of accidents & crashes and rehabilitation of damaged roads. The internalisation of externality costs can be induced through both “negative” and “positive” policy interventions. “Negative” policy instruments relate to measures such as congestion charges, emission taxes, noise controls, land use limitations and user-pay principles. “Positive” policy instruments relate to a regulatory framework supportive of the creation of industry associations, logistics hubs and public-private partnership models. This could encourage widespread modal shift to induce a systemic change by which most of rail-targetable freight is shifted to rail⁸.

⁸ For a case study on the internalisation of national externality cost please refer to:
Havenga, J.H. & Simpson, Z.P. 2016. Freight logistics' contribution to sustainability: Systemic measurement facilitates behavioural change.
Transportation Research Part D: Transport and Environment, 58: 320-331.

Highlights

- The total externality for road freight transport in the Western Cape amounts to R14.06 billion, which is 18.1% of current road freight transport costs.
- Road freight transport contributes 94% of the total freight transport externality cost of R14.95 billion.
- The four largest road freight transport externality cost drivers, namely emissions, accidents & crashes, noise, and congestion, contribute more than 80% to total freight transport externality costs in the province, impacting the general population while not being carried by the users of the service.
- The internalisation of externality costs can be induced through policy interventions.
- Policy interventions could induce a systemic change to shift rail-targetable freight to rail.



Scenarios

The WC FDM™ enables the development of data-driven scenarios to inform inter alia industrial and freight transport policies and spatial planning. Pressing policy issues were identified, and high-level scenarios were developed to estimate the potential annual impact on the Western Cape's freight transport costs and Gross Domestic Product (GDP). The current results are indicative, with the purpose of encouraging discussions to increase the accuracy of the scenario development inputs. Once agreement is reached on the high-level scope and outcomes of these scenarios, priorities will be set to guide the implementation process for these scenarios.

Modal shift scenarios

The modal shift scenario is for commodities identified as rail-friendly, based on the density attributed to the origin and/or destination, packaging type, and distance. To calculate the potential opportunity cost, at current prices, of a road-to-rail freight shift, or a lack thereof, the following baseline scenarios are quantified:

1. **Stagnant rail volumes**, where rail's volumes remain the same over the forecast period;
2. **Constant rail market share**, where rail's percentage remains the same over the forecast period;
3. **Growth in rail market share** where rail's market share grows to capture all the rail-friendly traffic (i.e. able to be shifted to rail).

The impacts on transport costs and emissions are calculated for each of these baseline scenarios.¹ That is, what is the potential for modal shift, given each of the three baselines.

Assumptions

- Assuming 2024 average transport costs per segment, total transport costs were calculated for each scenario.
- In the absence of an average cost per segment, the overall average cost per mode was used.
- Modal shifts for forecast years are calculated at 2024 prices. This provides a conservative estimate – it has been shown that as rail freight density increases, the mode becomes more efficient.
- Modal shift scenarios are developed for the Western Cape portion of each of the three (3) long-distance corridors traversing the Western Cape, namely the N1 (average travel distance of 1 388 km), N2 (679 km) and N7 (405 km), and for short-distance freight (87 km) transported locally in the Core Western Cape region.

Results

The modal shift scenario results are depicted in Tables 2, 4, 6 and 8.

N1 corridor

The key opportunities for modal shift on the N1 corridor are in the siding-to-siding and palletised Fast-Moving Consumer Goods (FMCG) segments. The volumes that could be shifted are shown in Table 1 and depicted graphically in Figure 1.

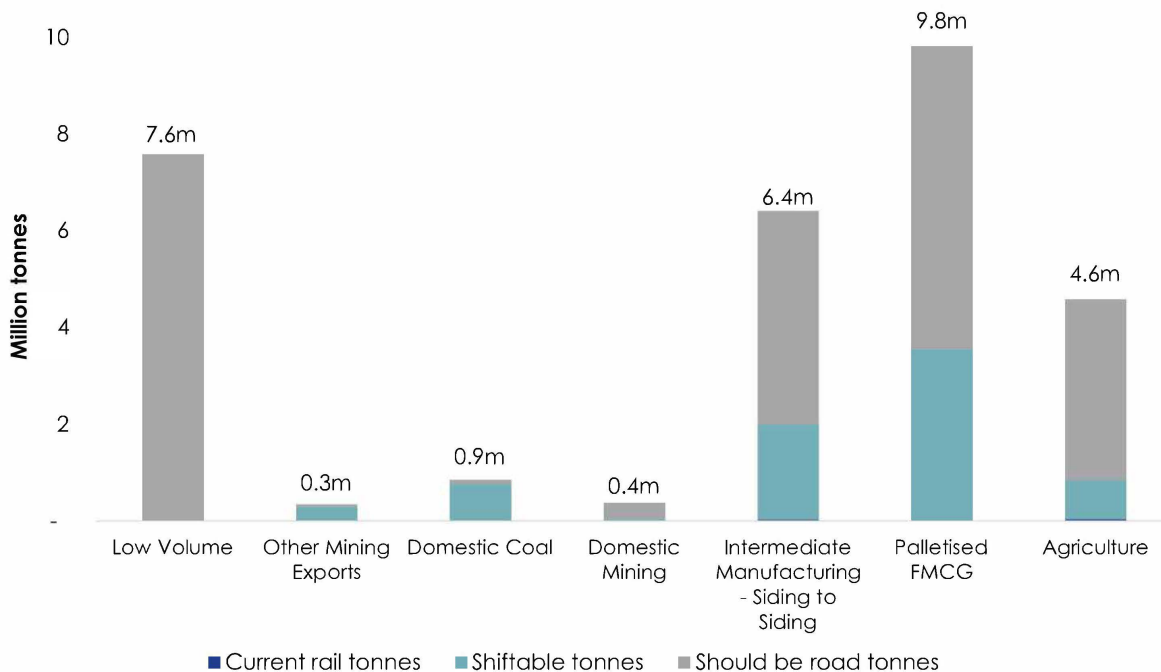


Figure 1: Modal shift opportunity per segment on the N1

¹ Where current rail rates are above road market rates it is assumed that freight switching to rail will do so at road market rates.

Table 1: Modal shift opportunity per segment on the N1

Segment	Road tonnes	Rail tonnes	Shiftable tonnes
Low volume targetable	7 583 787	-	(0.0%)
Other mining exports	348 993	-	298 496 (85.5%)
Domestic coal	855 146	-	768 841 (89.9%)
Domestic mining	379 423	-	47 410 (12.5%)
Intermediate manufacturing - Siding to siding	6 378 120	33 171	1 967 655 (30.9%)
Palletised FMCG	9 823 628	-	3 553 044 (36.2%)
Agriculture	4 551 179	35 638	814 399 (17.9%)
Total	29 920 275	68 809	7 449 844 (24.9%)

Transport costs² on the N1 corridor for these segments are currently 16.3% higher than costs under a scenario in which all shiftable freight was transported by rail (see Table 2). If rail volumes remain stagnant up to 2055, this premium will be 16.2%. If the rail market share remains constant up to 2055, this premium will remain the same.

Table 2: Cost and emission savings potential due to modal shift on the Western Cape section of the N1

Scenarios	Transportation cost before shift (Rbn)	% Transport cost premium with no modal shift	Shift Saving (Rbn)	CO ₂ emission reduction (000' tonnes)
2024 - Current market share	49.8	16.3%	6.98	390.5
2030 - Stagnant rail volumes	58.2	16.5%	8.23	459.4
2030 - Constant market share	58.1	16.5%	8.21	458.8
2030 - Growth market share	49.5	-	-	-
2055 - Stagnant rail volumes	83.7	16.2%	11.68	663.8
2055 - Constant market share	83.7	16.2%	11.65	661.9
2055 - Growth market share	71.5	-	-	-

N2 corridor

The key opportunities for modal shift on the N2 corridor are in the siding-to-siding, palletised FMCG and agriculture segments. The volumes that could be shifted are shown in Table 3 and depicted graphically in Figure 2.

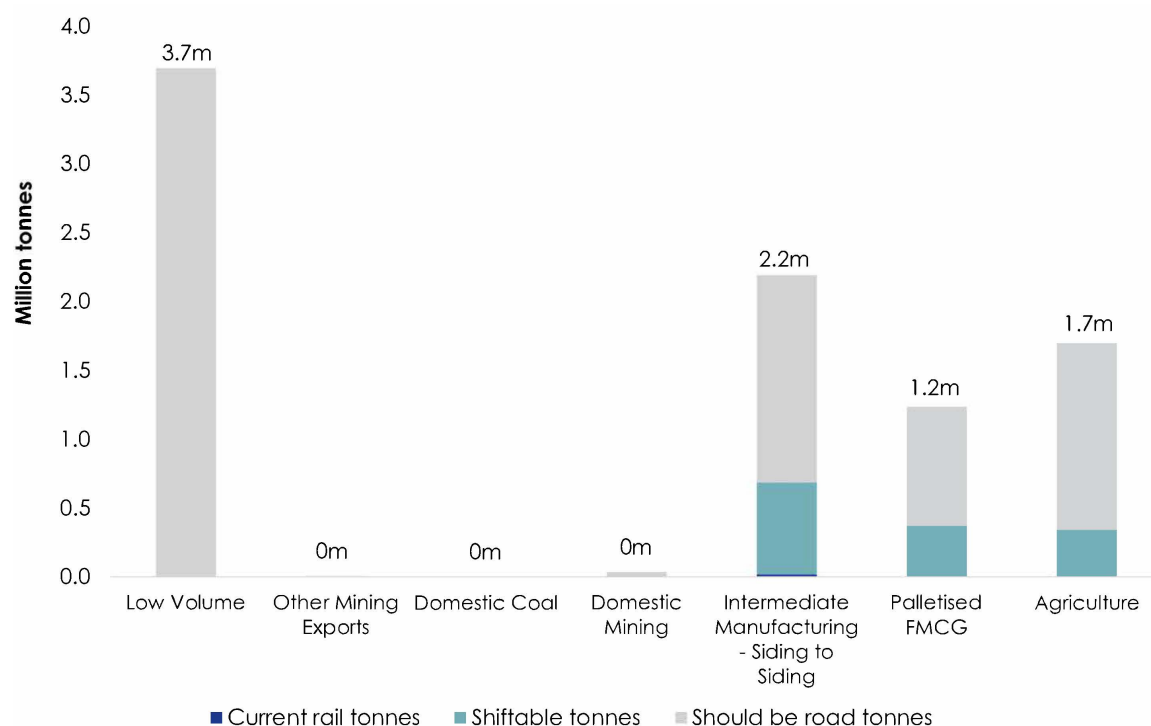


Figure 2: Modal shift opportunity per segment on the N2

² These transport costs are road and rail costs for the identified rail-friendly segments.

Table 3: Modal shift opportunity per segment on the N2

Segment	Road tonnes	Rail tonnes	Shiftable tonnes
Low volume targetable	3 696 181	-	(0%)
Other mining exports	3 673	-	3 142 (85.5%)
Domestic coal	-	-	(0%)
Domestic mining	34 954	-	4 368 (12.5%)
Intermediate manufacturing - Siding to siding	2 174 526	17 780	668 970 (30.8%)
Palletised FMCG	1 235 800	-	370 829 (30.0%)
Agriculture	1 695 781	-	342 788 (20.2%)
Total	8 840 916	17 780	1 390 096 (15.7%)

Transport costs on the N2 corridor across all segments are currently 5.1% higher than they would be if all shiftable tonnes were transported by rail (see Table 4). If rail volumes remain stagnant, this will be 4.3% by 2055.

Table 4: Cost and emission savings potential due to modal shift on the Western Cape section of the N2

Scenarios	Transportation cost before shift (Rbn)	% Transport cost premium with no modal shift	Shift Saving (Rbn)	CO ₂ emission reduction (000' tonnes)
2024 - Current market share	8.0	5.1%	0.38	35.8
2030 - Stagnant rail volumes	8.7	4.8%	0.40	38.3
2030 - Constant market share	8.7	4.8%	0.40	38.3
2030 - Growth market share	8.3	-	-	-
2055 - Stagnant rail volumes	11.5	4.3%	0.47	49.7
2055 - Constant market share	11.5	4.3%	0.47	49.8
2055 - Growth market share	11.0	-	0.00	-

N7 corridor

The key opportunity for modal shift on the N7 corridor is in agriculture, and to a lesser extent siding-to-siding freight. The volumes that could be shifted are shown in Table 5 and depicted graphically in Figure 3.

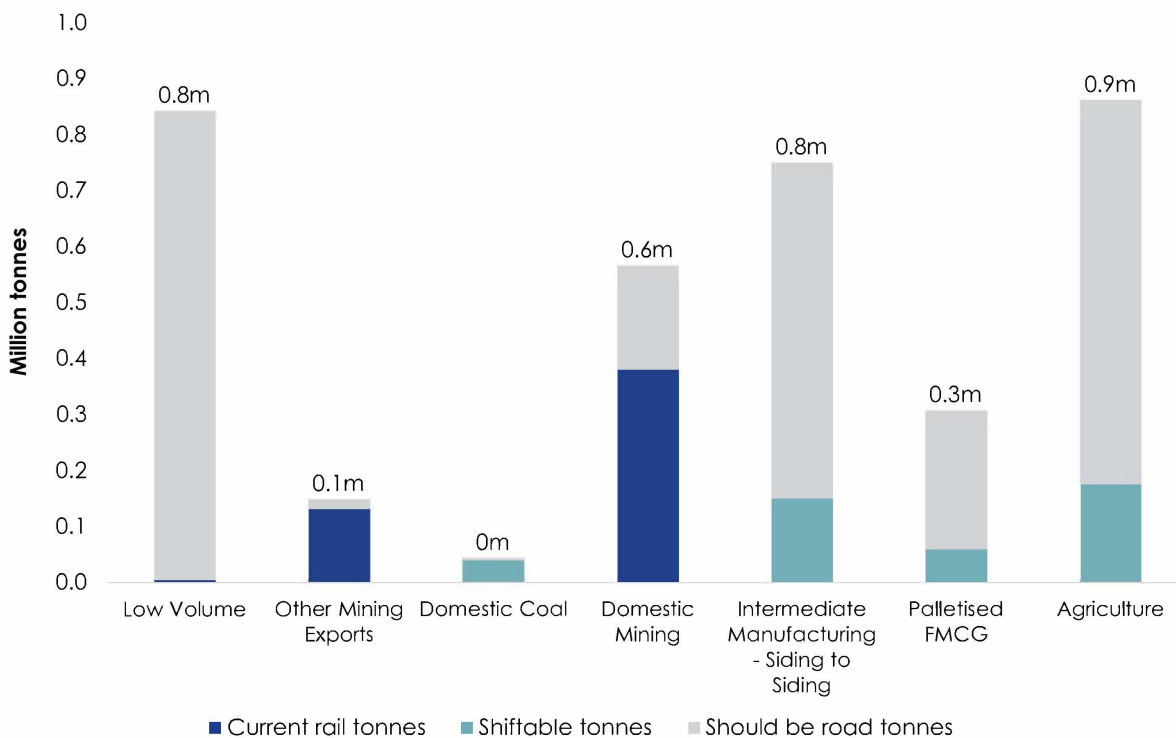


Figure 3: Modal shift opportunity per segment on the N7

Table 5: Modal shift opportunity per segment on the N7

Segment	Road tonnes	Rail tonnes	Shiftable tonnes
Low volume targetable	837 967	4 816	(0%)
Other mining exports	17 702	131 669	(0%)
Domestic coal	44 121	-	39 668 (89.9%)
Domestic mining	186 813	379 179	(0%)
Intermediate manufacturing - Siding to siding	750 094	-	150 900 (20.1%)
Palletised FMCG	307 930	-	59 863 (19.4%)
Agriculture	862 090	-	176 838 (20.5%)
Total	3 006 717	515 665	427 268 (14.2%)

Transport costs on the N7 corridor are currently 10.3% higher than they would be if all shiftable tonnes were transported by rail (see Table 6). If rail volumes remain stagnant, this will increase to 11.2% by 2055. If the rail market share remains constant this will be to 10.1%.

Table 6: Cost and emission savings potential due to modal shift on the Western Cape section of the N7

Scenarios	Transportation cost before shift (Rbn)	% Transport cost premium with no modal shift	Shift Saving (Rbn)	CO ₂ emission reduction (000' tonnes)
2024 - Current market share	1.9	10.3%	0.18	6.3
2030 - Stagnant rail volumes	2.4	14.7%	0.30	10.1
2030 - Constant market share	2.3	9.8%	0.20	7.2
2030 - Growth market share	2.1	-	-	-
2055 - Stagnant rail volumes	2.8	11.2%	0.28	10.1
2055 - Constant market share	2.8	10.1%	0.26	9.3
2055 - Growth market share	2.5	-	-	-

Western Cape core traffic

The key opportunity for modal shift in the Western Cape core traffic is in agriculture, and to a lesser extent domestic coal and siding-to-siding traffic. The volumes that could be shifted are shown in Table 7 and depicted graphically in Figure 4. Due to the low freight transport distances and density outside metro areas, road transport is currently more competitive for certain commodities than rail, particularly in the agriculture and intermediate manufacturing segments.

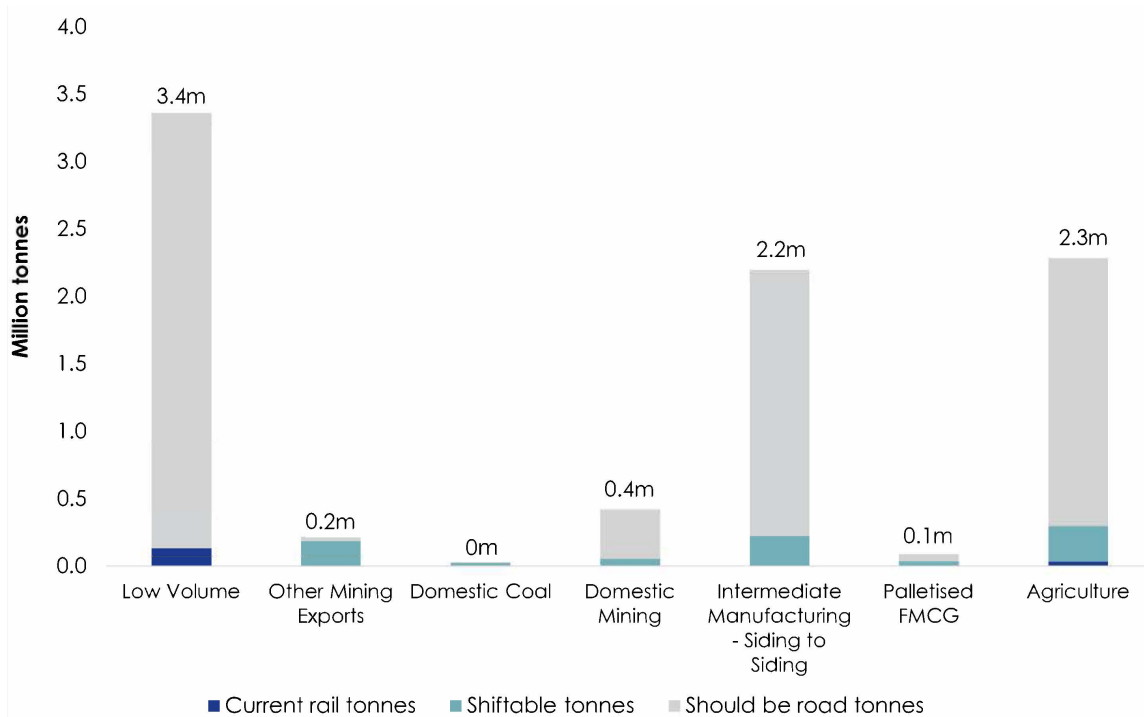


Figure 4: Modal shift opportunity per segment for Western Cape core traffic

Transport costs for the Core Western Cape across all segments are currently 3.8% higher in the absence of modal shift (see Table 7). Given that rail rates remain relatively high, it will be 3.6% if rail market share remains stagnant by 2055. This is due to the growth in freight flows, in which road is more competitive.

Table 7: Cost and emission savings potential due to modal shift on the Western Cape core traffic

Scenarios	Transportation cost before shift (Rbn)	% Transport cost premium with no modal shift	Shift Saving (Rbn)	CO ₂ emission reduction (000' tonnes)
2024 - Current market share	1.06	3.8%	0.04	2.51
2030 - Stagnant rail volumes	1.17	4.3%	0.05	2.91
2030 - Constant market share	1.17	4.3%	0.05	2.90
2030 - Growth market share	1.12	-	-	-
2055 - Stagnant rail volumes	1.67	3.6%	0.06	4.01
2055 - Constant market share	1.66	3.5%	0.06	3.96
2055 - Growth market share	1.61	-	-	-

Summary

In 2024, the total transport bill for freight touching the Western Cape was R79.9 billion. The combined effect of the modal shift on the three corridors and core Western Cape traffic would have been a reduction of R7.58 billion or 9.48% in transport costs for the Western Cape (refer to the 2024 market share data in the tables above)³.

Table 8: Summary - cost and emission savings potential due to modal shift in the Western Cape

Freight traffic zone	Shift saving 2024 (Rbn)	% saving on total Western Cape transport bill	CO ₂ emission reduction (000' tonnes)
N1	6.98	8.73%	390.54
N2	0.38	0.48%	35.85
N7	0.18	0.22%	6.31
Core Western Cape	0.04	0.05%	2.51
Total	7.58	9.48%	435.21

Table 9 shows the targetable modal shift opportunities across all zonal groupings. Just as the cost savings suggest, the N1 has the largest potential for modal shift. Of the 87.6m tonnes of Western Cape road freight, a portion of 42.6m tonnes are suitable for a shift to rail. The non-suitable road freight consists of low density freight flows, fuel and commodities which have a dedicated rail solution, like the iron ore export line.

Table 9: High-level estimate of total shiftable tonnes per zonal grouping of Western Cape Freight.

Zonal Grouping	Road tonnes (million)	Rail tonnes (million)	Total tonnes (million)	Shiftable tonnes (million)	Shiftable tonne-kms (billion)	Estimated Transportation Cost Saving (R billions)
N1 Corridor traffic	22.3	0.07	22.4	7.4 (33.3%)	10.6	6.98
N2 Corridor traffic	5.1	0.02	5.2	1.4 (26.9%)	1.0	0.38
N7 Corridor traffic	2.2	0.51	2.7	0.4 (15.9%)	0.2	0.18
Metropolitan traffic	3.8	0.08	3.9	0.3 (6.9%)	0.01	0.006
Core Western Cape	5.2	0.03	5.2	0.8 (14.9%)	0.07	0.039
Non-Corridor traffic	3.8	0.02	3.9	1.2 (30.7%)	1.5	0.79
Total	42.5	0.73	43.2	11.5 (26.6%)	13.4	8.37

Highlights

- As rail traffic density increases, it becomes more efficient.
- An estimated 9.48% of the Western Cape's total freight transportation cost could have been saved in 2024 through modal shift.
- At current rail volumes, road is more competitive within the Core Western Cape area.
- The largest modal shift opportunity is for the N1 corridor freight. This could potentially reduce total transport costs by 8.73%.



Introduction

The WC FDM™ enables the development of data-driven scenarios to inform inter alia industrial and freight transport policies, and spatial planning. Pressing policy issues were identified and high-level scenarios were developed to estimate the potential annual impact on freight transport costs and gross domestic product (GDP) in the Western Cape. The current results are indicative, with the purpose of encouraging discussions to increase the accuracy of the scenario development inputs. Once agreement is reached on the high-level scope and outcomes of these scenarios, priorities will be set to guide the implementation process for these scenarios.

Background

Intermodal freight terminals are specialised logistics facilities designed for the efficient transfer of containerised freight or cargo between different modes of transport. The aim of this scenario is to assess the viability of an intermodal freight terminal located in Worcester. Strategically located at the intersection of the N1 highway and the main rail line, Worcester serves as an important inland gateway for the Western Cape. Geographically, the N1 highway moves through Worcester with the main commercial and industrial activities located south of the N1.

The viability of the terminal is inherently tied to its connectivity with major inland hubs, specifically the City Deep Terminal in Johannesburg. As one of the largest dry ports in Africa, City Deep serves as the primary destination for rail freight from the coast. A Worcester-based terminal would function as a strategic consolidation point of cargo coming into and going out from the Western Cape.

Four operational models were considered for assessing the potential of an intermodal freight terminal in Worcester, which include:

1. A stand-alone option, with the Worcester terminal operating as the sole regional intermodal hub.
2. The expanded stand-alone option, with the Worcester terminal - including fruit terminals.
3. A dual hub option, with both the Worcester and the Kraaicon terminals.
4. The expanded dual hub option, with the Worcester and Kraaicon terminals - including fruit terminals.

The Kraaicon terminal was identified by pre-feasibility studies by Transnet and the City of Cape Town with a suggested location located adjacent to the N1 highway within the Kraaifontein suburb. Kraaicon aims to be an alternative inland terminal to allow vehicles to deliver or collect containers and avoid traveling into the congested Cape Town CBD area.

Figure 1 gives an overview of how the introduction of an intermodal freight terminal would be compared to the baseline.

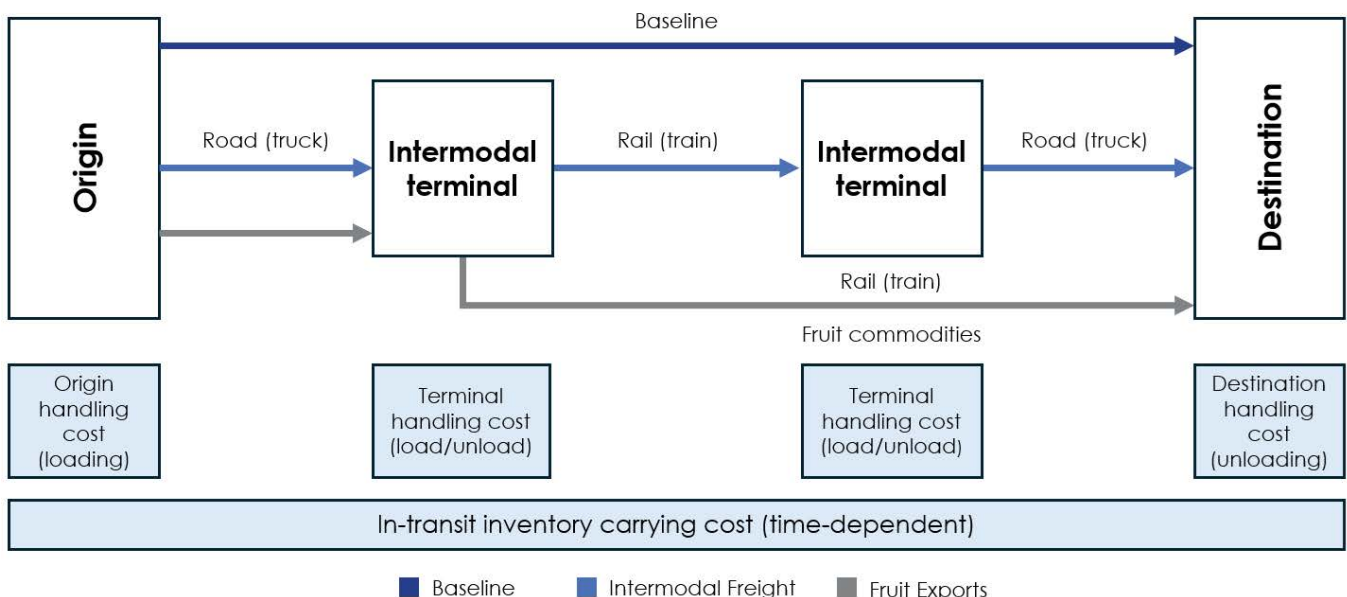


Figure 1: Intermodal freight terminal overview

The baseline for the WC FDM™ is represented by the dark blue arrow, with commodities being transported directly from the origin to the destination, whether on road or rail. The introduction of the intermodal terminal scenario splits the journey into multiple stages, represented by the blue arrows. The introduction of the intermodal terminals necessitates the inclusion of additional costs, such as the labour handling cost at both the origin and destination, and an intermodal terminal handling costs. Export fruit commodities differ slightly as they are transported from their origin to an intermodal terminal (Worcester-Kraaicon or fruit terminals) by road and from there shipped directly to the destination (the Port of Cape Town), by rail, shown by the grey arrow. The inclusion of these additional costs makes the analysis more comparative to the total cost of transporting the freight which freight owners and logistic service providers (LSP) need for their decision-making process.

Intermodal terminals serve as freight consolidation points where the inclusion of beneficiation facilities can offer advantages. Beneficiation is the process of transforming raw materials into higher-value processed products. However, the integration of these facilities needs to consider the existing industrial landscape, because relocating established operations to new intermodal terminals can be complex and cost prohibitive. Beyond the immediate cost of dismantling and reinstalling specialised equipment, the capital required can be so high that it completely offsets any gains offered by intermodal transport. This can especially be true for facilities that only recently reached profitability. Relocation may also not be possible as certain operations may only be profitable with their current geographic area. From a socio-economic perspective moving established facilities risk displacing workers and disrupt the local economy that currently supports them. To avoid these problems, the design of the intermodal facility or freight village needs to focus on accommodating beneficiation for new or emerging industries rather than moving existing ones.

Overview of South Africa's intermodal terminal facilities

Figure 2 shows assumed locations of various operational and potential intermodal terminal facilities located across South Africa, along with the associated catchment area for each facility. Some of these facilities are already operational, while others - needed to ensure sufficient national reach - have yet to be developed. Currently, the only operational facilities are those located in Estcourt, Johannesburg, and Polokwane.

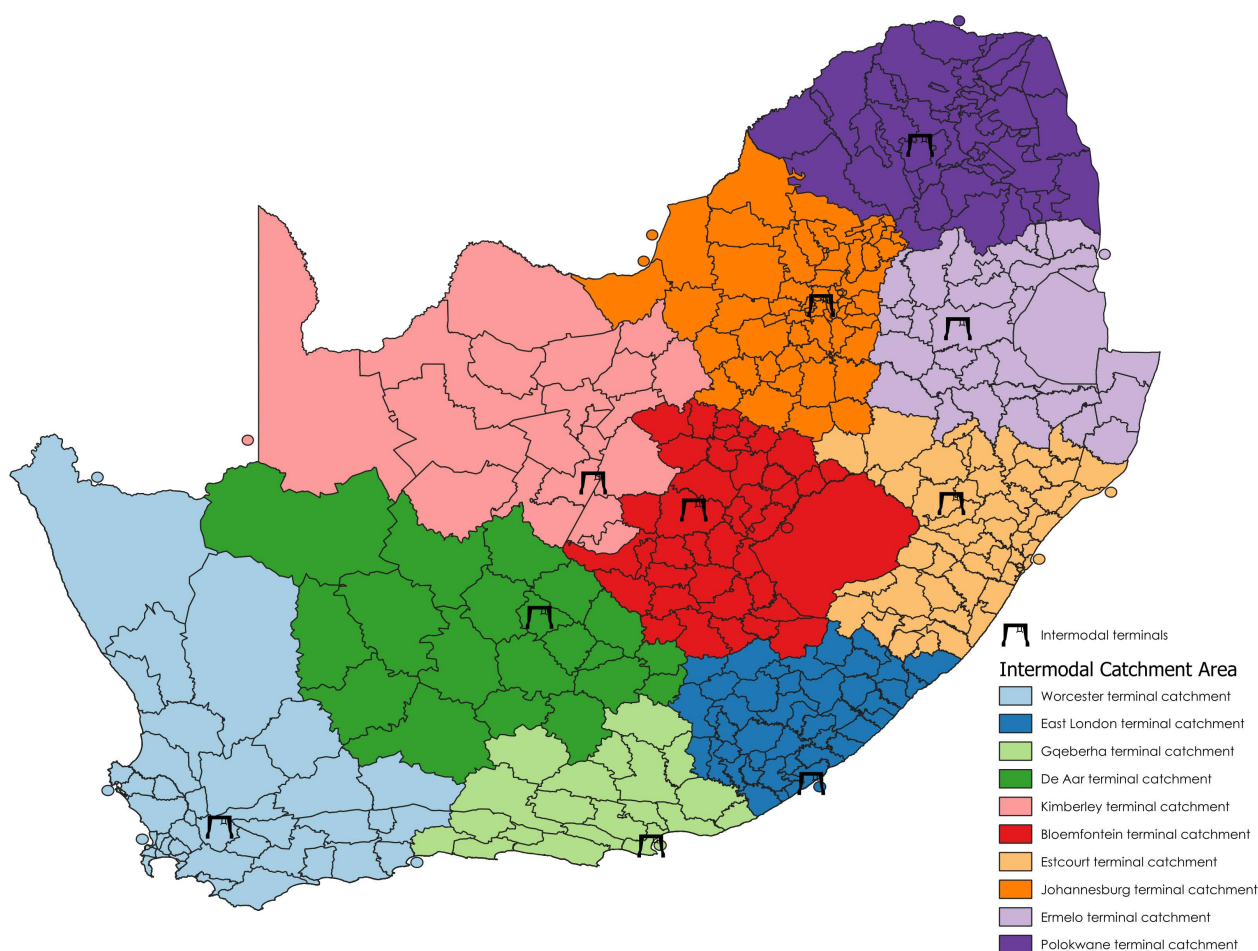


Figure 2: Assumed catchment areas for all the intermodal terminals operating in South Africa

Figure 3 shows the catchment areas if both the Worcester and Kraaicon terminals are operational, while Figure 4 shows the catchment area for the three fruit terminals located in Caledon, Ceres, and Vredendal.

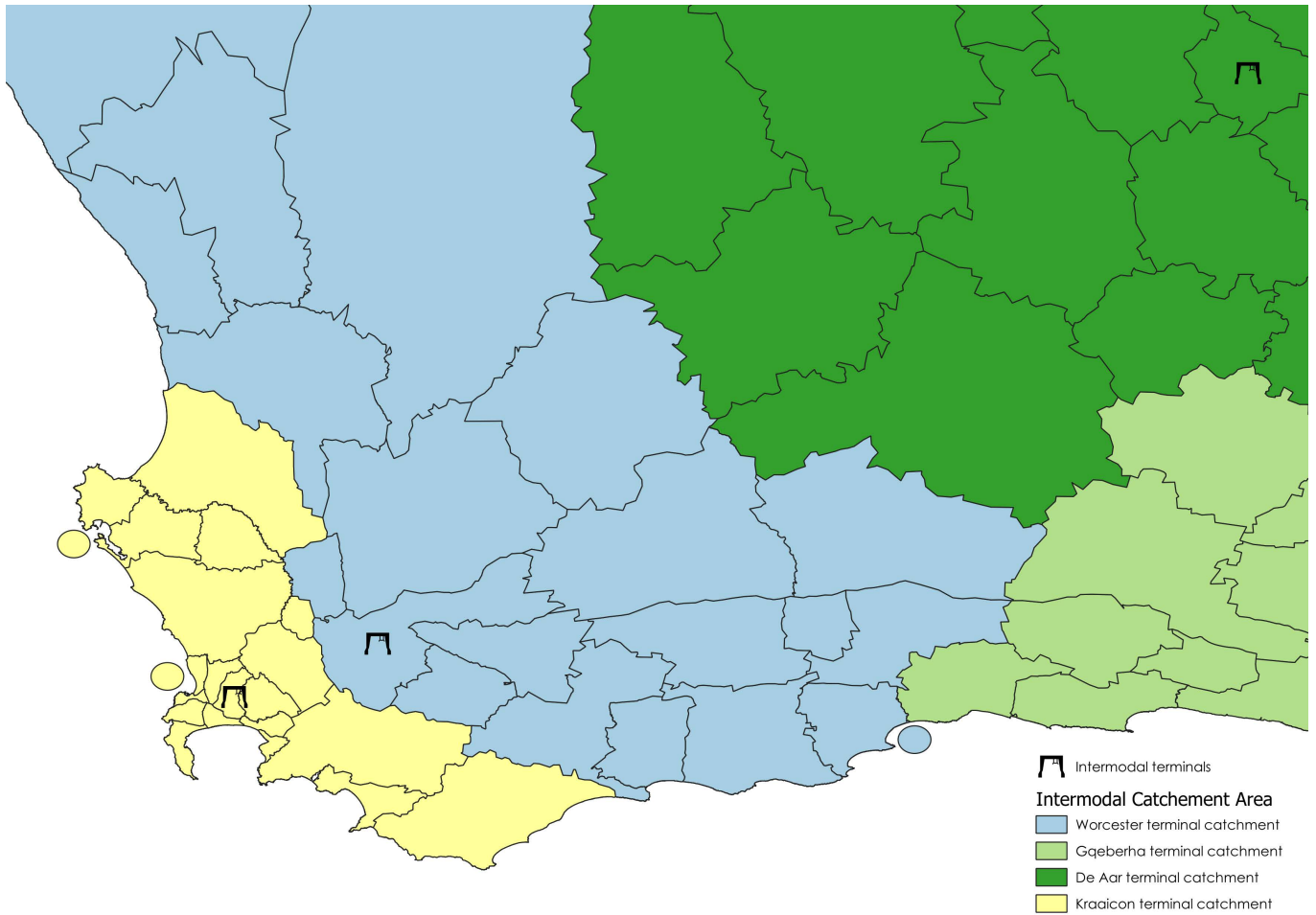


Figure 3: Intermodal catchment areas with both the Worcester and Kraaicon terminals operating

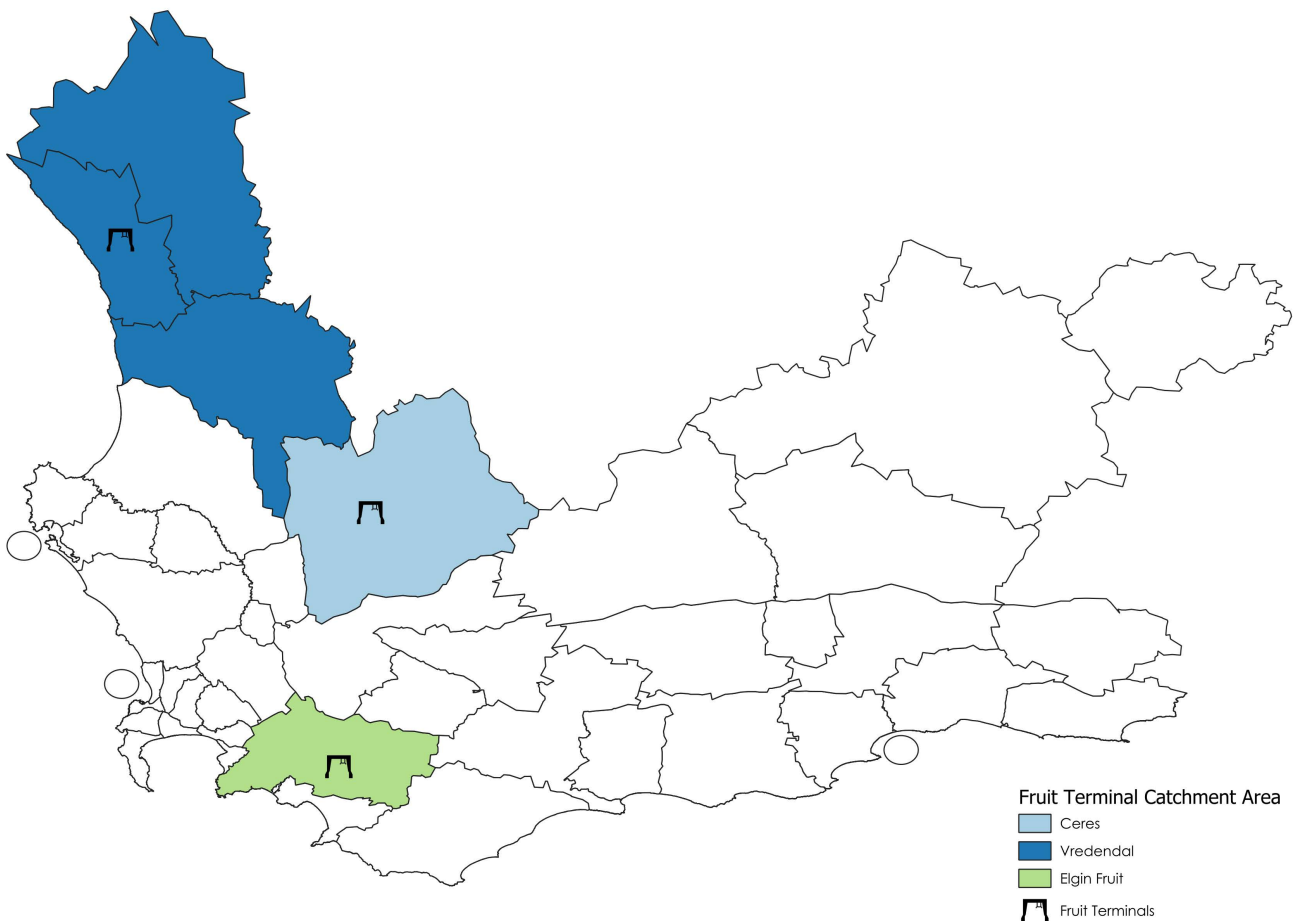


Figure 4: Fruit terminal catchment areas

The main catchment area for each Fruit Terminal is the magisterial district it is in, additionally the Vredendal terminal's catchment area includes Vanrhynsdorp and Clanwilliam.

Figure 5 shows the location of the intermodal terminals across South Africa alongside the national rail network, which is critical to ensure the operational links that are required for a functional national freight system.

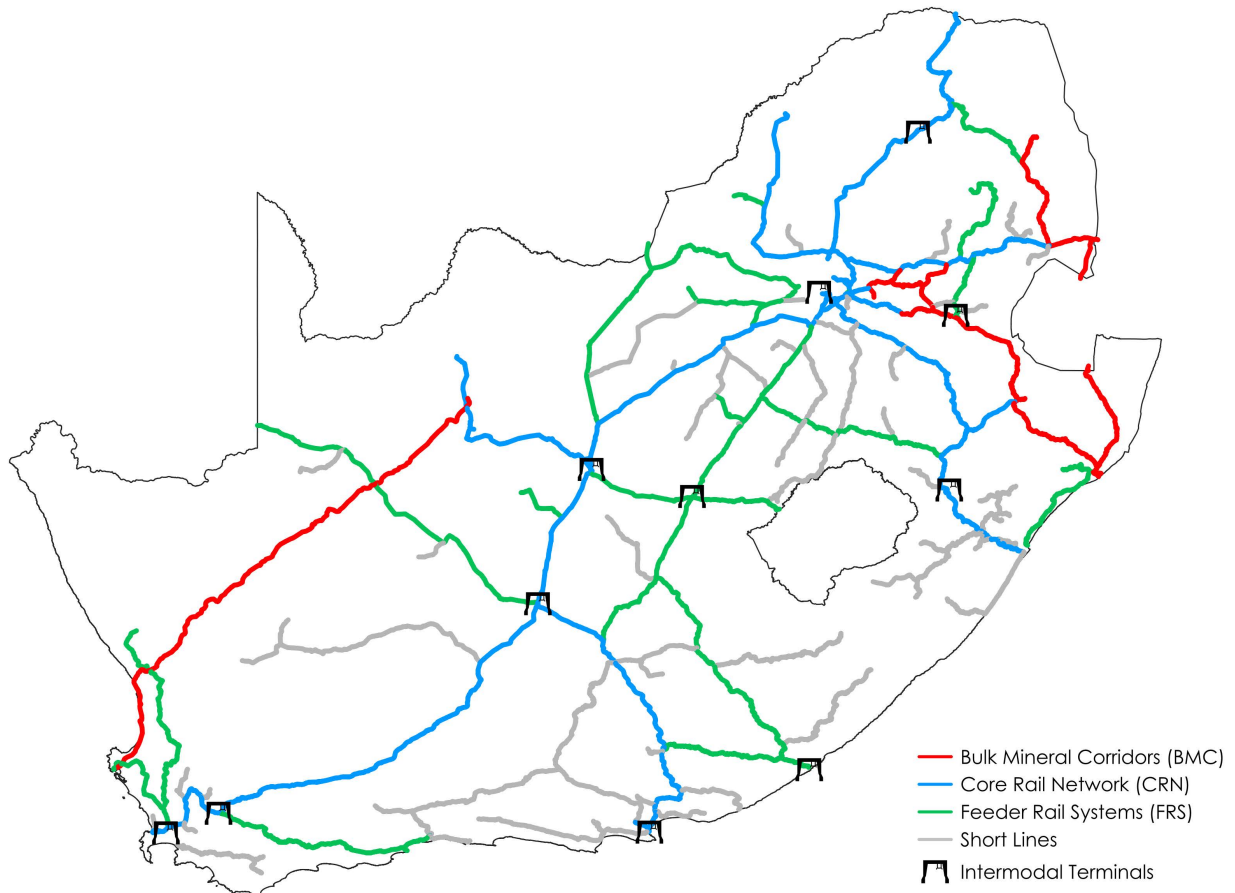


Figure 5: Intermodal terminals and rail lines

Assumptions

Commodities

The Worcester and Worcester-Kraaicon terminals evaluate all origin destination pairs categorised as "Palletised" or "Refrigerated" cargo. The freight is assigned to the nearest intermodal facility, either Worcester or Kraaicon. The volume of freight shifted from road to rail is calculated by taking all the shiftable tonnes identified in the base WC FDM™ as well as an additional 50% of the remaining road freight for those same OD pairs are added to get the total tonnes. This 50% is used to create a best case, which is aligned with the methodology used in Scenario 3: Terminal network (2024 base year). Because single OD flows are not split up, a binary (yes/no) selection is utilised for each OD flow, these total tonnes scale linearly based on the assumed pickup percentage, meaning if the pickup percentage is changed the total tonnes will change in proportion. Unlike the general intermodal terminals, the fruit export terminals (Ceres, Caledon, and Vredendal) operate within predefined catchment areas and these terminals specifically target all export fruit volumes destined for the Port of Cape Town.

Beyond the total volume, the scenario evaluates the viability of these tonnes based on their cost profile. The freight is segmented into three distinct categories:

1. **cost advantage** - intermodal costs are cheaper than the direct road cost,
2. **cost advantage with internalised externality cost** - the intermodal terminals becomes the preferred choice only when externality costs (e.g., emissions, accidents, congestion) are factored in and,
3. **cost disadvantage** - the intermodal freight remains more expensive than the direct road cost.

Travel time

The total travel time for any given origin-destination pair is made up of three distinct parts: the initial loading time, the active transit time, and the terminal dwell time. The initial loading time is dependent upon the vehicle configuration; specifically, flatbed trucks carrying containers require an estimated loading time of 1.50 hours, while volume vans and tautliners require 1.25 hours and 0.75 hours, respectively. The active transit time for both road and rail modes is calculated by dividing the total distance by an average operating speed of 60 km/h.

The most significant variable in the total travel time is the intermodal facility dwell time, which is set at a baseline of 36 hours per terminal stay. This is a conservative target derived from average actual dwell times that typically exceed the ideal 24 hours by more than 17 hours (J.B. Hunt, 2015)¹.

The total impact of facility dwell time is dictated by the commodity's logistical path. For fruit commodities, which move from a single terminal (Worcester, Kraaicon or fruit terminals) directly to the port, the total dwell time is limited to 36 hours. In contrast, non-fruit commodities follow a hub-and-spoke like model that requires processing at both an origin and a destination intermodal terminal. This results in a cumulative dwell time of 72 hours, a factor that significantly increases the total travel time and the associated inventory carrying costs.

Handling cost

The handling cost is made up of two components: a labour rate of R800 per hour of loading commodities and a fixed intermodal handling fee of R800 per trip. The intermodal handling cost is based on the fee that Maersk charges for moving a container from the Port of Durban Container Terminal to the Bayhead container yard.

The total labour rate is calculated by multiplying the labour rate per hour by the time it takes the commodities to be loaded and unloaded. The loading time for a commodity is determined by the type of vehicle that is used to transport the commodity. The associated loading time for the three vehicle types as well as the accompanying handling cost per trip can be seen in Table 1.

Table 1: Handling cost per trip by vehicle type

Vehicle type	Loading time (hours)	Handling cost per trip
Container/flat bed	1.50	R1 200
Volume van	1.25	R1 000
Tautliner	0.75	R600

For international movements, imports and exports incur a single labour handling charge because the container is only being loaded at its origin and not the destination, the port. In contrast, domestic freight requires handling at both the origin and the destination, effectively doubling the cost.

The intermodal handling cost differentiates between perishable and general goods. Fruit commodities that are exported, including citrus, grapes, deciduous fruits and subtropical fruits, are transported from its origin to an intermodal or fruit terminal and then transported directly to the Port of Cape Town. This involves handling at a single terminal, resulting in an intermodal handling cost of R800. In comparison, non-fruit commodities require transport between an origin-intermodal terminal and a destination-intermodal terminal. Because these goods are handled at two separate terminals during the rail journey, the intermodal handling cost is multiplied by two, bringing the total cost for non-fruit freight to R1 600.

In-transit inventory carrying cost

The in-transit inventory carrying cost (ICC) is used to quantify the expense of holding goods while they are being transported. It is calculated by multiplying the value of the goods being transported by an annual carrying cost percentage, adjusted for transit time. The ICC is impacted by longer transit times, i.e. the longer goods are in transit, the greater the capital costs. The ICC is greatly affected by terminal dwell time as the time spent at the terminals can accumulate to take up much of the total travel time for a commodity.

Results

A total of 10.4m tonnes of road freight were identified as freight that can utilise the intermodal freight terminals. The freight identified can either be deemed to be commercially advantageous or socially advantageous, or not. The freight is commercially advantageous when the total intermodal cost is less than the direct road linehaul cost, whereas to be socially advantageous the combined intermodal total cost and externality cost needs to be less than the combined road linehaul direct cost and externality cost. A freight owner can still be profitable even if the flows are deemed not to be commercially or socially advantageous as long as the input, manufacturing and transport costs are covered.

There are three combinations of the commercial and social advantage:

1. **net-positive** (both commercially and socially advantageous),
2. **subsidised gain** (socially advantageous but not commercially advantageous), and
3. **net-negative** (neither commercially nor socially advantageous).

¹ J.B. Hunt. 2015. *Dwell: How Intermodal Terminal Congestion Impacts Capacity and Service*. Lowell: J.B. Hunt Transport, Inc.

Total tonnes

Figure 6 shows the total tonnes for each operational model depending on commercial and social advantage. Across the four operational models, on average 39% (approximately 4.0m tonnes) of the total tonnes are deemed to be a net-negative, 21% (approximately 2.2m tonnes) are deemed to be a subsidised gain and 40% (approximately 4.2m tonnes) are deemed to be a net-positive.

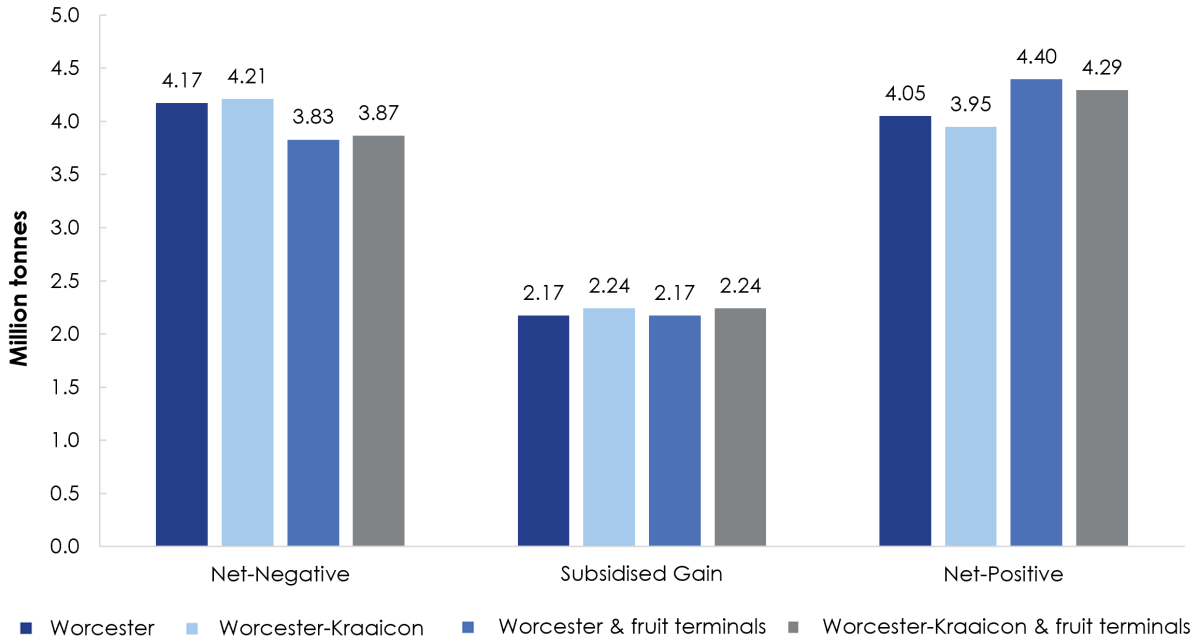
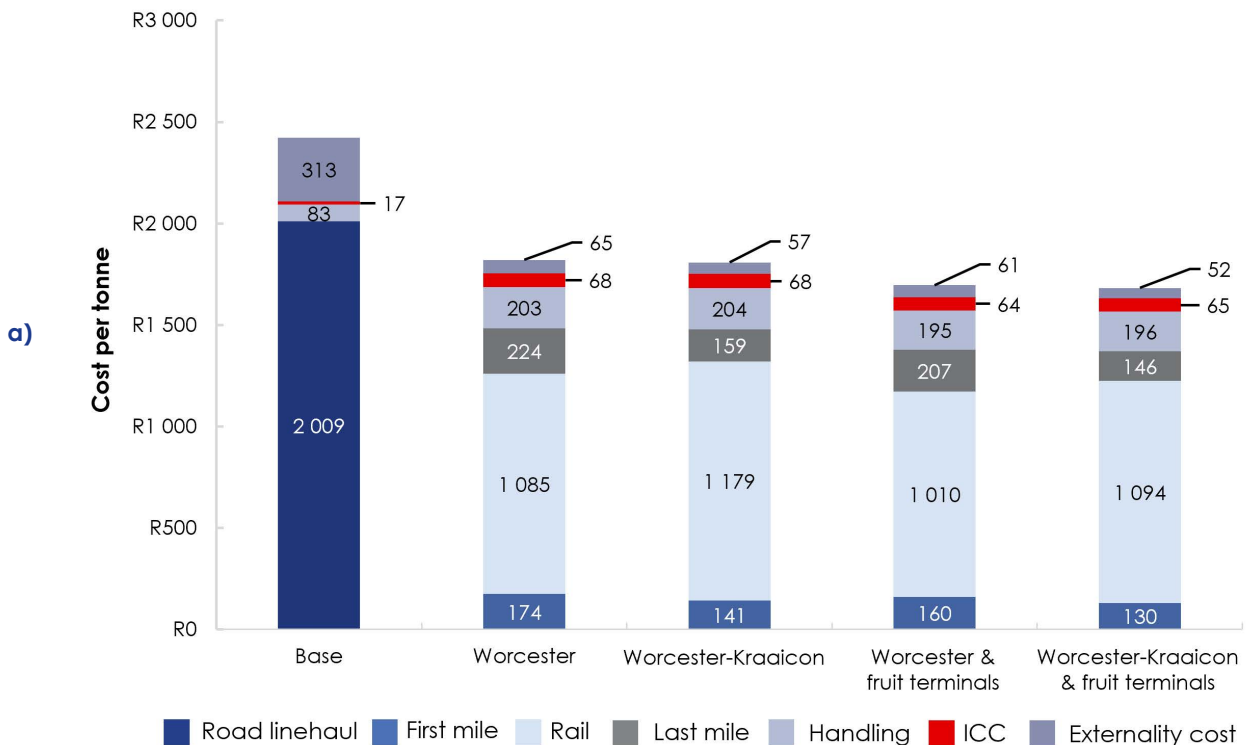


Figure 6: Total tonnes depending on the commercial and social advantage

The operational model with the most net-positive tonnes is Worcester and fruit terminals (4.4m tonnes). Worcester and fruit terminals also have the least net-negative tonnes and are tied with the Worcester operational model for having the least subsidised gain tonnes. The inclusion of fruit terminals into an operational model decreases the first mile distance leading to an increase in net-positive tonnes.

Net-Positive

Figure 7 shows the cost per tonne (see below) and the cost per tonne-km (see next page) for the base and the four operational models when it is a net-positive.



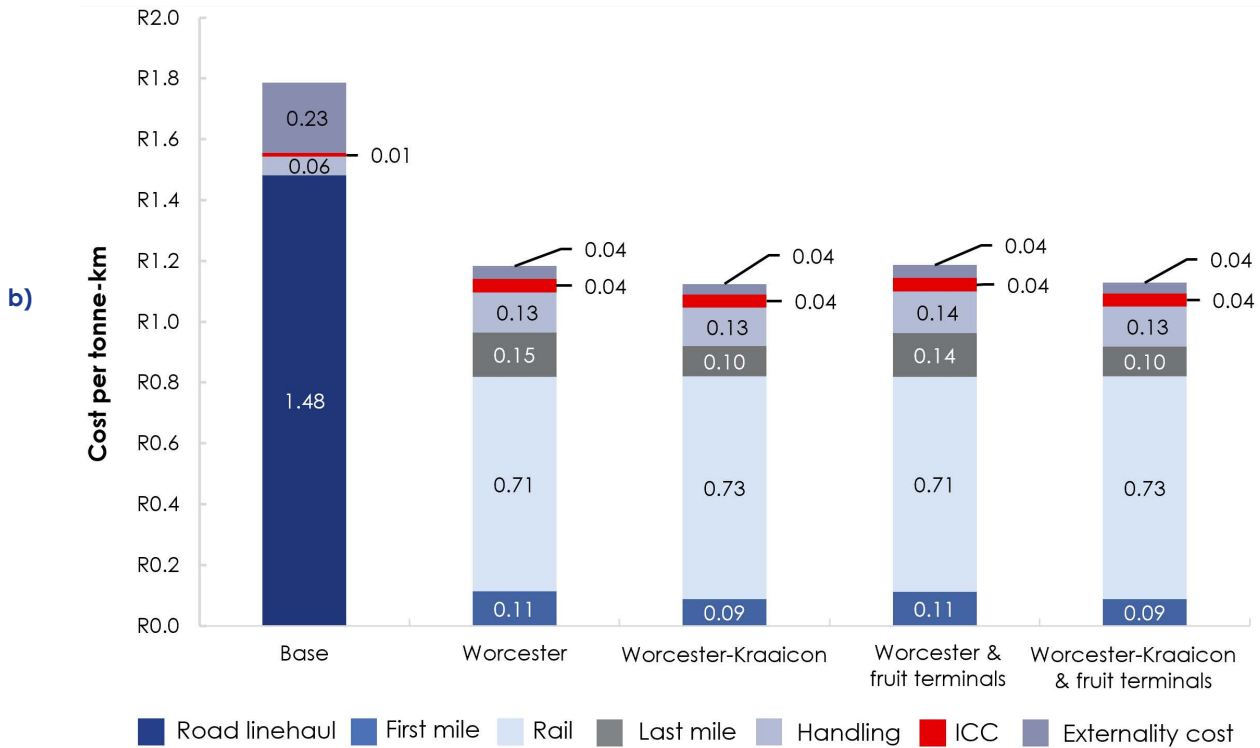


Figure 7: Cost per (a) tonne and (b) tonne-km for net-positive

In these cases where it is both commercially and socially advantageous. The use of an intermodal terminal would be cheaper for freight owners and would reduce the externality burden compared to the base. The cost is expressed per total tonne-km. The base cost includes the direct road linehaul cost, handling cost, ICC and externality cost, whereas the cost per tonne-km for the four operational models include the first mile (FM) cost, rail cost, last mile (LM) cost as well as the handling cost, ICC, and externality cost. As the distance increases, the lower the handling cost portion becomes.

For freight that is deemed to be a net-positive the total cost per tonne for the base are R2 109 (excluding externality cost) and R2 422 (including externality cost). There is a general decrease in the cost per tonne for both the total cost excluding externality cost and the total cost including externality cost compared to the base, as seen in Table 2.

Table 2: Percentage change in cost per tonne compared to the base for net-positive

Operational model	Total base cost	Total base cost and externality cost
Worcester	- 17%	- 25%
Worcester-Kraaicon	- 17%	- 25%
Worcester & fruit terminals	- 22%	- 30%
Worcester-Kraaicon & fruit terminals	- 23%	- 31%

Subsidised Gain

Figure 8 shows the cost per tonne and the cost per tonne-km for the base and the four operational models when it is a subsidised gain.

In these cases where it is socially advantageous but not commercially advantageous the use of an intermodal terminal would be more expensive for operators, however there would be a greater externality cost saving compared to the base. This would require governments subsidies to make the use of intermodal terminals both commercially and socially advantageous. Despite having an overall lower cost/tonne-km, the total transport cost from the same origin to destination is still more expensive when using the Intermodal Terminals when comparing it on a purely tariff basis. Only once externality cost is included in the price tag, does it become socially advantageous. This highlights that there is a potential trade-off between the efficiency of a mode of transport and the total distance that it is required to travel to meet the same demand.

The total cost per tonne for the base are R1 621 (excluding externality cost) and R1 944 (including externality cost). For the freight that is classified as a subsidised gain there is an increase in the cost per tonne for the total cost excluding externality cost and a decrease in the total cost including externality cost compared to the base, as seen in Table 3.

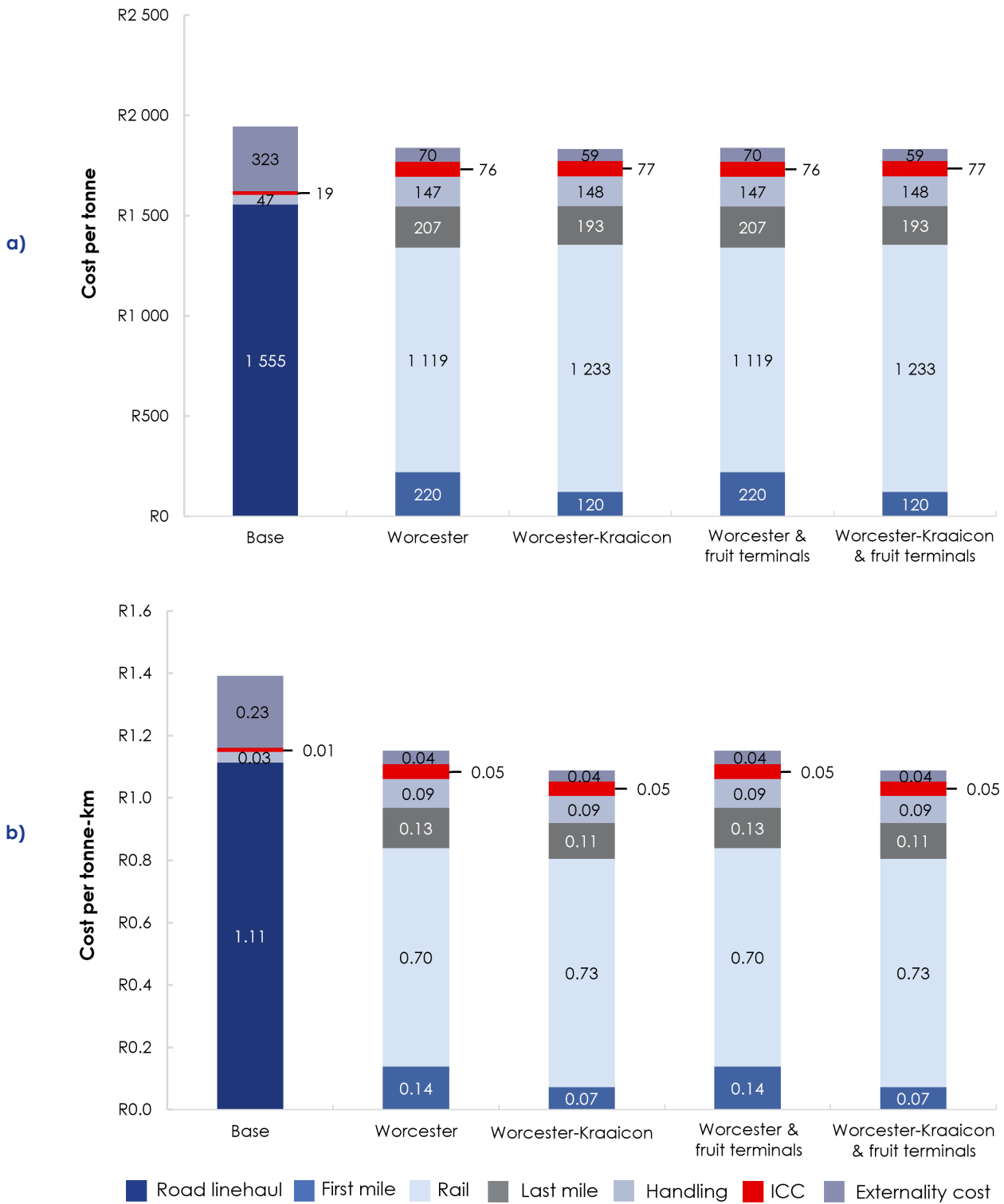


Figure 8: Cost per (a) tonne and (b) tonne-km for subsidised gain

Table 3: Percentage change in cost per tonne compared to the base for subsidised gain

Operational model	Total base cost	Total base cost and externality cost
Worcester	- 17%	- 25%
Worcester-Kraaicon	- 17%	- 25%
Worcester & fruit terminals	- 22%	- 30%
Worcester-Kraaicon & fruit terminals	- 23%	- 31%

Net-Negative

Figure 9 shows the cost per tonne and the cost per tonne-km for the base and the four operational models when it is a net-negative.

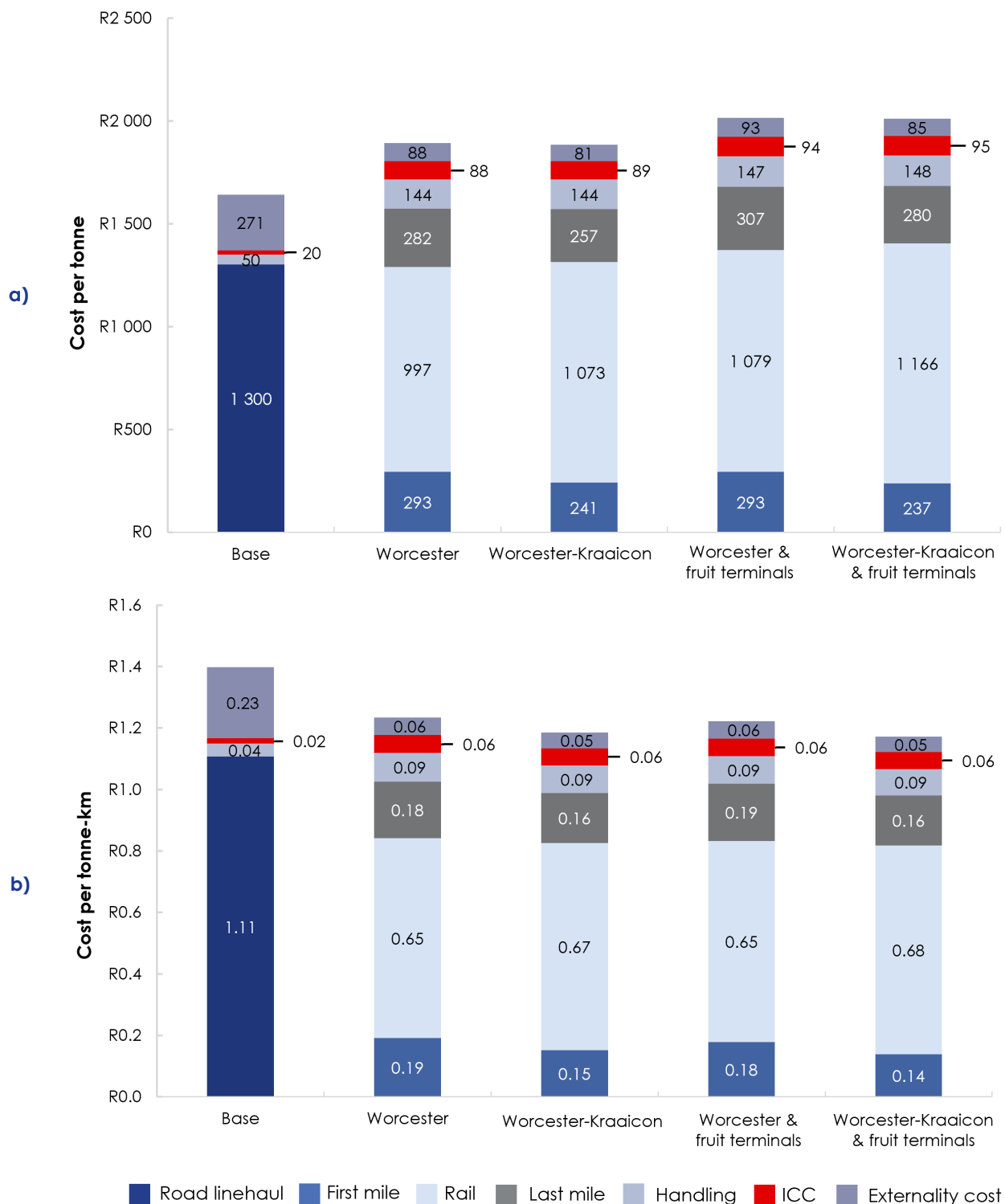


Figure 9: Cost per (a) tonne and (b) tonne-km for net-negative

In these cases where it is neither commercially nor socially advantageous the use of intermodal terminals are more expensive than the base case in every way. It would require subsidies and would still have a negative impact on the environment and society. Despite the cost per tonne-km being lower than the direct linehaul on road (the base), the total cost of moving the freight is higher. This is due to more tonne-km being generated by going via the intermodal freight terminals compared to the direct linehaul on road and the externality cost cannot offset the deficit as with the subsidised gain cases.

The total cost per tonne for the base are R1 370 (excluding externality cost) and R1 641 (including externality cost) for freight classified as a net-negative. There is a general increase in the cost per tonne for both the total cost excluding externality cost and the total cost including externality cost compared to the base, as seen in Table 4.

Table 4: Percentage change in cost per tonne compared to the base for net-negative

Operational model	Total base cost	Total base cost and externality cost
Worcester	9%	- 5%
Worcester-Kraaicon	9%	- 6%
Worcester & fruit terminals	9%	- 5%
Worcester-Kraaicon & fruit terminals	9%	- 6%

Average trip length and distance travelled

Figure 10 compares the average trip length of the base model to the four operational models.

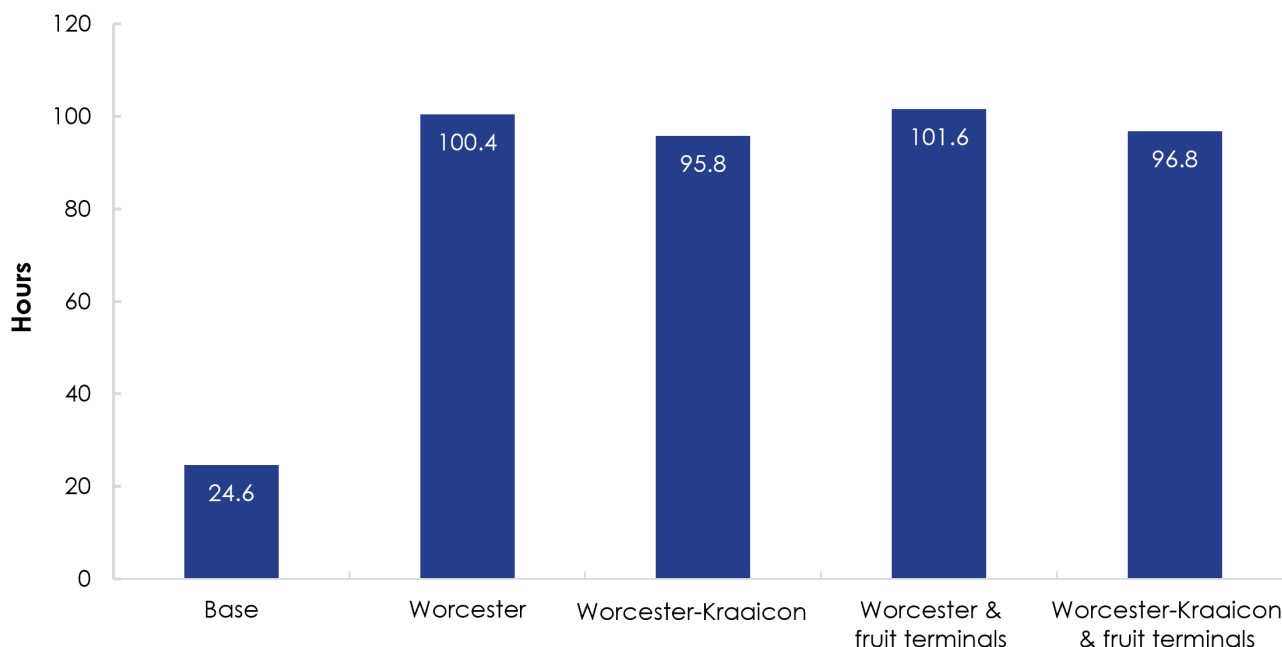


Figure 10: Average trip length in hours (base versus four operational models)

The average trip length for the Worcester terminal and Worcester & fruit terminals saw an increase of 309% (75.9 hours) and 290% (71.2 hours) against the base, respectively. In a similar fashion, the Worcester-Kraaicon terminal and Worcester-Kraaicon & fruit terminals saw an increase in average trip length of 314% (77.0 hours) and 294% (72.2 hours), respectively.

The significant increase in average trip length is mostly driven by the accumulation of intermodal dwell time and increased total travel distance. The integration of the intermodal facilities introduces significant stationary time, adding between 36 and 72 hours to the travel time of a trip. The delay is further increased by the physical reconfiguration of the route, unlike direct road/rail trips, intermodal models necessitate an additional FM and LM trip to connect origins and destinations to the intermodal facilities.

It is important to note that these additional legs often result in a longer total travel distance (compared to more direct transport routes) when they are combined with the fixed rail corridor between intermodal terminals.

The average distance travelled for the combined FM and LM trips can be seen in Figure 11(a). Figure 11 (b) further shows the average travel distance during the rail leg for each of the four operational models.

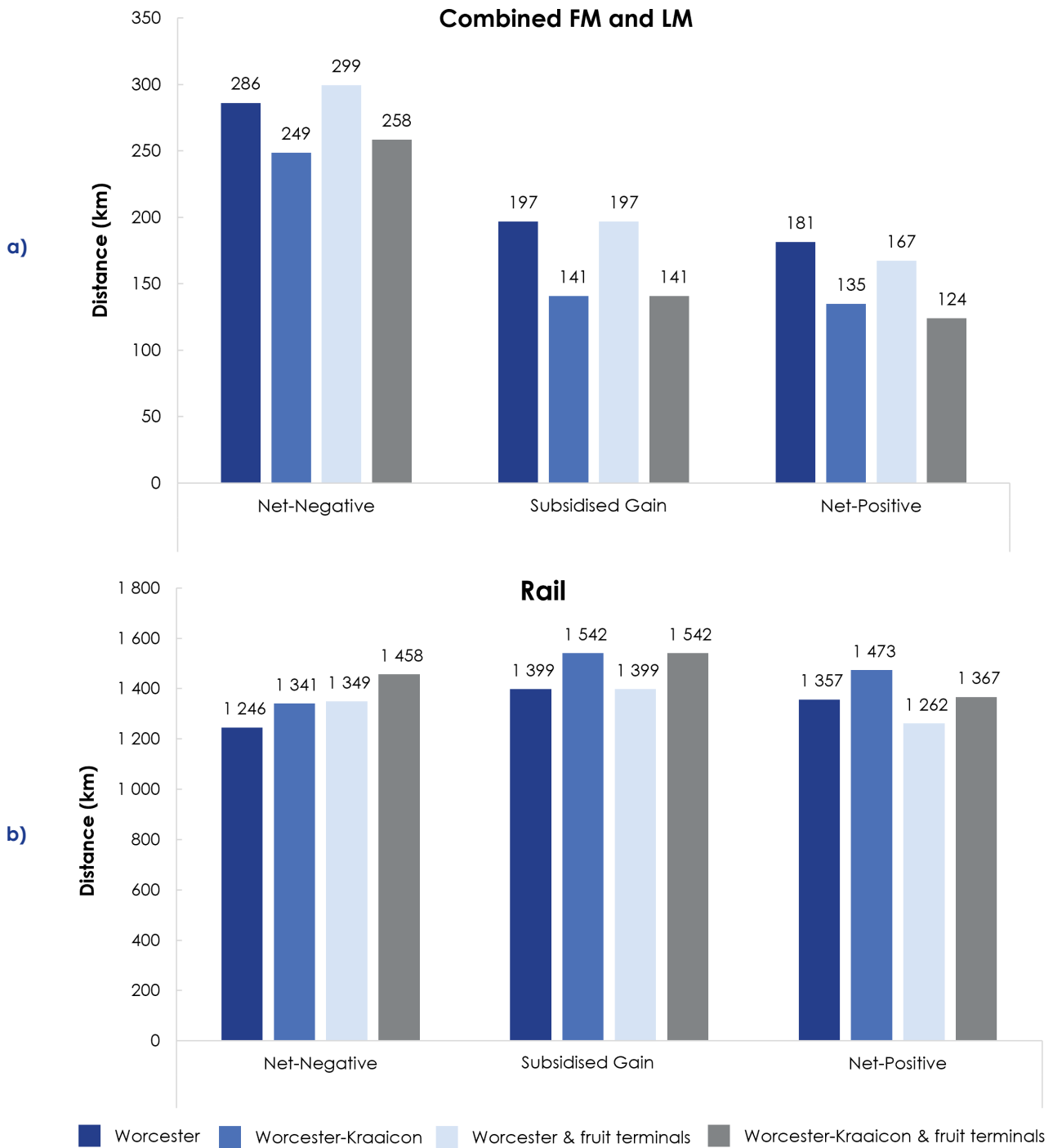


Figure 11: Average travel distance for a) combined FM and LM and (b) rail

The figure shows a general decrease in travel distance as it moves from a net-negative to a net-positive. Thus, indicating that the combined FM and LM distance for an operator needs to be less than 197km to be socially advantageous and less than 181km to be both commercially and socially advantageous if an intermodal terminal were to only be operated in Worcester, given a rail rate of 80c/tonne-km. For the Worcester and Worcester-Kraaicon operational models, the average travel distance for net-negative flows is lower than both the subsidised gain and net-positive cases. This suggests that there is a viability threshold, in net-negative cases the combination of a long FM and LM road legs and shorter rail linehaul prevents the lower rail costs from offsetting the high fixed costs (handling cost, ICC and FM and LM costs). Whereas the net-positive cases highlight that for an intermodal terminal to be truly viable in the South African operating environment it requires a short FM and LM road leg with a relatively long rail distance.

Freight flows

Figure 12 shows the freight flows if there is only an intermodal terminal constructed in Worcester. The light blue shows the combined FM and LM freight, with the red showing the rail freight movements between intermodal terminals. The dark blue shows the freight movements that remains on road. Despite the aggressive intermodal freight pickup, most of the long-distance freight remains on road.

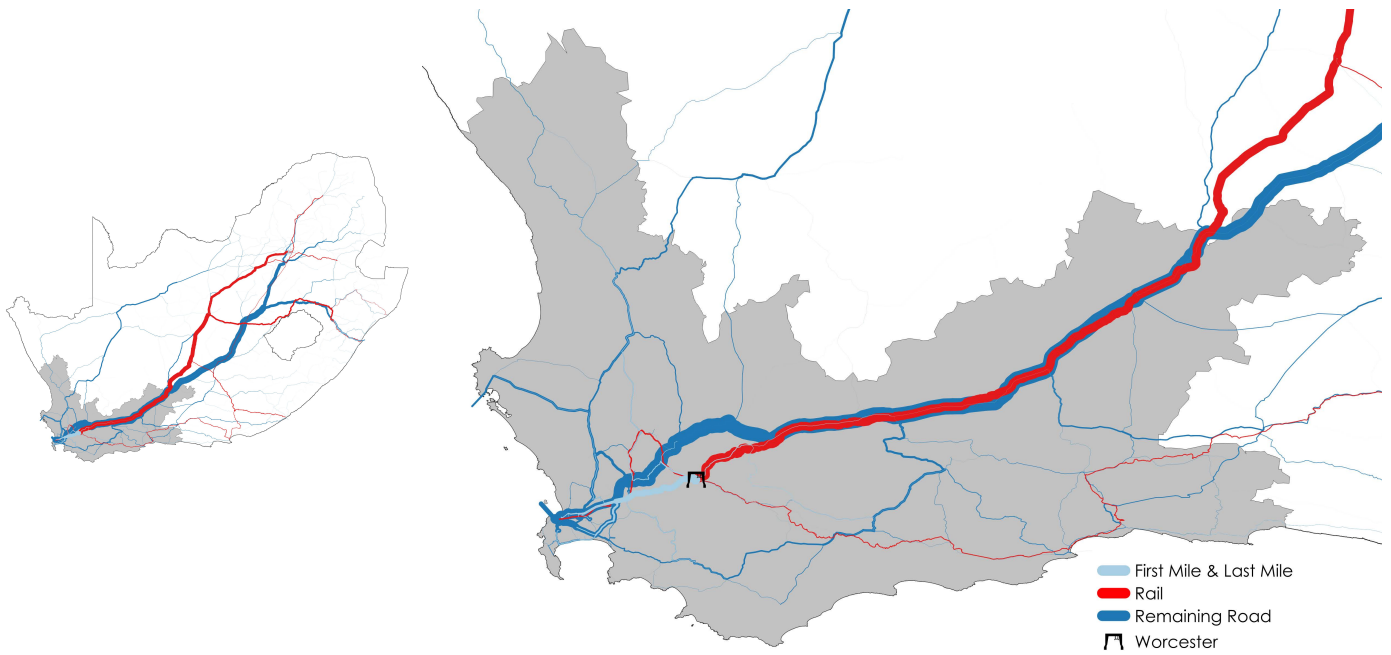


Figure 12: Freight flows for the Worcester terminal with a national (left) and Western Cape (right) view

Figure 13 shows the freight flows for the operational model in which both the Worcester terminal and the fruit terminals were operational.

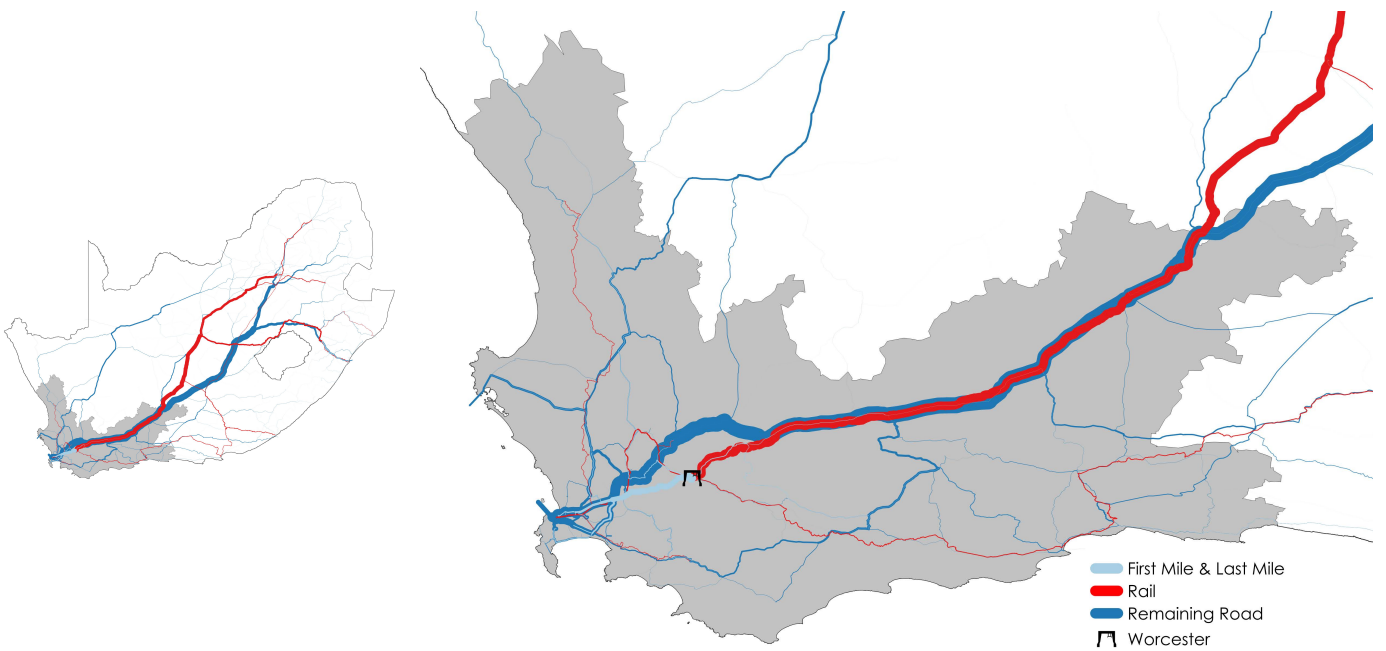


Figure 13: Freight flows for the Worcester & fruit terminals with a national (left) and Western Cape (right) view

The main difference between Figure 12 and Figure 13 is the rail freight movements from the fruit terminals directly to the port instead of first going to the Worcester terminal.

Figure 14 shows the freight flows if freight were to either be transported via the Worcester or Kraaicon terminal. The main difference observed in the figure when compared to the previous two is the rail freight moving further along the mainline towards Kraaicon. The introduction of the Kraaicon terminal also leads to a reduction in the FM and LM distances for freight bound for Cape Town Metro and the Port, when compared to the Worcester terminal.

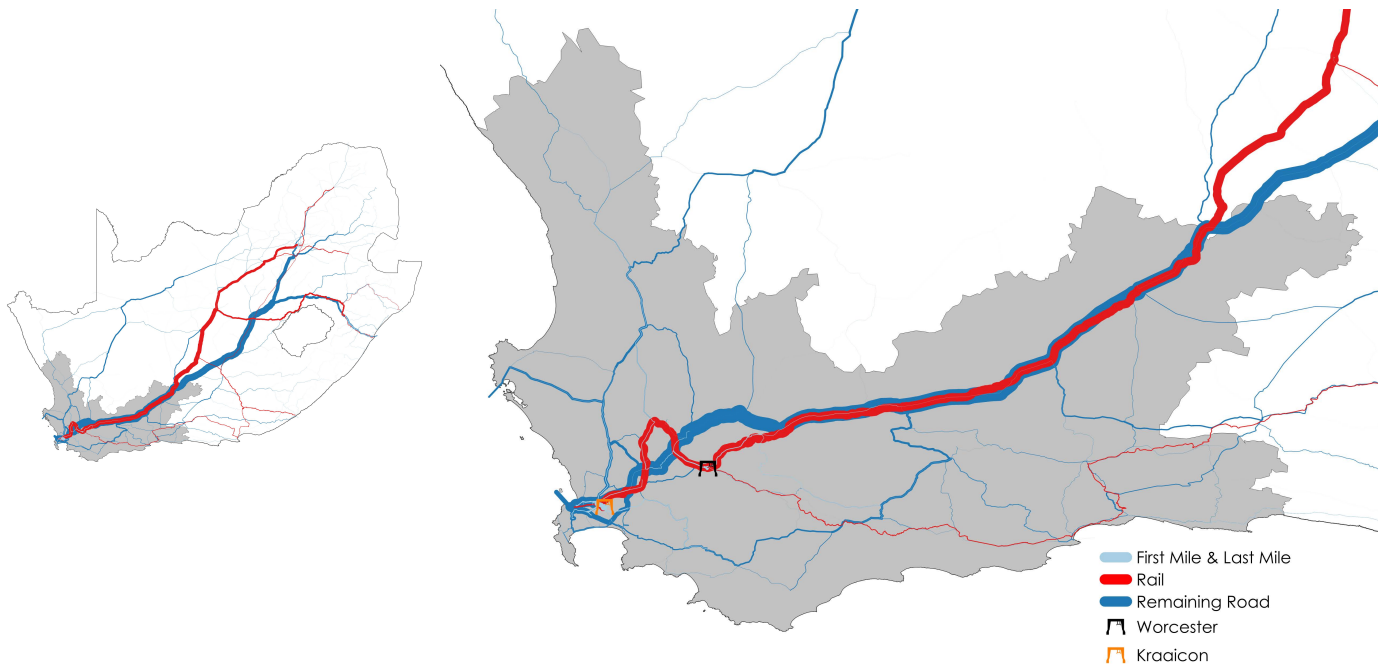


Figure 14: Freight flows for the Worcester and Kraaicon terminals with a national (left) and Western Cape (right) view

Figure 15 shows the freight flows if both the Worcester and Kraaicon terminals were operational as well as the fruit terminals.

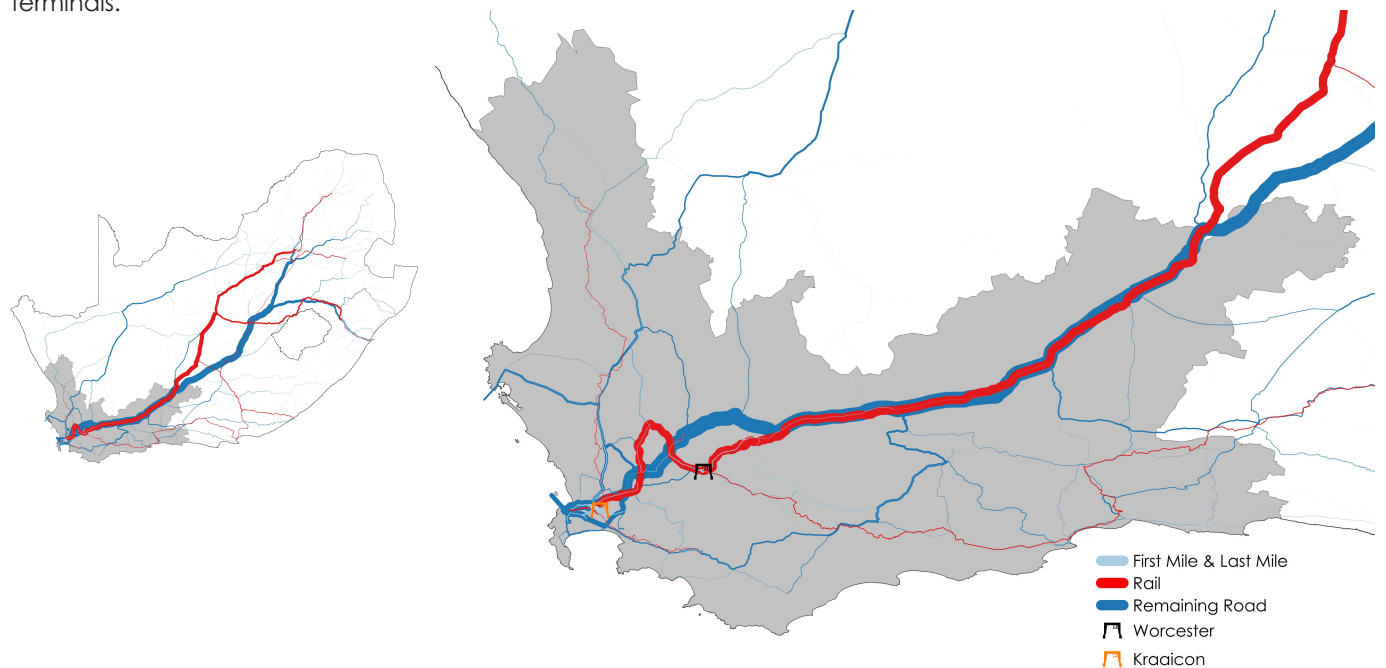


Figure 15: Freight flows for the Worcester and Kraaicon terminals with fruit terminals with a national (left) and Western Cape (right) view

The introduction of the fruit terminals in Ceres, Caledon and Vredendal incurs additional rail movements to the port as well as a reduction in FM and LM distance for freight moving on the N1 between Worcester and Kraaicon.

Table 5 provides an overview of impact on port-related traffic shifting from road to rail across the four operational models. While the total number of trips remains constant at 41 859 trips in the base, with approximately 60% (25 302 trips) shifting to rail, the commercial and social advantage varies across the four operational models. The total trips that remain on road for each model adds up to 16 557 trips. The table shows that the addition of the fruit terminals to the intermodal terminals increases the economic viability, with net-positive shifted trips increasing from 124 trips for the Worcester and Worcester-Kraaicon operational modes to 17 604 trips (Worcester & fruit terminals) and 17 446 trips (Worcester-Kraaicon & fruit terminals). The table further shows port-related trips for the national intermodal network, these trips are transported directly to/from an intermodal terminal (excluding Worcester-Kraaicon) as identified in Figure 2. For the national intermodal network there are 65 043 trips port-related trips in the base of which 62% (40 041 trips) can be shifted to rail. Of the 40 041 shifted trips approximately 70% (28 123 trips) are a net-positive, 14% (5 565 trips) are a subsidised gain, and 16% (6 353 trips) are a net-negative. The national terminal network can be effective in reducing trips to and from the port, whereas intermodal facilities (without the fruit terminals) have limited incentives from a cost structure perspective due to low volume of trips. The fruit terminals, however, are more effective because they focus solely on fruit exports to the port.

Table 5: Number of trips to and from the port shifted from road to rail

Operational models	Trip classification	Net-Negative	Subsidised Gain	Net-Positive
Worcester	Number of trips (base)	41 646	-	213
	Shifted trips	25 178	-	124
	Remaining trips	16 468	-	89
Worcester-Kraaicon	Number of trips (base)	41 646	-	213
	Shifted trips	25 178	-	124
	Remaining trips	16 468	-	89
Worcester & fruit terminals	Number of trips (base)	12 760	-	29 099
	Shifted trips	7 698	-	17 604
	Remaining trips	5 062	-	11 495
Worcester-Kraaicon & fruit terminals	Number of trips (base)	13 060	-	28 799
	Shifted trips	7 855	-	17 446
	Remaining trips	5 204	-	11 353
National intermodal network	Number of trips (base)	10 470	9 003	45 571
	Shifted trips	6 353	5 565	28 123
	Remaining trips	4 116	3 438	17 448

Sensitivity analysis

The fluctuation in the percentage of freight that is deemed to be a net-positive, subsidised gain, or net-negative with a change in the rail rate can be seen in Figure 16.

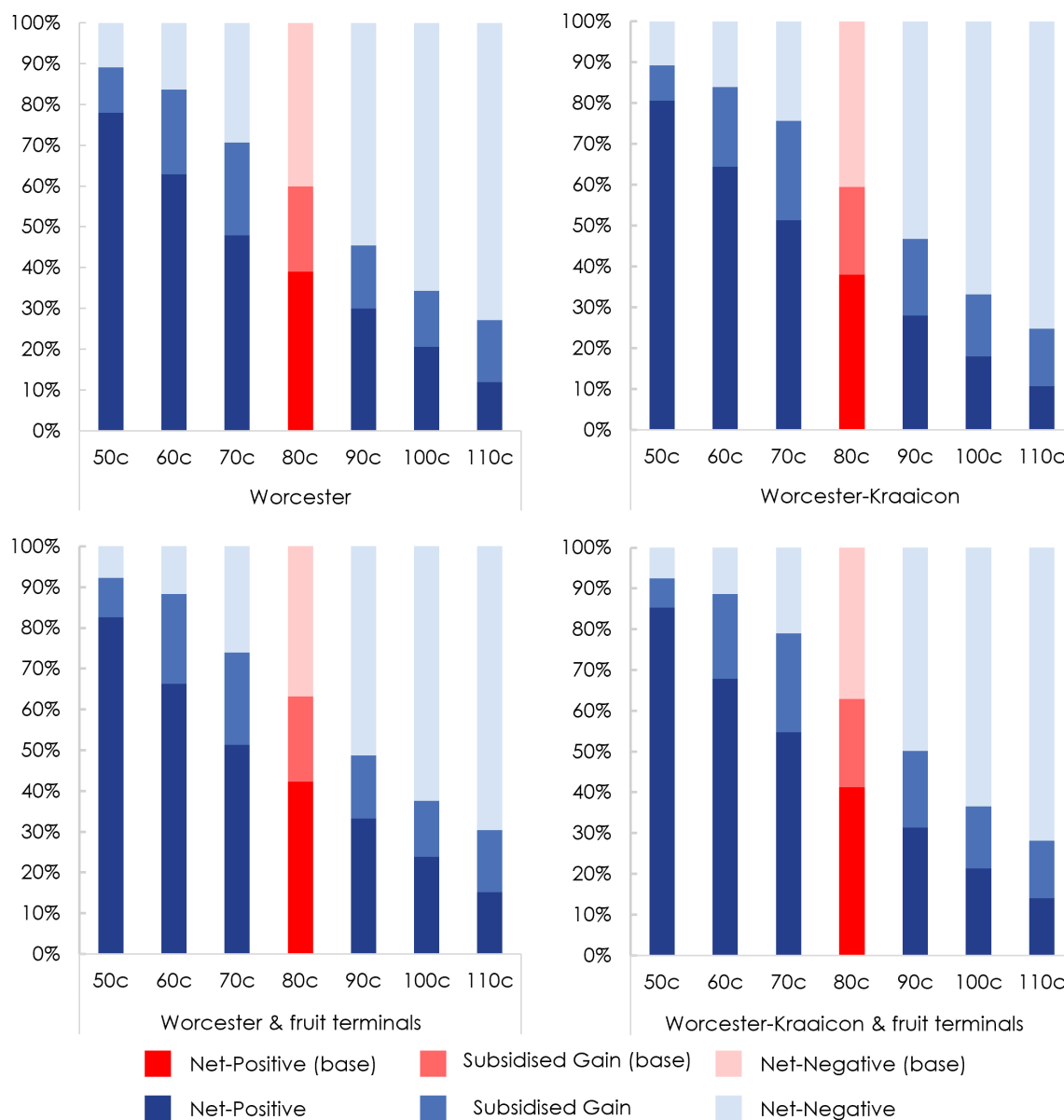


Figure 16: Sensitivity analysis of intermodal tonnes by location with a rail rate change

For each of the four operational models an increase in the rail rate (cent per tonne-km) causes a decrease in the proportion of net-positive freight. At a rail rate of 50c per tonne-km the percentage of net-positive freight for all the operational models is between 78% and 85%, with the Worcester-Kraaicon with fruit terminals have the largest proportion. When the rail rate increases to 110c per tonne-km the percentage of net-positive freight decreases to between 11% and 14%.

While the rail rate is the primary determinant in the viability of an intermodal terminal, success is constrained by the rail linehaul distance and the FM and LM distance. While adjusting the rail rate can shift volumes into the subsidy band (potentially capturing an additional 10% - 20% of freight), it is not always the solution. Due to geographical limitations, certain freight will never be able to use intermodal terminals due to the FM and LM distance being simply too long to be offset.

Table 6 examines how a change in the rail rate has an impact on the viability across the four operational models. For the Worcester and Worcester-Kraaicon operational models at a 50c per tonne-km there are 16 594 net-negative trips to the port, which increases to 24 927 as the rail rate reaches 80c per tonne-km. The net-positive trips remain relatively low regardless of the rate. Adding the fruit terminals significantly changes the viability of the operational models. At the 50c per tonne-km rail rate the number of net-positive trips to the port increases to 24 574. However, as the rate increases to 60c per tonne-km and above the net-positive trips remain at 17 540.

Table 6: Sensitivity analysis of shifted trips to the port with a rail rate change

Operational models	Trip classification	Net-Negative	Subsidised Gain	Net-Positive
Worcester	Number of trips (base)	41 646	-	213
	Shifted trips	25 178	-	124
	Remaining trips	16 468	-	89
Worcester-Kraaicon	Number of trips (base)	41 646	-	213
	Shifted trips	25 178	-	124
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	Shifted trips	7 698	-	17 604
	Remaining trips	5 062	-	11 495
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	Shifted trips	7 855	-	17 446
	Remaining trips	5 204	-	11 353
National intermodal network	Number of trips (base)	10 470	9 003	45 571
	Shifted trips	6 353	5 565	28 123
	Remaining trips	4 116	3 438	17 448

Table 7 shows the effect of a change in the rail rate has on the number of trips to and from the port for the national intermodal network. The national intermodal network maintains strong net-positive to the port until the rail rate exceeds 90c per tonne-km. Once the rail rate reaches 100c per tonne-km the net-positive trips to the port drop sharply to 4 482 trips, while net-negative to the port increases to 7 320. Trips from the port show a unique peak in net-positive volumes (20 699) at 70c per tonne-km. However, by 110c per tonne-km, the net-positive trips decrease to just 2 225 trips.

Table 7: Sensitivity analysis of shifted trips to the port with a rail rate change for the national intermodal network

Terminal	Rail rate	Net-Negative		Subsidised Gain		Net-Positive	
		To the Port	From the Port	To the Port	From the Port	To the Port	From the Port
National intermodal network	50c	1 222	369	903	360	22 725	14 463
	60c	2 712	611	318	919	21 820	13 661
	70c	1 005	2 824	3 025	1 327	11 162	20 699
	80c	3 738	2 615	1 548	4 017	19 563	8 560
	90c	5 116	4 660	3 735	3 781	15 998	6 751
	100c	7 320	5 720	3 389	6 465	4 482	12 665
	110c	11 129	9 542	5 857	3 424	7 864	2 225

Conclusion

The Worcester terminal scenarios serves as a high-level estimate on the potential transportation cost impact of different permutations of intermodal facility locations in the Western Cape (Worcester, Kraaicon and fruit terminals) without taking congestion effects or rail slots into account. At a baseline rail rate of 80c per tonne-km, 39% (approximately 4.0m tonnes) of the total tonnes are deemed to be a net-negative, 21% (approximately 2.2m tonnes) are deemed to be a subsidised gain and 40% (approximately 4.2m tonnes) are deemed to be a net-positive. The model demonstrates price sensitivity, as a reduction in the rail rate to 50c per tonne-km would increase the net-positive portion to between 78% and 85% of the total identified freight. Despite this, the introduction of intermodal terminals increases average trip lengths compared to direct road transport, and a significant portion of long-distance freight remains more efficient on road.

The findings suggest that while Worcester appears to be a favourable location in the current vacuum, the size and design of this facility should not be considered in isolation, the scenario makes a high-level quantification of introducing other intermodal terminals, minimising first and last mile distance within the province, to see how the freight distribution will shift. Unlike Belcon, which primarily functions as an extension of the PoCT's stacking capacity to ease congestion in the port, Worcester represents the first potential domestic-intermodal facility designed specifically to serve the provincial hinterland. While this gives Worcester a unique strategic advantage, its development must be balanced against the proposed Kraaicon and the fruit terminals. If the market becomes over-saturated with competing facilities, the province risks the same pitfalls seen in the UK's historical rail expansion, where over-investment eventually necessitated the Beeching cuts, the closure of major rail lines to increase density on the remaining network.

Ultimately, the viability of the Worcester terminal depends on its ability to attract sufficient daily volume to maintain consistent rail schedules. If a facility fails to fill at least one train per day, the resulting increases in container dwell times, truck turnaround times and buffer inventory costs will inevitably affect the willingness of freight owners to use such an inter-modal facility. To move towards a definitive decision, in future research all these secondary impacts need to be sufficiently investigated in detail and simultaneously to make an informed long-term decision of what the ideal inter-modal facility solution inside the province should be.

Afterword

The 2022 WC FDM™ terminal network scenario considered a terminal network for the Western Cape comprising of a central super terminal or freight village, port connectivity, and network of handling points for containers, fruit, processed food, and fuel. The scenario identified four terminal types and nine potential terminal locations. These included a super terminal in Kraaicon, container terminals in George and Bitterfontein, fruit terminals in Ceres, Caledon and Vredendal, as well as processed food terminals in Malmesbury, George and Laingsburg.

While an evaluation of the Worcester terminal as a standalone intermodal freight terminal reveals potential advantages, the impact diminishes when analysed within the broader terminal network. Table 8 shows the net-positive shifted tonnes (based on a rail rate of 80c per tonne-km) assuming a wider network terminal implementation.

Table 8: Shifted tonnes within the broader terminal network

Terminal	Shifted tonnes
Caledon	517 891
Ceres	408 512
Vredendal	243 197
George	297 722
Laingsburg	83 206
Malmesbury	680 247
Directly to Port of Cape Town	579 569
Other (Outside WC)	11 681
Kraaicon	2 185 030
Worcester	492 662

This assumes that all the terminals function as intermodal terminals for any containerised goods and not just function as specialised terminals (fruit, processed food or fuel). Currently within the model, origins are assigned to a terminal based on the shortest road distance, and as such Kraaicon dominates due to its proximity to the Cape Town Metro area. In this context almost 40% (2 185 030 tonnes) of freight would be transported via Kraaicon and only 9% (492 662 tonnes) through Worcester.

While these results provide a baseline, it only represents the first stage of the evaluation process. The current model primarily prioritises distance and omits variables such as traffic congestion, which may diminish the viability of terminals that are located in high traffic areas. Future research may employ a generalised cost model that can provide a more accurate and nuanced analysis, leading to a better representation of terminal competitiveness.

Highlights

- A total of 10.4m tonnes of road freight were identified as possible freight that can utilise the intermodal freight terminals.
 - On average 39% (approximately 4.0m tonnes) of the total tonnes are deemed to be a net-negative, 21% (approximately 2.2m tonnes) are deemed to be a subsidised gain and 40% (approximately 4.2m tonnes) are deemed to be a net-positive.
 - A decrease in the rail rate of 30c per tonne-km would result in between 78% and 85% of the total identified freight to be classified as a net-positive, with net-negative then only making up between 8% and 11%.
 - The introduction of the intermodal freight terminals would, however, lead to an increase in the average trip length when compared to direct road transport. Compared to the base the increase in average trip length was 309% (75.9 hours) for the Worcester terminal, 290% (71.2 hours) for the Worcester & fruit terminal, 314% (77.0 hours) for the Worcester-Kraaicon terminal, and 294% (72.2 hours) for the Worcester-Kraaicon & fruit terminal.
 - The national terminal network can be effective in reducing trips to and from the port, whereas intermodal facilities (without the fruit terminals) have limited incentives from a cost structure perspective due to low volume of trips. The fruit terminals, however, are more effective because they focus solely on fruit exports to the port.
 - Despite the aggressive inter-modal freight pickup, most of the long-distance freight yet remains on road.
-



Introduction

The WC FDM™ enables the development of data-driven scenarios to inform inter alia industrial and freight transport policies and spatial planning. Pressing policy issues were identified, and high-level scenarios were developed to estimate the potential annual impact on the Western Cape's freight transport costs and Gross Domestic Product (GDP). The current results are indicative, with the purpose of encouraging discussions to increase the accuracy of the scenario development inputs. Once agreement is reached on the high-level scope and outcomes of these scenarios, priorities will be set to guide the implementation process for these scenarios.

The terminal network scenario was first developed for the 2022 base year. This update for the 2024 base year includes another terminal, located in Worcester, to evaluate its impact on the broader terminal network.

The National Infrastructure Plan 2050 (NIP 2050)¹ emphasises that transport policy must align with supply chain requirements and encourage the development of transport hubs to foster industrial diversification and clustering. It further states that South Africa needs to integrate rail, road, ports, intermodal hubs, and freight villages (also referred to as super hubs or terminals - see definitions included as an endnote).

Terminal options

Freight logistics hubs serve as important consolidation points where the value in logistics is added to the movement of containers and bulk or break-bulk freight. These hubs can become integrated inland intermodal facilities as consolidation points between modes, enabling the transition between road and rail (subject to a functional rail system). Terminals can have many forms as depicted in Table 1.

Table 1: Terminal options

Facility description	Use
Rail siding or depot	Dedicated to a single user
Dedicated commodity terminal	Single focus transshipment
Multi-purpose terminal (MPT)	Multi-purpose transshipment
Logistics park	MPTs and warehouse combination
Logistics service centre	Logistics parks providing ancillary logistics services
Freight village	Logistics service centres with light manufacturing

Various development possibilities around these options exist and at least one freight village (super terminal) is required for the Western Cape. As the terminals become increasingly integrated, they provide not only consolidation platforms but also service centres and logistics planning platforms for the province as a whole. A freight village that also includes light manufacturing shortens links in supply chains, making these more efficient and relative infrastructure use and externalities less for the same unit of output. It could link all rail sidings, dedicated commodity terminals, multi-purpose terminals, and ports in the province in an integrated whole.

Western Cape terminal network

In this scenario, a terminal network for the Western Cape was considered, comprising of a central super terminal or freight village, port connectivity, and network of handling points for containers, fruit, processed food, and fuel. The following assumptions were applied:

- **Overall:** A functional rail system.
- **Fruit terminals:** The volume target is the full export volumes (due to being dedicated to those specific fruit exports).
- **Other terminals:** The volumes target is natural modal shift volumes suitable to rail, plus an additional 50% of the remaining road volumes (due to the assumed positive effect of such terminal).

The proposed terminal network is shown in Figure 1.

¹ Department of Public Works and Infrastructure. 2022. *South Africa's National Infrastructure Plan 2050*. Pretoria, South Africa: Department of Public Works and Infrastructure (Republic of South Africa).

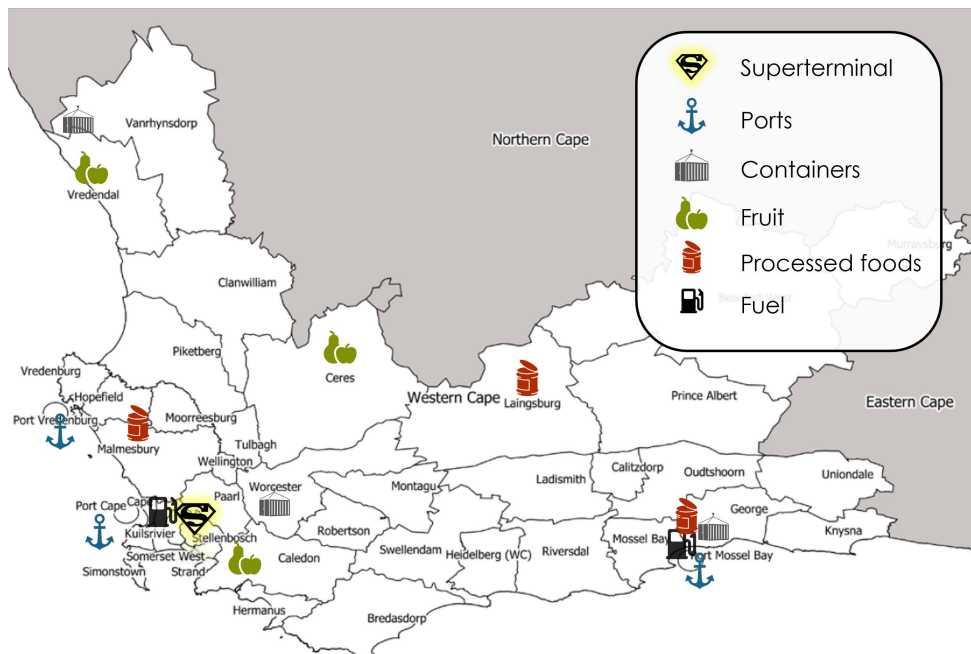







Figure 1: Proposed Western Cape freight terminal network


 The super terminal targets palletised freight between the Western Cape and either Gauteng, Limpopo, Mpumalanga, and Durban surrounds (excluding the volumes of the two smaller container terminals identified). The Kraaicon terminal was identified in pre-feasibility studies by Transnet and the City of Cape Town (CoCT). This terminal could have an annual handling potential of over 3.7 million tonnes, and alleviate a significant volume of trucks off the roads by utilising rail connections to and from it. This proposed network design could save R 2 160.1m and R1 499.1m in transport and externality costs, respectively.

 The two smaller container terminals identified, target palletised freight between the Garden Route and Gauteng, or the Garden Route and the CoCT - including any freight between the CoCT and Namibia or Namaqualand. These terminals are at George and on the Bitterfontein rail line (north of Vredendal) and have the potential to handle approximately 160 000 tonnes and 80 000 tonnes each annually. The proposed George container terminal could save R46.3m and R35.5m in transport and externality costs, respectively. However, the Bitterfontein terminal is estimated to result in a transport cost increase of R42.8m and an externality cost saving of only R2.1m, despite making use of the super terminal. The Worcester terminal targets the same freight as the super terminal, with freight allocated to the nearest terminal to minimise first- and last-mile distances. The terminal can have an annual handling potential of approximately 550 000 tonnes. This proposed network design could save R205.7m and R218.9m in transport and externality costs, respectively.

 Fruit terminals target all export fruit and the three potential fruit terminal locations identified, based on the cluster of fruit volumes in the region, are in Ceres, Caledon and Vredendal. The Ceres terminal has the potential to handle approximately 260 000 tonnes annually, while the Caledon and Vredendal terminals can each handle approximately 270 000 tonnes annually. This proposed network design could save R46.8m and R24.0m in transport and externality costs, respectively.

 The identified processed food terminals are in Malmesbury, George and Laingsburg. These terminals target palletised food and beverages between their immediate surroundings and either Gauteng, Limpopo, Mpumalanga, and Durban surrounds. The Malmesbury terminal should have an annual potential of 470 000 tonnes, with the George and Laingsburg terminals having an annual potential of 240 000 and 100 000 tonnes, respectively. This proposed network design could save R188.3m and R288.2m in transport and externality costs, respectively.

 The identified fuel terminals are situated in the Mossel Bay and Cape Town areas. There is a need for an integrated strategy for fuel flows between the CoCT and Mossel Bay. To execute this strategy effectively, it is essential to involve all stakeholders participating in the Western Cape fuel supply chain. This includes the Airports Company South Africa (ACSA), Central Energy Fund, PetroSA, Transnet, Transnet National Port Authority, Civil Aviation Authority, Western Cape provincial government, and local governments.

 An integrated strategy for the Western Cape's ports - Cape Town, Saldanha Bay, and Mossel Bay - promises multiple advantages. By aligning activities and resources, these ports can significantly improve overall efficiency, optimise resource allocation, refine processes, and manage traffic more effectively. This could also elevate shipping interest and investment, ultimately strengthening the province's economic prospects. Together, these ports can gain a competitive edge in global trade by presenting more attractive and efficient logistics solutions to shipping companies. A crucial aspect of this strategy involves focusing on specialised opportunities tailored to the strengths of each port, aligning with the integrated terminal approach. Available capacity can also be exploited more efficiently from a combined back of port or dry port facility, that services all three ports.

Conclusion

The estimated cost savings for the proposed terminal network is R2.6bn in transport cost and R2.07bn in externality cost. A well-planned and executed terminal network significantly boosts the efficiency, cost-effectiveness, and overall competitiveness of South African supply chains. To support this, the provincial government's role is pivotal. Creating supportive regulatory frameworks aligned with national policies and fostering collaborative partnerships with businesses and stakeholders in the logistics and supply chain industry are key steps. Through proactive engagement, the provincial government can optimise supply chains, drive economic growth, and enhance the province's competitiveness. The value of this network extends beyond individual facilities; it lies in the collaborative interactions and shared benefits among interconnected connections. This interconnectedness cultivates resilience, innovation, efficiency, and growth within the supply chain ecosystem.

The difference between the 2022 and 2024 base year analysis demonstrates an evolution in the terminal network, primarily driven by the introduction of the Worcester terminal. The potential annual volume increased from 5.86m tonnes in 2022 to 6.15m tonnes in 2024, a 5% increase. The super terminal's annual potential volume decreased from 4.0m in 2022 to 3.73m tonnes in 2024, largely due to 550 000 tonnes being diverted to the Worcester terminal, which offers closer proximity to specific origin-destination pairs, thereby reducing first- and last-mile distances. Despite a slight reduction in the volume of the super terminal, the total transport cost savings across the network rose from R1.99bn in 2022 to R2.6bn in 2024, a 31% increase. The total externality cost savings passed the R2bn mark, increasing from R1.96bn in 2022 to R2.07bn in 2024. These results provide a high-level estimation of what the terminal network could provide to the Western Cape logistics sector. Further investigation is, however, required to determine the financial viability of constructing these terminals. Specifically, the Worcester terminal would require additional research to determine if its proximity to the super terminal would lead to inefficiencies or redundant infrastructure.

The Western Cape Government is currently developing an integrated maritime logistics strategy for the Western Cape's ports. This is a positive development since the previous terminal network scenario highlighted the need for such a strategy.

Definitions

- **Terminal:** Refers to a central point or location where freight either originates, terminates, is consolidated, or is handled in the transport of freight. Terminals can specialise in specific commodities or packaging types, for example, containers, fruit, processed food, and fuel.
- **Super terminal:** Refers to a specialised area designed to facilitate various aspects of freight transport, logistics, and distribution activities. It is a strategic hub that not only integrates various logistics functions and services to streamline the movement and storage of goods, but also enables light manufacturing around basic food processing, packaging, product assembly and beneficiation. Super terminals are often called freight villages or super hubs.
- **Port:** Refers to the latin word "portus", which means gate or gateway². Ports serve as convergence points where land-based freight and maritime freight intersect.

²Rodrigue, JP, Comtois, C. & Slack, B. 2017. The Geography of Transport Systems, 4th edition. New York: Routledge.

Highlights

Potential Western Cape terminal network:

Terminal type	Location	Annual potential volume (tonnes)	Transport cost saving (Rm)	Externality cost saving (Rm)
Super terminal	Kraaicon	3 730 000	2 160.1	1 499.1
	Worcester	550 000	205.7	218.9
Container terminal	George	160 000	46.3	35.5
	Bitterfontein	80 000	(42.8)	2.1
Fruit terminal	Ceres	260 000	8.1	7.4
	Caledon	270 000	13.1	7.1
	Vredendal	270 000	25.7	9.4
Processed food terminals	Malmesbury	470 000	133.4	142.3
	George	260 000	18.2	106.0
	Laingsburg	100 000	36.7	39.9

An integrated strategy for the Western Cape's ports - Cape Town, Saldanha Bay, and Mossel Bay - is in development.



Introduction

The WC FDM™ enables the development of data-driven scenarios to inform inter alia industrial and freight transport policies, and spatial planning. Pressing policy issues were identified and high-level scenarios were developed to estimate the potential annual impact on freight transport costs in the Western Cape. The current results are indicative, with the purpose of encouraging discussions to increase the accuracy of the scenario development outputs.

Background on the RTMS and its adoption in the road freight transport sector

The Road Transport Management System (RTMS) is an industry led, government-supported, voluntary, self-regulation scheme that encourages consignees, consignors, and road transport operators to implement a management system through the RTMS national standard, SANS 1395:1:2019 (RTMS, 2022)¹. Through the thirteen elements of the standard, the RTMS seeks to foster a corporate culture of observing the law, promote good corporate governance – and citizenship, and provide a foundation for the development of structural management systems that ensure road transport operators achieve legal compliance, reduce corporate risk, and improve profits. These outcomes are achieved by a specific focus on the following key areas identified for heavy vehicle transport: loading control, safety, driver wellness, and training.

Adoption of the RTMS standard, which is published by the South African Bureau of Standards (SABS) and certified by South African National Accreditation System (SANAS), demonstrates a transport operator's compliance with road traffic regulations and contributes to preserving road infrastructure, improving road safety, and increasing productivity. This adoption has resulted in proven cost savings, detailed in the methodology section of this chapter, which outlines how the impact of RTMS adoption on the Western Cape's road freight transport sector is modelled. Before presenting the scenario's methodology, the next section first provides an overview of RTMS certification statistics for South Africa.

RTMS certification statistics

RTMS data for 2017 until 2023, provided by the RTMS Office of the RTMS non-profit company, first allowed Neethling (2025)² to determine how many trucks in South Africa were RTMS certified. By combining this information with National Traffic Information System (NaTIS)'s Live Vehicle Population data for the country's trucks³, the researcher determined the annual national RTMS certification rates within this period. Given newly available RTMS and NaTIS data for 2024 and 2025, this scenario expands on Neethling's 2025 study to include these years. This section provides a detailed breakdown of the national RTMS certification rate for 2024, which is used as the baseline RTMS adoption rate to correspond with the latest available WC FDM™ data, which is related to the 2024 base year. The section also highlights how the adoption rate has changed between 2017 and 2025.

According to NaTIS data (2024)⁴, South Africa's registered truck population reached 398 542 vehicles by December 2024, representing 3.3% of the country's near 12.1m self-propelled vehicles. Note that this excludes trucks operational in South Africa that are unregistered or originate from neighbouring countries like Namibia. Since the number of RTMS certified trucks reached 17 308 by the end of 2024 according to Nordengen (2025)⁵, an estimated 4.3% of the national truck population in 2024 was RTMS certified.

Importantly, the national baseline RTMS adoption rate also applies to the Western Cape. This is because the national RTMS certified truck population cannot be assigned to specific provinces to determine provincial RTMS adoption rates. This is largely due to these trucks usually being operational across various provinces or even countries. Additionally, there are concerns about the validity and reliability of the RTMS data since it is derived from quarterly self-reported monitoring data that RTMS certified organisations must submit to uphold their certification.

¹ Road Transport Management System (RTMS). 2022. [Online]. Available: <https://rtms-sa.org/>

² Neethling, H. 2025. *An assessment of the drivers and barriers impacting the adoption of self-regulation in road freight transport – the case of the RTMS in South Africa*. Published master's thesis. Stellenbosch: Stellenbosch University.

³ Heavy load vehicles with a gross vehicle mass of over 3 500 kg.

⁴ NaTIS. 2024. *31 December 2024 - Live vehicle population as per the National Traffic Information System - eNaTIS* [Online]. Available: <https://www.natis.gov.za/index.php/statistics/live-vehicle-population/live-vehicle-population-2024?download=319:november-december-2024>

⁵ Nordengen, P. 2025. *Personal communication with Henk Neethling at the RTMS Awareness Workshop held in Cape Town on 30 October*.

The Western Cape-registered truck population reached 48 566 vehicles by December 2024, representing 2.5% of the province's near 2 million (m) self-propelled vehicles and 12.2% of the national truck population (NaTIS, 2024). Given the baseline RTMS adoption rate of 4.3%, an estimated 2 088 of the Western Cape's trucks were RTMS certified in 2024. Note that many of the trucks operational in the Western Cape are not necessarily registered in the province itself and may originate from other provinces or even neighbouring countries. These trucks are, therefore, not captured in the province's total vehicle population and cannot be considered in this scenario. The RTMS certification statistics are summarised in Table 1.

Table 1: Changes in the national RTMS certification rate between 2017 and 2025

Year	Total trucks	RTMS certified trucks	RTMS certification rate (% of total trucks)
2017	372 679	6 832	1.8
2018	377 090	10 466	2.8
2019	380 710	11 654	3.1
2020	377 788	9 906	2.6
2021	389 112	10 325	2.7
2022	385 845	13 548	3.5
2023	392 349	15 798	4.0
2024	398 542	17 308	4.3
2025	402 198	18 157	4.5

Source: NaTIS Live Vehicle Population data as of the last day of December for 2017 to 2025, along with RTMS data on certified trucks (2017 to 2025) provided by Neethling (2025) and the RTMS Office (2026)⁶

Methodology

The current level of RTMS adoption (i.e. baseline adoption), along with freight demand modelling inputs from the WC FDM™, are used to model the impact of baseline and increased RTMS adoption. These inputs included road tonne-kilometres, fuel consumed (in litres), road accident and crash externality cost (in South African Rands), and carbon dioxide (CO₂) emissions (in tonnes).

To model the impact of each level of adoption, the related transport and externality cost savings are calculated using generalised RTMS-related savings figures (i.e. RTMS saving assumptions). These assumptions are adjusted conservatively and applied to the Western Cape province's fuel consumed, road accidents and crash externality cost, and CO₂ emissions for 2024 according to the WC FDM™. This enables the scenario to quantify the impact different levels of RTMS adoption had on provincial transport and externality costs in 2024.

It is important to note that the RTMS saving assumptions (see summarised in Table 2) are based on comparisons between various cases of improvements reported by RTMS certified operators to inform conservative estimates. The reported cases used to do this stem from:

- confidential information shared during interviews in the study by Neethling (2025)⁷,
- historical RTMS case studies (Nordengen, 2021)⁸, and
- a study by Steenkamp, Nordengen, Berman and Kemp (2017)⁹.

Table 2: Summary of RTMS saving assumptions

RTMS-related saving description	Saving %	Sources
Fuel consumption reduction	20%	Neethling (2025) and historical RTMS case studies
Accident and crash reduction	60%	Neethling (2025) and Steenkamp <i>et al.</i> (2017)
Transport cost reduction	30%	Neethling (2025) and Steenkamp <i>et al.</i> (2017)

⁶ RTMS Office. 2026. Latest stats - RE: Latest RTMS certification statistics, E-mail to H, Neethling [Online], 2 Feb. Available E-mail: rtms@rtms-sa.org

⁷ In the study, Neethling (2025) compared all responses by interviewees who represented RTMS certified organisations (17 interviewees) with each of the RTMS saving assumptions to ensure that they are accurate. Additional information gathered through the study's observation research was also compared to the assumptions, albeit to a lesser extent.

⁸ Nordengen, P. 2021. RTMS case studies, E-mail to H, Neethling [Online], 23 Apr. Available E-mail: pnordengen@hvtech.co.za

⁹ Steenkamp, A.J., Nordengen, P.A., Berman, R. & Kemp, L. 2017. Investigation into the smart truck pilot project: Progress made and way forward. 36th Southern African Transport Conference (SATC) proceedings, 10-13 July, Pretoria, South Africa: SATC2017.

Results

The impact of baseline RTMS adoption in the Western Cape

In theory, the Western Cape's total fuel consumption, accident and crash externality cost, and CO₂ emissions would have been about 514m litres, R717m, and 1.38m tonnes, respectively without RTMS adoption (i.e. at a 0% RTMS certification rate). At the baseline RTMS adoption rate for 2024 (i.e. 4.3%), these measures are 509.35m litres, R698.47m, and 1.37m tonnes, respectively. RTMS adoption in the Western Cape, therefore, saved the road freight transport sector 4.42m litres in fuel, R18.50m in accident and crash externality cost, and 11 881 tonnes in CO₂ emissions in 2024. It is important to note that these calculated savings are conservative because the modelling does not account for organisations that adopt the principles of the RTMS national standard without being RTMS certified.

The potential impact of increased RTMS adoption in the Western Cape

While an estimated 4.3% of road freight transporters in the Western Cape were RTMS certified in 2024, it is assumed that RTMS certification can increase in the future. The potential impact of increased RTMS adoption in the province can be illustrated by modelling the additional savings for 2024 at increased RTMS certification rates of 10%, 15%, 25% and 50% (see Table 3). Note that these savings are related to reduced fuel consumption, road accident and crash externality cost, and CO₂ emissions related to trucks.

Table 3: Summary of RTMS scenario results

RTMS certification rate (%)	Fuel (million litres)		Accident and crash externality cost (million South African Rands)		CO ₂ emissions (tonnes)	
	Total consumption	Cumulative savings	Total cost	Cumulative savings	Total emissions	Cumulative savings
0	513.77	-	716.97	-	1 381 473	-
4.3	509.35	4.42	698.47	18.50	1 369 593	11 881
10	503.49	10.28	673.95	43.02	1 353 844	27 629
15	498.36	15.41	652.44	64.53	1 340 029	41 444
25	488.08	25.69	609.43	107.55	1 312 400	69 074
50	462.39	51.38	501.88	215.09	1 243 326	138 147

Source: Updated Neethling (2025) using WC FDM™ data for 2024

The first row in the table indicates what the Western Cape road freight transport sector's total fuel consumption, accident and crash externality cost, and CO₂ emissions would have been in 2024 without RTMS adoption. The second row, which is highlighted by a darker cell shading, indicates the corresponding savings the baseline RTMS adoption rate (4.3%) enabled in 2024. The remaining rows indicate how these totals would have decreased at higher RTMS adoption rates to show what savings could have been realised through increased adoption. It is important to note that these savings are expressed cumulatively and conservative because the modelling does not account for organisations that adopt the principles of the RTMS national standard without being RTMS certified.

At a 10% RTMS certification rate, the increased certification could have led to about 10.28m litres in fuel and 27 629 tonnes in CO₂ emissions being saved, along with an accident and crash externality cost saving of R43.02m.

Table 4 highlights the additional savings of each of these scenarios compared to the baseline RTMS adoption savings.

Table 4: Additional savings of the increased adoption scenarios compared to the baseline RTMS adoption savings

RTMS certification rate (%)	Fuel (million litres)		Accident and crash externality cost (million South African Rands)		CO ² emissions (tonnes)	
	Cumulative savings	Additional savings	Cumulative savings	Additional savings	Cumulative savings	Additional savings
4.3	4.42	-	18.50	-	11 881	-
10	10.28	5.86	43.02	24.52	27 629	15 748
15	15.41	10.99	64.53	46.03	41 444	29 563
25	25.69	21.27	107.55	89.05	69 074	57 193
50	51.38	46.96	215.09	196.59	138 147	126 266

Source: Updated Neethling (2025) with WC FDM™ data for 2024

Conclusion

According to various stakeholders in the national road freight transport sector¹⁰, the Western Cape is not as challenged by an ongoing culture of non-compliance and poor safety, ineffective enforcement of government regulations, and ever increasing demand as the rest of the country. They do, however, believe that the province still has a long road ahead to combat these overarching challenges. It is imperative to address these challenges swiftly since they cause high accident and overloading rates, poor driver behaviour and road infrastructure, and subsequent economic, social and environmental cost inefficiencies. The modelling results for 10%, 15% and 25% and 50% RTMS adoption scenarios clearly indicate how increasing RTMS adoption can aid public and private stakeholders within the provincial sector in this task.

It is evident that baseline RTMS adoption in 2024 (which was 4.3%) already helped the sector reduce both its total fuel consumption and CO₂ emissions by 0.9% and its accident and crash externality cost by 2.6%. While it is a positive sign that the RTMS certification rate grew to an estimated 4.5% by the end of 2025, the modelling results for 2024 strongly underscores the need for higher adoption rates. Increasing RTMS adoption threefold, fivefold and even tenfold is required to realise the full potential of implementing the RTMS national standard and its principles across the sector.

To illustrate, a 50% RTMS adoption rate would have saved nearly 47m litres in fuel, R197m in accident and crash externality cost, and about 130 000 tonnes in CO₂ emissions more than baseline adoption in 2024. To put this into context, this scenario would have seen the sector reduce both its total fuel consumption and CO₂ emissions by 10% and its accident and crash externality cost by 30%.

According to Neethling (2025), increasing RTMS adoption requires various developments within the sector, including:

- increased RTMS awareness among industry (especially SMMEs) and the general public via new, more deliberate awareness efforts than those used currently, and greater collaboration;
- current RTMS adoption incentives to be increased and implemented better, with the introduction of new incentives driven by the industry instead of the government;
- the continued ability to use Performance Based Standards (PBS)¹¹/Smart trucks (a prominent RTMS adoption incentive¹²) and improved implementation of PBS; and
- leading industry role-players (such as freight owners and clients) to have a value chain and total cost of ownership approach to RTMS adoption.

¹⁰ Captured in 48 online- and 20 in-person interviews conducted by Neethling (2025).

¹¹ The PBS pilot project, which began in 2004, aimed to introduce high productivity PBS demonstration vehicles (PBS/Smart trucks) in South Africa's road freight transport sector. Despite various benefits, the project has faced challenges since its inception, particularly through resistance from some authorities due to the increased length and weight of PBS/Smart trucks compared to standard trucks.

For more information on using PBS/Smart trucks in the Western Cape, see: <https://www.westerncape.gov.za/mobility/revolutionise-your-heavy-vehicle-fleet>

¹² The ability to use PBS trucks was a prominent reason why 50% (7 of 14) of the RTMS-certified fleets included in Neethling's 2025 study became RTMS certified, according to their representatives (interviewees).

There has already been notable progress in these regards. The Western Cape Mobility Department held a RTMS Awareness Workshop on 30 October 2025, where the department demonstrated its digital RTMS toolkit - which garnered great interest among various transport operators. This is a positive sign, as the toolkit is designed to help road freight operators adopt the RTMS national standard, supporting the department's objectives of improving road safety and enhancing road freight efficiency.

The workshop was followed a day later by the announcement that the department's Western Cape PBS policy was approved for implementation. Smart truck/heavy vehicle owners were subsequently invited to apply for permits to operate PBS/smart trucks within the Western Cape from 1 November 2025. Since RTMS certification is a requirement to obtain a PBS/smart truck permit, this development is expected to boost RTMS adoption in the province, especially since it is the first time that these trucks are allowed to operate on public roads within the province and various road freight transport operators expressed their intention to apply for PBS permits.

The value of PBS implementation in the Western Cape freight transport sector was quantified in the previous iteration of this report, in Scenario 2: Performance Based Standards (see pages 11-1 to 11-10), which was based on the 2023 base year.

Highlights

- 4.3% of the Western Cape's truck population is estimated to have been RTMS certified in 2024, which grew to an estimated 4.5% in 2025. This means about 2 088 of the province's 48 566 registered truck population in 2024 were RTMS certified.
- The baseline RTMS adoption rate (4.3% of 2024) saved the Western Cape road freight transport sector about 4.5m litres in fuel, R18.5m in accident and crash externality cost, and nearly 12 000 tonnes in CO₂ emissions.
- Illustrating the importance of increasing this adoption, slightly more than doubling baseline RTMS adoption in 2024 (i.e. to 10%) would have seen additional savings of almost 6m litres of fuel, 16 000 tonnes of CO₂ emissions, and R25m in accident and crash externality cost.
- An ambitious RTMS adoption rate of 50% in 2024 would have seen the sector reduce both its total fuel consumption and CO₂ emissions by 10% and its accident and crash externality cost by 30%.
- It is important to note that this scenario is conservative because it does not account for organisations that adopt the principles of the RTMS national standard without being RTMS certified. Furthermore, the RTMS can be applied by passenger vehicles as well, which is excluded from this analysis.
- There has been notable progress made regarding increasing RTMS adoption in the Western Cape, most notably with the introduction of the PBS policy and the development of the WCG digital RTMS Toolkit. More effort is, however, needed among government and industry role-players to unlock the full potential of RTMS adoption within the sector.



Introduction

The WC FDM™ freight flows are derived from economic activity, specifically activities that contribute to transportable GDP, which consists of the extraction of raw materials and manufacturing (also known as the primary and secondary economic sectors, respectively). Although waste does not directly contribute to the GDP, it has an indirect impact since its transportation and disposal require resources that could have been used for activities that contribute to the GDP.

The WC FDM™ waste forecast investigates a plausible relationship between waste being landfilled (i.e. waste landfilled) and commodity demand. Waste management and the logistics behind it is itself a complicated subject. Waste landfilled is inherent to the consumption of goods, and extraction and manufacturing processes. A portion of transportable GDP will, therefore, end up in landfills. The amount of waste landfilled per product type can also vary depending on the packaging type. For instance, wrapping four apples with plastic mesh on a paper container (which is covered with another layer of plastic) as opposed to 1.5 kg apples in a plastic bag.

The third goal of the Western Cape Integrated Waste Management Plan (IWMP) 2022 – 2027 is the effective and efficient utilisation of resources, which has the following objectives: Minimise the consumption of natural resources and promote the circular economy; stimulate job creation within the waste economy; and increase waste diversion through reuse, recovery, and recycling. The private sector, both locally and internationally, has also seen opportunities to reduce its waste footprint with zero-waste stores where consumers bring their own containers when purchasing goods. Waste landfilled is, therefore, a changing landscape depending on the manufacturer of final goods and consumer behaviour, both of which can be influenced by the local and provincial government.

When goods are not reused or recycled, they eventually end up in a landfill or polluting the environment. Knowing the lifespan of a landfill site is integral to any integrated waste management planning. Forecasting waste volumes is, therefore, an important but difficult task and what proves sufficient for one waste stream will not be for another. The difficulty of waste forecasting can be seen in a study of municipal waste landfilled in the City of Logan in Australia. The study used different Artificial Intelligence methodologies rather than previously used methodologies such as descriptive statistics, regression analysis, material flow modelling or time series analysis (Abbasi & Hanandeh, 2016). Their model accurately forecasted waste landfilled from 2012 to 2014 based on training data from 1996 to 2012. The study predicted that Logan City will landfill 94 000 tonnes of Municipal Solid Waste by 2020. In reality, in the year 2020/21 the City of Logan landfilled 132 780 tonnes of municipal solid waste, of which 48 289 tonnes were diverted.

Waste Overview

For the WC FDM™ waste forecast the following data inputs were used:

- City of Cape Town waste data from 2010 to 2024,
- WC FDM™ 2017 to 2024,
- National Freight Demand Model (FDM™) 2014 to 2016, and
- P3041.2 - Manufacturing: Production and sales - Statistics South Africa¹

Reliable provincial waste data was unavailable before 2017 and was, therefore, left out of the analysis. Waste landfilled data was compared to WC FDM™ and national FDM™ demand data for the City of Cape Town (CoCT) to establish a link between freight demand and waste landfilled. The P3041.2 indices were used to extrapolate the demand for 2010 to 2013 from the FDM™ data.

The data processing methodology for the three WC FDM™ waste streams for the CoCT is discussed below. Apart from the 6 major facilities in the CoCT, there are 24 other municipalities within the Western Cape that are served by 167 waste facilities (as can be seen in Figure 1) that report handling waste of which municipal, garden, organic (now included in the WC FDM™ 2024) and construction and demolition make up the majority. The forecast that was used for the CoCT municipal waste assignments was also applied to WC FDM™ districts. For 2024, of the 123 580 tonnes of organic waste reported in the Western Cape as GW20, 49 115 tonnes were landfilled within the City of Cape Town. Of the 49 115 tonnes, 48 425 tonnes were garden waste (GW20.01), whereof 34 900 tonnes (72%) were recycled. The remaining organic waste tonnes were food waste. Therefore, the organic waste forecast uses the same growth factors as the garden waste forecast on the assumption that fertilizer has the same link to organic waste landfilled as garden waste.

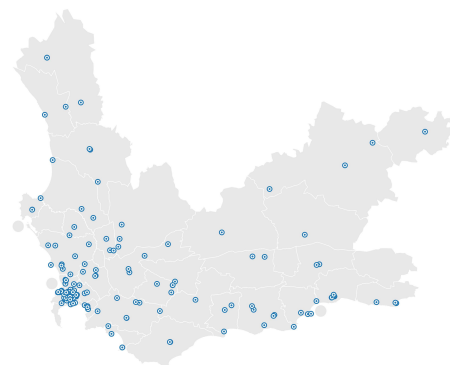


Figure 1: Waste facilities

¹ This statistical release contains information regarding indices of the physical volume of manufacturing production and the total value of sales of manufactured products, according to manufacturing divisions on a monthly basis. https://www.statssa.gov.za/?page_id=1861&PPN=P3041.2&SCH=73155

Abbasi, M. & Hanandeh, A.E. 2016. Forecasting municipal solid waste generation using artificial intelligence modelling approaches. *Waste Management*, 56:13-22, <https://doi.org/10.1016/j.wasman.2016.05.018>

1. GW01 – Municipal waste

Figure 2 shows the major catchment areas for each waste facility within the CoCT Municipality, with Figure 3 illustrating the waste collection and transfer process.



Figure 2: Catchment areas for the various refuse transfer stations and landfills in the CoCT Municipality.

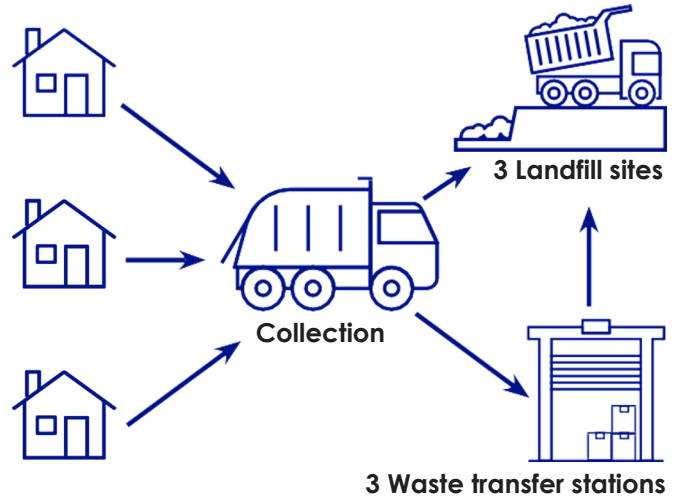


Figure 3: The waste collection and transfer process

Waste is not always taken directly to a landfill. There are three refuse transfer stations where waste gets dropped off and consolidated before being transported to one of the landfills.

For the WC FDM™, waste OD flows were generated based on the intersection of each WC FDM™ district with each of the municipal waste facilities catchment area. For districts that fall into multiple catchment areas, the waste flows were split between the different waste facilities.

It was assumed that municipal waste could be linked to the demand for processed foods and beverages. Unsurprisingly, the demand for processed foods and beverages in the CoCT Municipality has grown since 2010. This contrasts with municipal waste landfilled, which has been on a slight decline since 2010 as seen in Figure 4.

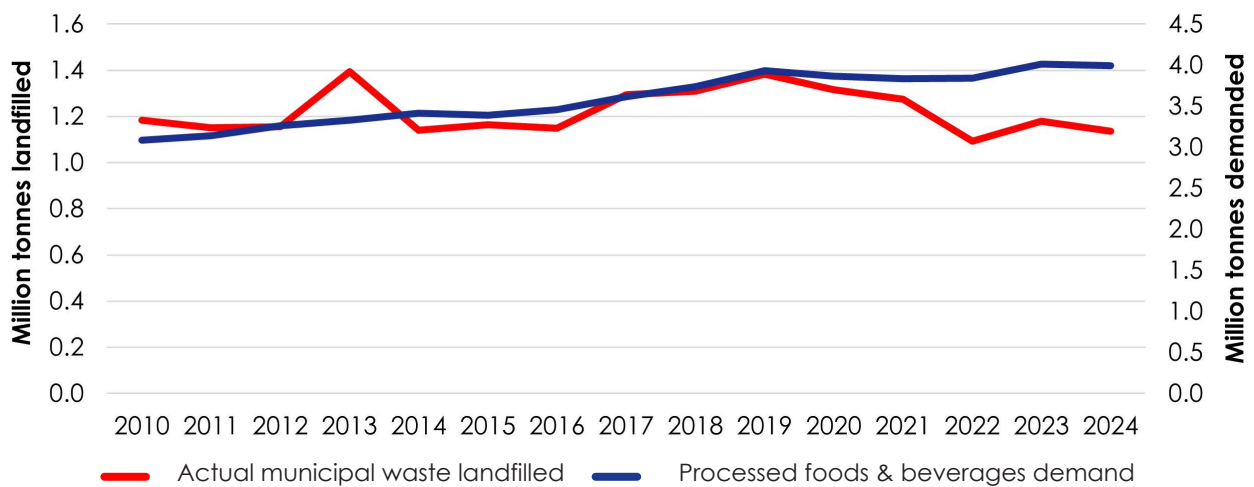


Figure 4: Municipal waste landfilled (left axis) and demand for processed foods and beverages (right axis) in CoCT Municipality 2010-2024.

Processed foods and beverages forecasts in the WC FDM™ considers population growth, therefore, population was not explicitly used as a means of the forecast, but it is indirectly accounted for.

For processed foods and beverages, if all the packaging is recycled and there is no wastage of the contents, then there is no waste landfilled. Conversely, if no packaging is recycled and all the contents go to waste, all demand for processed foods and beverages turns into waste. The amount of waste landfilled per tonne of processed foods and beverages per consumption is, therefore, subject to consumer behaviour regarding food waste and recycling. This behaviour is in turn shaped by initiatives like the Think Twice initiative pilot², which encouraged the separation of recyclable waste, and the Food Forward project³, which encouraged the reduction of food waste.

² Western Cape Government. 2007. *Think Twice - The City's Environmental Initiative: Waste Separation at Source - Launched in Pinelands and Parts of Blaauwberg* [Online]. Available: <https://www.westerncape.gov.za/news/think-twice-citys-environmental-initiative-waste-separation-source-launched-pinelands-and-parts> [2022, November 18].

³ Western Cape Government. 2022. *Food Forward Project* [Online]. Available: <https://www.westerncape.gov.za/110green/projects/food-forward-project> [2022, November 18].

It is, therefore, assumed that there is a constant relationship between the amount of packaging required for processed foods and beverages. However, it appears that waste reduction initiatives have been shaping consumer behaviour which led to a reduction of the municipal waste landfilled between 2010 and 2024, 'decoupling' demand for processed foods and beverages and municipal waste landfilled. When the 2024 (28.4%) ratio of municipal waste landfilled to the demand for processed foods and beverages is compared to the ratio for 2010 (38.3%), it indicates that waste landfilled has decreased by 9.9% as stated as a proportion of the demand for processed foods and beverages. Without these structural and behavioural changes, an additional 394 356 tonnes of municipal waste could have been landfilled in 2024. The estimated cumulative saving since 2010 amounts to 2.73m tonnes, which is currently equivalent to two years of municipal waste landfilled.

This reduction implies that a new baseline of waste landfilled is established, and that additional manufacturers and consumers further reduce their waste landfilled in the following year as seen in Figure 5.

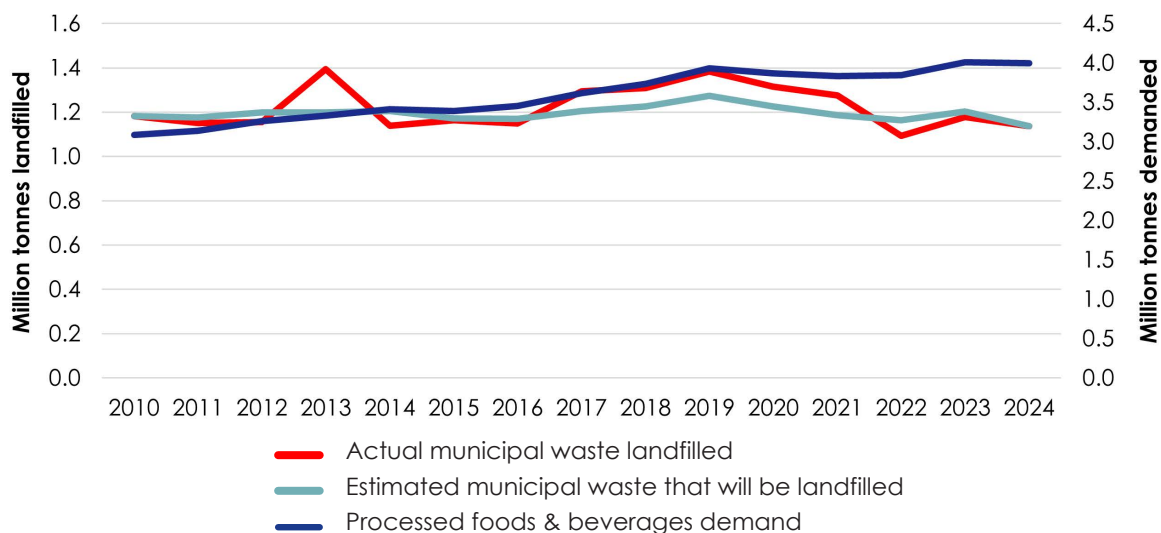


Figure 5: Actual and estimated municipal waste landfilled, assuming an accumulating 25 679 tonnes per year offset (left axis), and demand for processed foods and beverages (right axis) in CoCT Municipality 2010-2024.

For the waste forecast, it was assumed that the cumulative offset was still present in 2024, after which the proportion of waste to processed foods and beverages remains fixed at 28.4% for future years which leads to the municipal waste forecast for the CoCT as seen in Figure 6.

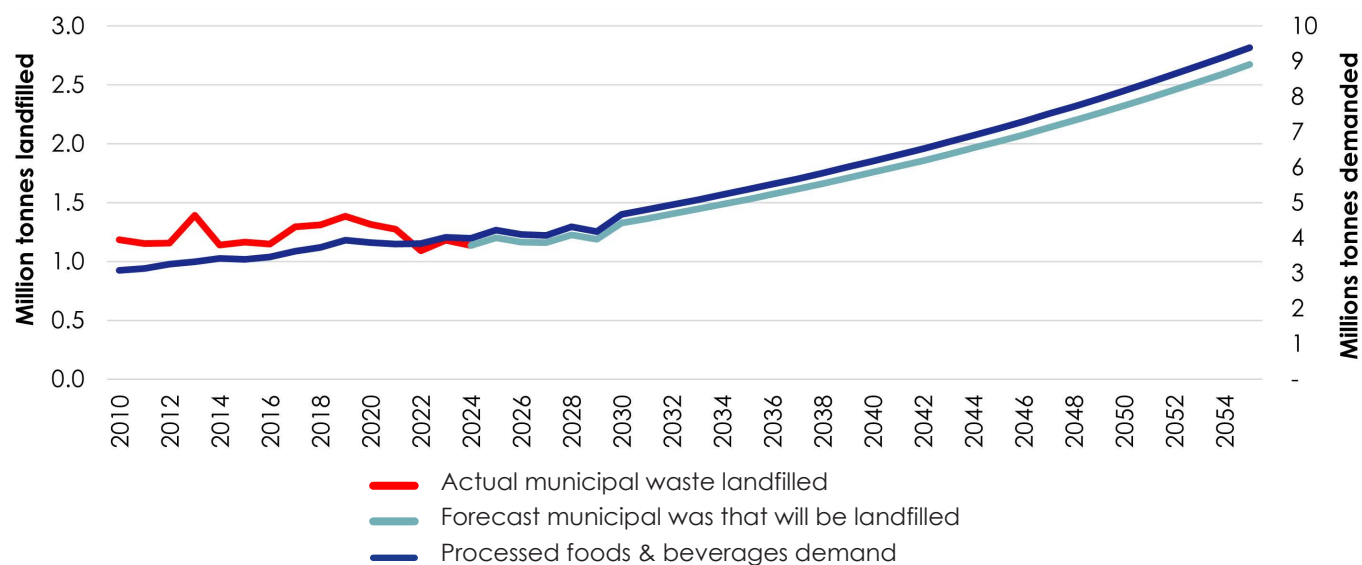


Figure 6: Processed foods and beverages demand in CoCT Municipality and municipal waste landfilled forecast.

Even though there is a definite disconnect between urban and rural municipal waste landfilled, the CoCT municipal forecast of 28.4% of processed foods and beverages is used to grow the 2024 municipal waste flows in the WC FDM™, as seen in Table 1.

Table 1: Municipal waste forecast for the Western Cape (million tonnes).

Origin	Actual	Forecast		
	2024	2025	2030	2055
CoCT	1.14	1.20	1.33	2.67
Rest of Province	0.43	0.45	0.50	1.00
Total	1.56	1.65	1.83	3.68

Given that there is no additional reduction at source or recycling uptake by consumers, municipal waste is forecast to increase 2.35 times by 2055, based on the forecast processed foods and beverage demand of the Western Cape.

2. GW20 – Organic waste

There are two main flows of organic waste (GW20), namely GW20.01 (garden waste) and GW20.02 (food waste), which have the same catchment as municipal waste. Garden waste is separated at source by being dropped off at drop-off points. Some of this garden waste is then composted by private companies and sold as compost material. Reliance Compost (Pty) Ltd is the principal composting company that transports all the garden waste to its composting site just outside Paarl. Some food waste ends up in landfills and is already included in municipal waste.

Demand for fertilizer was the most likely commodity that could be linked to garden waste landfilled within the CoCT Municipality. It should be noted that there would be a definite disconnect between the demand for fertilizer in the CoCT and the rest of the province, where fertilizer is used primarily for agricultural purposes, such as garden waste landfilled. However, because organic waste is included in the WC FDM™ 2024, it is assumed that the relationship between garden and organic waste landfilled and fertilizer is similar enough, in the absence of a similar length time series for provincial municipal data on organic waste landfilled.

Figure 7 shows the waste landfilled of GW20.01 as well as the demand for fertilizer in the CoCT from 2010 to 2024.

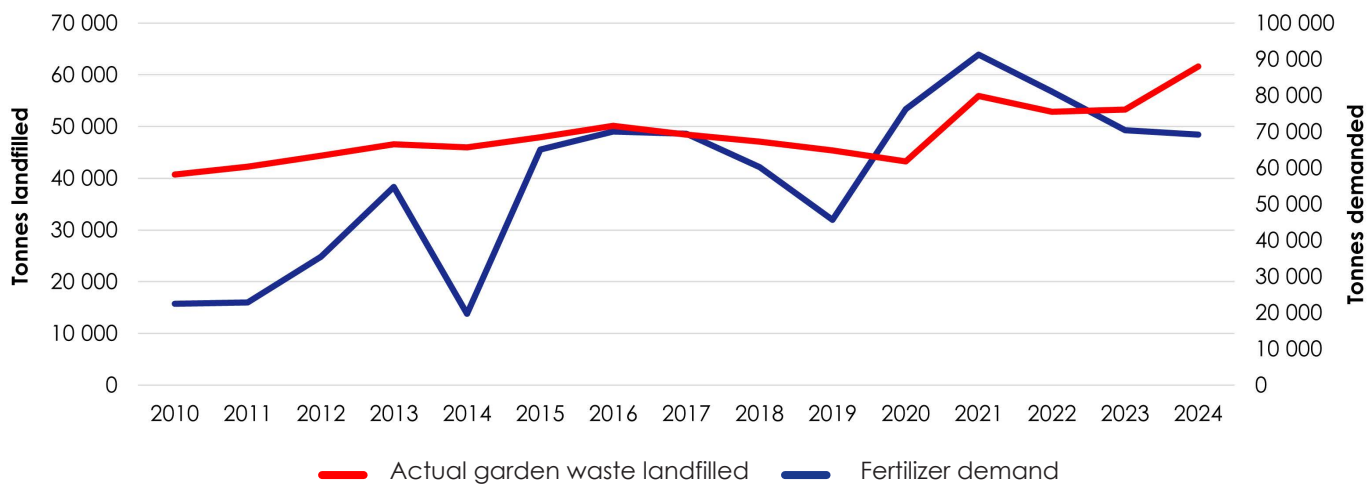


Figure 7: Garden waste landfilled (left axis) and demand for fertilizer (right axis) in CoCT Municipality 2010-2024.

The formula used to forecast the garden waste was $GW20.01 = X * (\text{fertilizer demand})$, where X is the ratio (proportion) of cumulative garden waste landfilled relative to the historical cumulative fertilizer demand from 2010 to 2024. This proportion is 0.577; therefore, for every tonne of fertilizer demand, 577 kg of garden waste is landfilled. This relationship is expected to hold in the long term. The estimated garden waste landfilled can be seen in Figure 8.

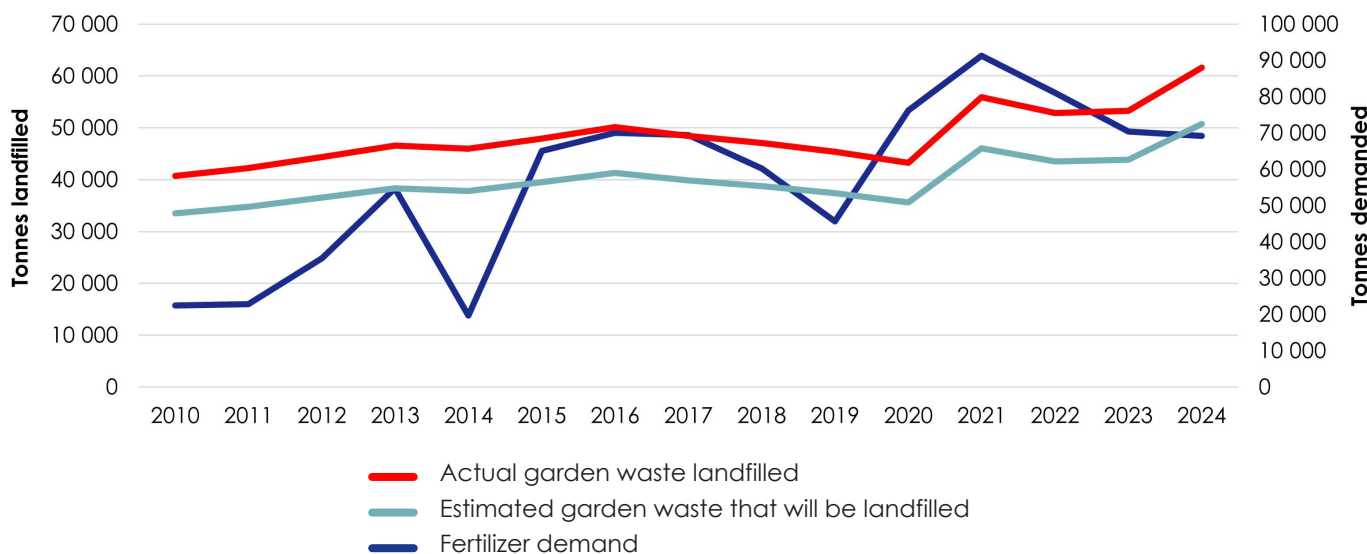


Figure 8: Actual and estimated garden waste landfilled (left axis) and fertilizer demand (right axis) in CoCT Municipality 2010-2024.

Due to the nature of how garden waste is landfilled and its durability, another avenue of analysis would be to consider a simplified material flow approach as it shares many similarities with construction and demolition waste (It is also stockpiled and partially reused). This is done by comparing the cumulative amount of garden waste landfilled to the cumulative demand for fertilizer from 2010 to 2024. That is the sum of garden waste divided by the sum of fertilizer demand for the CoCT, which comes to 577 kg of garden waste landfilled per tonne of fertilizer demand. This highlights the plausibility of using a simplified material flow approach for forecasting durable waste such as garden waste and construction and demolition waste. The forecasting of provincial garden waste can be seen in Figure 9.

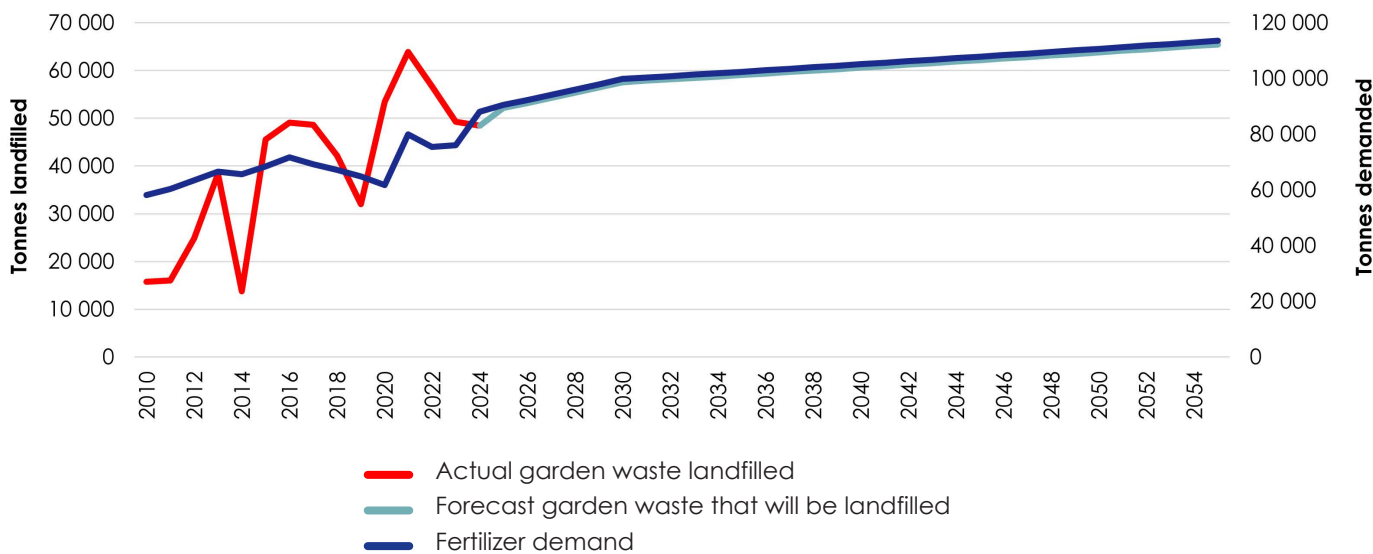


Figure 9: Fertilizer demand in CoCT Municipality and garden waste landfilled forecast.

Garden waste was forecast on the same principle as municipal waste: The rate of change between 2024 and 2025, 2030 and 2055 based on the forecast of fertilizer demand was applied to all garden waste landfilled within the province as can be seen in Table 2.

Table 2: Forecast garden waste landfilled for the Western Cape (million tonnes)

Origin	Actual	Forecast		
	2024	2025	2030	2055
CoCT	0.05	0.05	0.06	0.07
Rest of Province	0.03	0.03	0.03	0.04
Total	0.08	0.08	0.09	0.10

Based on the forecast demand for fertilizer, the total amount of garden waste landfilled is set to increase by 28.9% by 2055.

3. GW30 – Construction and demolition waste

Figure 10 shows the movement of construction and demolition waste. Residents, as well as companies, can drop off small quantities of builders' rubble at one of the city's drop-off sites. There are 37 drop-off sites in Cape Town for this type of waste. From these sites, the waste is primarily taken directly to landfill. The catchment areas for construction and demolition waste are shown in Figure 2.

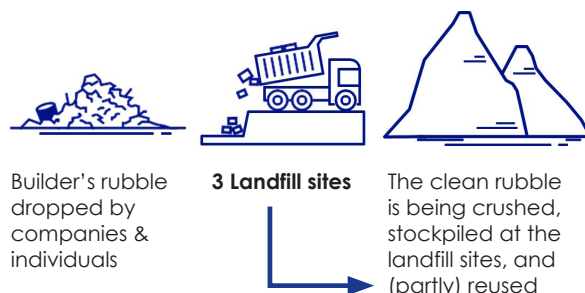


Figure 10: GW30 – Construction and demolition waste.

When considered in the context of the waste streams discussed up until now, construction and demolition waste is the most durable. All infrastructure and buildings are potential future sources of construction and demolition waste. Similar to how garden waste landfilled is dependent on the number of trees grown and eventually cut down or trimmed; construction and demolition waste landfilled is dependent on infrastructure, housing, or commercial construction projects. Therefore, it was assumed that the long-term construction and demolition waste landfilled could be explained by the demand for bricks and cement. As infrastructure is expanded and new buildings are constructed, the raw material stocks are moved from the respective sources to waste facility stockpiles for future re-use.

Figure 11 shows that there was a sharp increase in construction and demolition waste landfilled between 2014 and 2017.

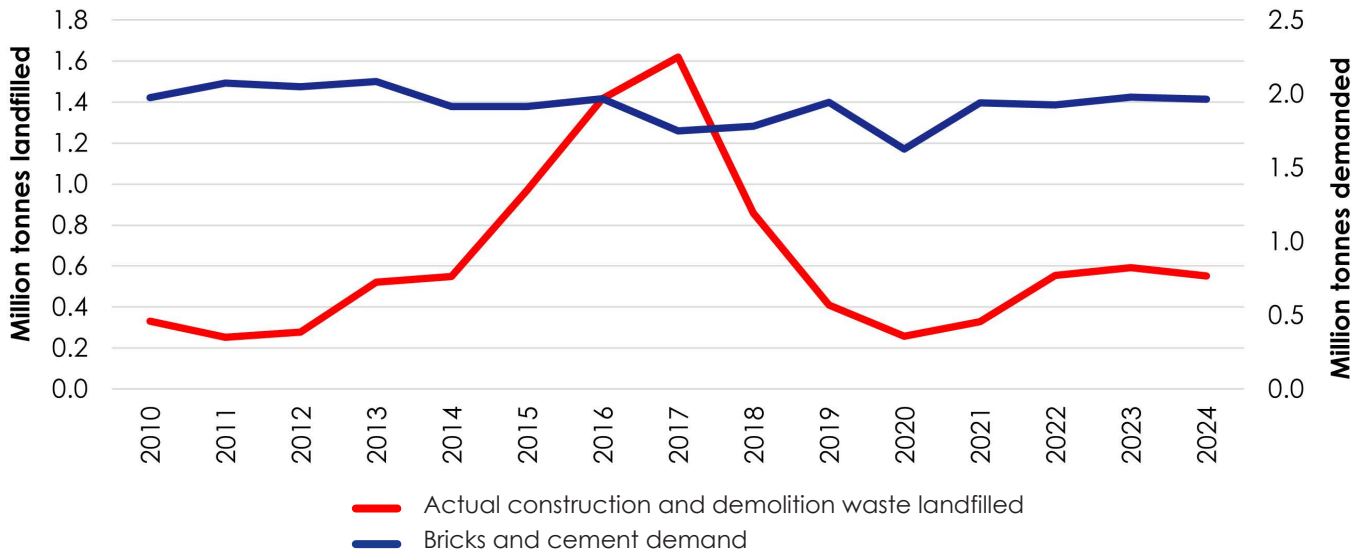


Figure 11: Construction and demolition waste landfilled (left axis) and the demand for bricks and cement (right axis) in CoCT Municipality 2010-2024.

Due to this significant spike in construction and demolition waste, a simplified Urban metabolism inspired approach was used to forecast the construction and demolition waste landfilled, rather than trying to estimate or account for what could be an apparent cyclical construction and demolition waste trend. The tonnes of construction and demolition waste were compared to the total tonnes of bricks and cement demand over the period 2010 to 2024. This fraction gives the medium- to long-term expected annual movement of construction materials from one stockpile (infrastructure and buildings) to construction and demolition waste stockpiles.

For every tonne of bricks and cement that is demanded in the CoCT, it is, therefore, estimated that 329 kg of construction and demolition waste is landfilled, as can be seen in Figure 12.

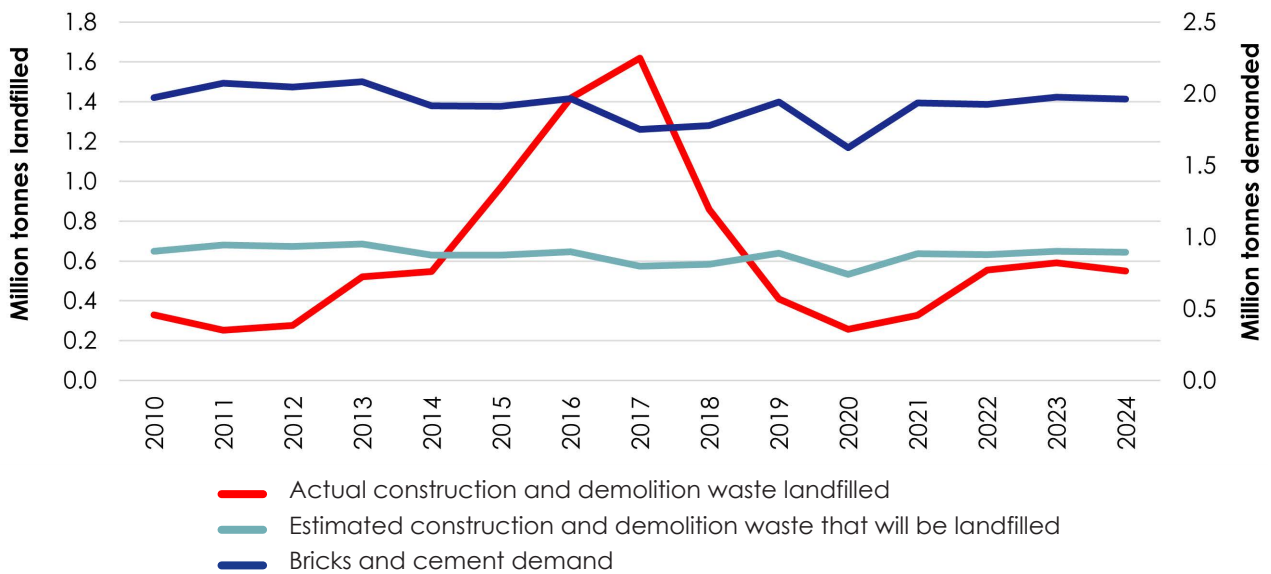


Figure 12: Actual and estimated construction and demolition waste landfilled (left axis) and the demand for bricks and cement (right axis) in CoCT Municipality 2010-2024.

The rate of change from 2024 to 2025, 2030 and 2055, respectively, was used to forecast construction and demolition waste supply for all the districts in the WC FDM™, despite the assumption that the turnover rate from buildings and infrastructure to stockpiles at waste facilities outside the CoCT municipality will be lower. However, as urbanisation, urban sprawl, and densification increase, the assumption might not be too unrealistic. This leads to a provincial construction and demolition waste forecast as can be seen in Figure 13.

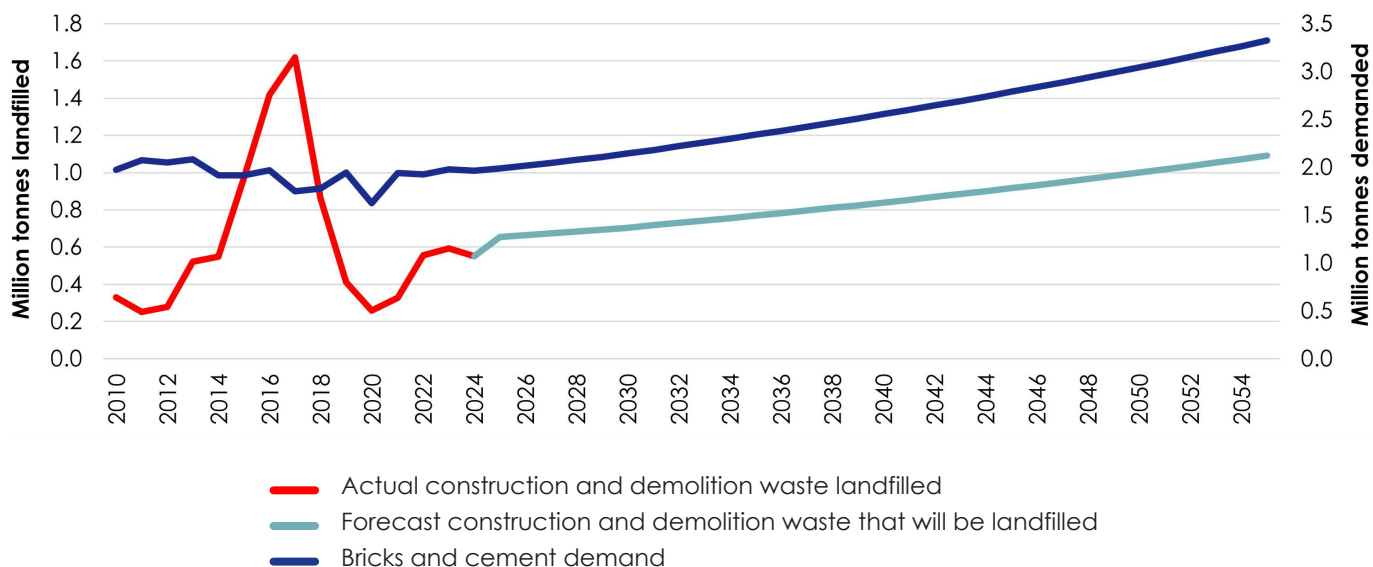


Figure 13: Bricks and cement demand in CoCT Municipality and construction and demolition waste landfilled forecast.

Table 3 shows the forecast construction and demolition waste landfilled. Given the medium- to long-term tempo of construction and waste landfilled, supply can be predicted by the growth in demand for bricks and cement in the CoCT – with construction and demolition waste landfilled in the Western Cape set to increase 1.69 times by 2055.

Table 3: Forecast construction and demolition waste landfilled for the Western Cape (million tonnes)

Origin	Actual	Forecast		
	2024	2025	2030	2055
CoCT	0.55	0.65	0.70	1.09
Rest of Province	0.32	0.22	0.24	0.37
Total	0.87	0.88	0.95	1.47

Highlights

- Municipal waste reduction initiatives have seemingly been reducing the waste landfilled cumulatively by 25 679 tonnes per year since 2010 up until 2024, given that the demand for processed foods and beverages in the CoCT explains the waste landfilled.
- Municipal waste forecasts for the CoCT, based on demand for processed foods and beverages, in the absence of additional waste reduction measures such as recycling and reuse, are expected to increase to 2.67m tonnes per year by the year 2055.
- Garden waste landfilled is expected to increase by 28.9% by 2055 based on the forecast of fertilizer demand in the CoCT.
- Construction and demolition waste is expected to grow the fastest of the three waste streams, as mentioned in this chapter, based on the forecast of bricks and cement demand in the CoCT.



The Western Cape Freight Demand Model historically included all modes of transport except air freight data. It has been included since the 2020 WC FDM™ update but with limited integration due to the unavailability of detailed domestic air freight data. The model, and this chapter, therefore only reflect international air freight via the Cape Town International Airport.

Data gathering

While sufficient and reliable data is available for international air freight values and volumes, sparse data is available for domestic air freight volumes, specifically, data disaggregated by origin-destination and commodity. Commodity-related information is provided as a general description at best, yet commodity detail is usually completely absent.

The cause of this knowledge gap has been a significant topic of discussion within government and industry, with the following reasons often provided:

- The domestic air freight market's relatively small impact on economic growth;
- Data anonymity concerns since the market is relatively small, making it easy to trace the origin of data if information is shared;
- Owners of domestic air freight data want to protect their competitive advantage and intellectual property;
- Precise commodity-level information rarely being captured for most air freight parcels;
- Insufficient levels of awareness and promotion of the Western Cape's important and growing air freight agenda; and
- A lack of collaboration, information-sharing and transparency between air freight service operators.

As evident from the details above, there is a definite need for a domestic air freight database to be developed for the Western Cape. Government and industry stakeholders emphasised the need to improve the availability, reliability and level of detail of domestic air freight data since the market space is key to economic job creation and competitiveness in the province. Such a database would also allow for a more integrated and detailed air transport view in the WC FDM™, similar to current capabilities for other freight transport modes.

While addressing this need has clear advantages, it is important to realise that bridging this knowledge gap would be a complicated and resource-intensive task. The previously mentioned stakeholder engagements revealed that creating such a database will require active involvement from the South African Reserve Bank (SARB) and the South African Revenue Service (SARS). Furthermore, the creators of this envisaged database will need to get buy-in from air freight service operators such as South African Airways (SAA) and Airlink to ensure sufficient levels of data availability and transparency. Collaboration with South African airports (through Airports Company South Africa, i.e. ACSA), especially CTIA, and air transport-related industry associations and researchers/experts will also be vital. Moreover, all collaborating parties will need to help establish well-designed and purposeful data-capturing processes to ensure future air data is reliable, detailed and disaggregated by origin-destination and commodity. Since competitive advantage and intellectual property are of considerable concern to many of these parties, both government and industry will need to ensure data-sharing can benefit all stakeholders concerned.

Overview of international air freight

In 2024, 74 888 freight tonnes were transported via CTIA, whereof 45 381 tonnes (61%) were exported and 29 506 tonnes (39%) were imported. This shows a growth in total trade of 24.8% (14 865 tonnes) from the 2023 volumes of 60 023 tonnes; and 42.9% (22 498 tonnes) from the 2022 volumes of 52 389 tonnes. Air trade volumes are more than the previous recorded high of 63 006 tonnes, which were transported in 2019. The extent of air freight arriving (import) and departing (export) from CTIA is depicted in Figure 1.

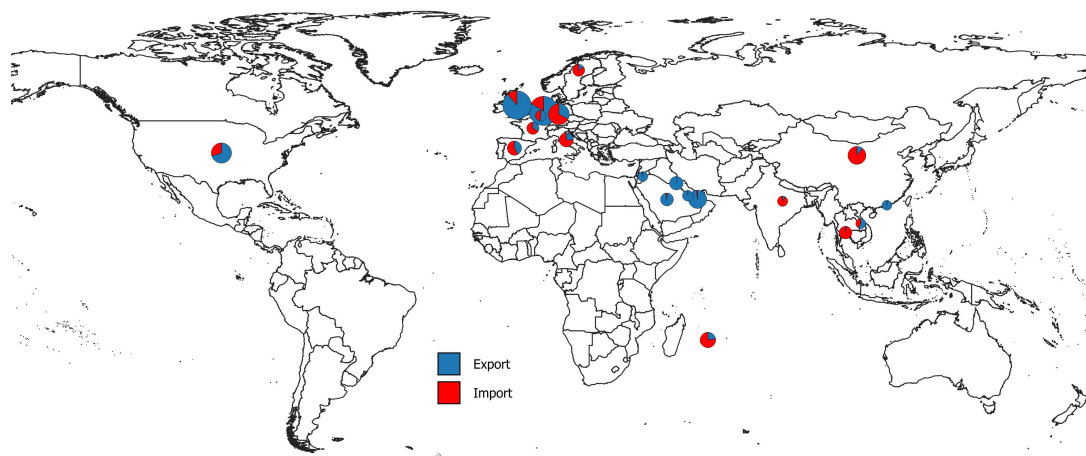


Figure 1: Map showing the import and export freight volumes for Cape Town International Airport in 2024

Tables 1 and 2 below show how the most significant air freight commodities have changed between 2022 and 2024 for exports and imports, respectively. As seen in Figure 2 and Table 1, CTIA predominantly exports food in its role as a facilitator of international trade. Note that food trade relates to the commodity groups of fresh foods, frozen foods, and foodstuffs and beverages for human consumption (see detailed breakdown in Tables 1 and 2 for exports and imports). Apart from food-related commodities, most of the air trade volumes in 2024 are related to perishable non-foods (4 688 tonnes); basic industrial raw materials (1 545 tonnes); parts and components: power, agriculture, construction, mining, handling (1 077 tonnes); odours and flavours (623 tonnes); and clothing and accessories (605 tonnes). Furthermore, while 2024's export and import volumes are higher than in 2023, imports are still lower than those traded in 2019.

Table 1: The most significant Cape Town air freight commodities between 2022 and 2024 based on export trade volumes

Exports by commodity in tonnes (% of total exports)	2022	2023	2024
Food	17 031 (57.0%)	23 426 (64.0%)	30 471 (67.1%)
<i>Foods, fresh</i>	14 603 (48.9%)	20 982 (57.3%)	27 979 (61.7%)
<i>Foods, frozen</i>	1 254 (4.2%)	1 043 (2.8%)	657 (1.4%)
<i>Foodstuffs and beverages for human consumption</i>	1 174 (3.9%)	1 402 (3.8%)	1 835 (4.0%)
Perishable non-foods	4 338 (14.5%)	4 465 (12.2%)	4 688 (10.3%)
Basic industrial raw materials	897 (3.0%)	875 (2.4%)	1 545 (3.4%)
Parts and components: power, agriculture, construction, mining, handling	578 (1.9%)	598 (1.6%)	1 077 (2.4%)
Odours and flavours	496 (1.7%)	448 (1.2%)	623 (1.4%)
Clothing and accessories	489 (1.6%)	553 (1.5%)	605 (1.3%)
Colours and dyes	459 (1.5%)	650 (1.8%)	585 (1.3%)
Consumer goods for personal consumption	495 (1.7%)	495 (1.4%)	559 (1.2%)
Consumables for the leather and fur industry	331 (1.1%)	422 (1.2%)	488 (1.1%)
Machinery for general industrial uses	651 (2.2%)	631 (1.7%)	463 (1.0%)
Other air commodities	4 091 (13.7%)	4 033 (11.0%)	4 277 (9.4%)
Total exports	29 857	36 593	45 381

Table 2: The most significant Cape Town air freight commodities between 2022 and 2024 based on import trade volumes

Imports by commodity in tonnes (% of total imports)	2022	2023	2024
Food	2 972 (13.2%)	2 962 (12.6%)	3 787 (12.8%)
<i>Foods, fresh</i>	1 432 (6.4%)	1 374 (5.9%)	2 019 (6.8%)
<i>Foods, frozen</i>	58 (0.3%)	54 (0.2%)	135 (0.5%)
<i>Foodstuffs and beverages for human consumption</i>	1 482 (6.6%)	1 534 (6.5%)	1 633 (5.5%)
Clothing and accessories	2 506 (11.1%)	2 459 (10.5%)	5 006 (17.0%)
Land Vehicle Parts	647 (2.9%)	1 014 (4.3%)	1 516 (5.1%)
Consumer goods for personal consumption	627 (2.8%)	1 057 (4.5%)	1 389 (4.7%)
Machinery for general industrial uses	1 298 (5.8%)	1 263 (5.4%)	1 266 (4.3%)
Semi-manufactured industrial consumables	825 (3.7%)	847 (3.6%)	1 145 (3.9%)
Semiconductors	818 (3.6%)	994 (4.2%)	1 075 (3.6%)
Pharmaceuticals	1 299 (5.8%)	930 (4.0%)	903 (3.1%)
Consumer goods for household consumption	692 (3.1%)	732 (3.1%)	896 (3.0%)
Other chemicals and products	901 (4.0%)	901 (3.8%)	895 (3.0%)
Other air commodities	9 953 (44.2%)	10 271 (43.8%)	11 629 (39.4%)
Total imports	22 539	23 431	29 506

As seen in Table 3, the largest trading partners for export air freight were the United Kingdom (UK) and the Netherlands, very similar to 2023. Export volumes to the UK continued to increase in 2024 and were 80.3% (3 605 tonnes) higher than in 2022. Exports to the Netherlands also continued to increase, being 49.3% (2 650 tonnes) higher in 2024 than in 2022. Export volumes to Jordan, Iran and Belgium overtook those to Italy, Japan and France in 2024, which is the reason for the former countries' addition to the table - replacing the latter countries that were included in the same table of the previous report.

Table 3: The top 15 Cape Town air freight export trading partners between 2022 and 2024 based on the export trade volumes shown in Table 1

Top 15 export partners (% of total exports)	2022	2023	2024
United Kingdom	4 492 (15.0%)	5 274 (14.4%)	8 097 (17.8%)
Netherlands	5 376 (18.0%)	6 240 (17.1%)	8 026 (17.7%)
United Arab Emirates	1 679 (5.6%)	3 167 (8.7%)	3 676 (8.1%)
United States of America	2 557 (8.6%)	3 175 (8.7%)	3 247 (7.2%)
Kuwait	479 (1.6%)	1 497 (4.1%)	2 061 (4.5%)
Saudi Arabia	523 (1.8%)	1 086 (3.0%)	1 814 (4.0%)
Germany	1 737 (5.8%)	1 710 (4.7%)	1 605 (3.5%)
Qatar	2 428 (8.1%)	2 005 (5.5%)	1 285 (2.8%)
Hong Kong	1 255 (4.2%)	1 151 (3.1%)	1 091 (2.4%)
Jordan	11 (0.0%)	158 (0.4%)	1 081 (2.4%)
Ethiopia	433 (1.4%)	643 (1.8%)	1 048 (2.3%)
Spain	923 (3.1%)	1 020 (2.8%)	968 (2.1%)
Iran	5 (0.0%)	8 (0.0%)	878 (1.9%)
Vietnam	550 (1.8%)	1 134 (3.1%)	656 (1.4%)
Belgium	526 (1.8%)	422 (1.2%)	651 (1.4%)

2024 saw an interesting movement amongst import trading partners, with Mauritius becoming the third highest import trading partner (with volumes increasing by 1 634 tonnes, a 345.2% growth, since 2022). Similarly, the largest trading partners for import air freight, Germany and China, continued to show positive growth. On the other hand, the United States of America and Israel showed a slight decrease in volumes (see Table 4). In 2024, Madagascar and Bangladesh surpassed Vietnam and Belgium in import volumes, resulting in their replacement of the latter in the Top 15 import partners table.

Table 4: The top 15 Cape Town air freight import trading partners between 2022 and 2024 based on the import trade volumes shown in Table 2

Top 15 import partners (% of total imports)	2022	2023	2024
Germany	2 397 (10.6%)	2 813 (12.0%)	3 274 (11.1%)
China	2 071 (9.2%)	2 568 (11.0%)	3 249 (11.0%)
Mauritius	473 (2.1%)	629 (2.7%)	2 108 (7.1%)
Thailand	999 (4.4%)	1 325 (5.7%)	1 752 (5.9%)
Italy	1 422 (6.3%)	1 514 (6.5%)	1 705 (5.8%)
Netherlands	1 440 (6.4%)	1 280 (5.5%)	1 574 (5.3%)
United States of America	1 371 (6.1%)	1 456 (6.2%)	1 381 (4.7%)
Norway	1 250 (5.5%)	1 120 (4.8%)	1 374 (4.7%)
Spain	1 016 (4.5%)	1 257 (5.4%)	1 348 (4.6%)
France	1 111 (4.9%)	860 (3.7%)	1 122 (3.8%)
India	1 161 (5.1%)	952 (4.1%)	1 091 (3.7%)
United Kingdom	823 (3.6%)	954 (4.1%)	1 029 (3.5%)
Madagascar	254 (1.1%)	207 (0.9%)	786 (2.7%)
Bangladesh	327 (1.4%)	333 (1.4%)	647 (2.2%)
Israel	521 (2.3%)	620 (2.6%)	594 (2.0%)

As seen in Table 5, CTIA's largest air freight food trade partners in 2024 are the UK, United Arab Emirates, and the Netherlands. Jordan and Iran's food trade volumes overtook those of Taiwan and China in 2024, which is the reason for the former countries' addition to the table - replacing the latter countries that were included in the same table of the previous report. In the previous years, the volumes of Jordan and Iran were significantly lower.

Table 5: The most significant Cape Town air freight trading partners between 2022 and 2024 based on food trade volumes

Food trade partner (% of total food trade)	2022	2023	2024
United Kingdom	3 760 (18.7%)	4 574 (17.3%)	7 326 (21.4%)
Netherlands	2 480 (12.4%)	2 891 (10.9%)	3 681 (10.7%)
United Arab Emirates	1 520 (7.6%)	2 929 (11.1%)	3 236 (9.4%)
Kuwait	432 (2.2%)	1 466 (5.5%)	2 014 (5.9%)
Saudi Arabia	421 (2.1%)	957 (3.6%)	1 651 (4.8%)
Norway	1 320 (6.6%)	1 250 (4.7%)	1 476 (4.3%)
United States of America	794 (4.0%)	1 455 (5.5%)	1 388 (4.0%)
Qatar	2 363 (11.8%)	1 998 (7.6%)	1 275 (3.7%)
Jordan	0 (0.0%)	150 (0.6%)	1 071 (3.1%)
Hong Kong	1 226 (6.1%)	1 103 (4.2%)	1 057 (3.1%)
Spain	860 (4.3%)	1 013 (3.8%)	1 040 (3.0%)
Ethiopia	420 (2.1%)	656 (2.5%)	1 037 (3.0%)
Iran	1 (0.0%)	1 (0.0%)	873 (2.5%)
Vietnam	504 (2.5%)	1 089 (4.1%)	633 (1.8%)
France	497 (2.5%)	516 (2.0%)	600 (1.7%)
Germany	346 (1.7%)	709 (2.7%)	579 (1.7%)
Italy	438 (2.2%)	683 (2.6%)	536 (1.6%)



Table 1 below lists all the manufacturing freight flows that originate within the Western Cape (intra-provincial and outgoing traffic). The grouping 'Other commodities' is also detailed in Table 1.

Table 1: Manufacturing freight flows that originate within the Western Cape (2024)

Commodity	Million tonnes 2024	Percentage contribution
Processed foods	8.90	29.2%
Beverages	3.42	11.2%
Diesel	2.42	7.9%
Cement	2.14	7.0%
Other petroleum products	2.12	7.0%
Petrol	1.74	5.7%
Animal feed	1.73	5.7%
Other manufacturing industries	1.59	5.2%
Bricks	1.25	4.1%
Other commodities:	5.17	16.9%
Iron and steel	0.78	2.6%
Jet fuel	0.63	2.1%
Fertilizer	0.57	1.9%
Slaughtered animal meat	0.51	1.7%
Metal products, machinery and electronic equipment	0.45	1.5%
Textile products	0.33	1.1%
Chemicals	0.33	1.1%
Paper	0.31	1.0%
Wood timber and products	0.30	1.0%
Scrap metals	0.23	0.8%
Pharmaceutical products	0.19	0.6%
Non-ferrous metal products	0.14	0.4%
Recycled paper	0.13	0.4%
Soya bean products	0.12	0.4%
Printing and publishing	0.08	0.3%
Motor vehicle parts and accessories	0.04	0.1%
Transport equipment	0.02	0.1%
Pulp of wood and paper	0.00	0.0%
Motor vehicles and trucks	0.00	0.0%
Tobacco products	0.00	0.0%
Wood chips	0.00	0.0%
	30.49	100.0%

Other manufacturing industries consist of manufactured goods that can be classified by the following (HS2¹) codes: (36) Explosives; pyrotechnic products; matches; pyrophoric alloys; certain combustible preparations. (71) Natural or cultured pearls, precious or semi-precious stones, precious metals, metals clad with precious metal, and articles thereof; imitation jewellery; coin. (90) Optical, photographic, cinematographic, measuring, checking, precision, medical or surgical instruments and apparatus; parts and accessories thereof. (91) Clocks and watches and parts thereof. (92) Musical instruments; parts and accessories of such articles. (93) Arms and ammunition; parts and accessories thereof. (95) Toys, games and sports requisites; parts and accessories thereof. (96) Miscellaneous manufactured articles. (97) Works of art, collectors' pieces and antiques.

¹ Harmonised System is a standardised numerical method of classifying traded products. The first two digits (HS-2) identify the chapter the goods are classified in.