Western Cape Government

Transport and Public Works

WESTERN CAPE FREIGHT DEMAND MODEL

2019 Model | Report | May 2021

WESTERN CAPE FREIGHT DEMAND MODEL (WCFDM)

The first version of the Western Cape Freight Demand Model (WCFDM) was developed during the 2017/18 FY, utilising the then latest 2015 national FDM, and available 2017 data, to estimate a 2017 WCFDM. Since then the WCFDM has been updated annually, making this the fourth iteration of the WCFDM and the basis for this report. The major new inputs were an updated national Freight Demand Model™ (updated for 2019 during the course of 2020), and the full calendar year WC-specific data which became available for 2019. Additional research (including various data sources) was also conducted to enhance the data inputs for the WCFDM.

The WCFDM enables data-driven policy development and infrastructure plans with the primary focus on enabling the most efficient freight transport configuration in the province. This includes both reducing the cost of transport supply as well as spatial management that will reduce demand. The WCFDM results, therefore, provide significant insights into the current state and possible futures for the freight system in the province. However, the WCFDM output database is substantial and requires in-depth data analysis and discussion to extract this value and determine the usefulness of these metrics for planning, decision-making and stakeholder engagement. Moreover, the results of the analysis need to be aligned with the strategic direction of the Western Cape Government, the updated Western Cape Freight Strategy and Implementation Programme. This WCFDM report, therefore, aims to give context to the development of the WCFDM in terms of its data sources and methodology and presents various results that support strategic decision-making and implementation of the Western Cape Freight Strategy.

Report content include:

Western Cape Freight Demand Model (WCFDM)

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Executive summary

The WCFDM supports strategic decision-making in the implementation of the Western Cape Freight Strategy. This report outlines the methodology and data sources of the model, and summarises key characteristics and costs associated with freight flows to, from, and within the Western Cape, as well as potential scenarios for improvement.

Methodology

The national and provincial freight demand models comprise 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.

Data

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), and publicly available industry and business data.

National freight flows

Freight to, from, and within the Western Cape constitutes 17.9% of the total national freight (tonnes), and 10.5% if the iron ore and manganese export lines are excluded. The Western Cape contributes 10.9% to the national transportable GDP and 38.7% of the total tonne-kms (33.1% when excluding bulk export freight). With the exclusion of bulk exports, the manufacturing sector freight contributes 47.9% and 68.5% of national and provincial tonne-kms, respectively, and the agricultural sector contributes 16.5% and 21.6%, respectively. Manufactured goods constitute 47.9% of Western Cape and 31.2% of national general freight business (GFB)[1] tonnes. Western Cape consignments are transported over the highest average transport distance of any province in South Africa. The beneficiation efforts of the province are hampered by significant transport and spatial challenges, and high logistics costs considerations.

Provincial modal split

The total freight with an origin or destination in the Western Cape amounted to 150.2m tonnes in 2019. The modal split of the total Western Cape freight is 55% on road and 45% on rail. For GFB freight, 96% is transported on road and 4% on rail. Rail is used mainly for low value, bulk agricultural and mining (e.g., iron ore) commodities. The manufacturing sector is dominant in GFB freight volumes. Opportunities exist in the Western Cape for long-distance GFB rail freight.

[1] GFB is defined as the competitive market space and consists of the total freight tonnes less iron ore exports, manganese exports, and pipelines.

GAIN GROUP Insight drives growth

Provincial trade

The Western Cape GFB freight (65.0 million tonnes) is split approximately between intra-Western Cape freight (21.3 million tonnes), freight transported to other provinces (25.0 million tonnes) and freight received from other provinces (18.5 million tonnes). Waste is an intra-provincial flow only, and amounts to 2.8 million tonnes (13% of intra-provincial flow). Almost half (48.6%) of intra-Western Cape freight and 78.7% of freight to other provinces, amounting to 30.0 million tonnes, consists of manufacturing commodities. Processed foods represent the largest manufactured commodity group (31.3%), followed by beverages (10.1%). KwaZulu-Natal is the Western Cape's main GFB trading partner, followed closely by Gauteng.

Corridors

Rail has a 3.6% tonnage market share of non-ring-fenced[2] total Western Cape road and rail freight. In terms of tonne-kilometres, there is a decrease from 3.1% in 2018 to 2.0% in 2019. Corridor freight transport is dominated by road, with 98.6% non-ring-fenced tonnage market share on the N1 corridor, 98.4% on the N2 corridor and 78.3% on the N7 corridor. The average travel distance of freight on the N1, N2 and N7 is 1383 km, 606 km and 416 km, respectively. Modal shift opportunities exist for long-distance road freight in the Western Cape.

Flow segmentation

Manufactured goods, transported over long distances on road, present two opportunities for rail, namely (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 palletisable and containerisable freight, which can be transported through domestic intermodal solutions from private distribution centres through public intermodal terminals. The inability of the railway to develop these solutions collaboratively with road impacts transport cost, and as such hampers the competitiveness of industries in the Western Cape.

Economic forecast

Iron ore and manganese exports constitute the majority of the Western Cape's mining sector freight intensity[3]. Manufacturing and agricultural commodities from the Western Cape are transported over significantly longer distances than the mining commodities. The impact of COVID-19 results in a more pessimistic view of manufacturing in the long term. Social and economic factors are also believed to be more challenging than before due to the longer term impact of COVID-19.

Freight transport costs

In 2019, road freight accounted for 84% of the total transportation cost. The main road freight transport cost drivers were fuel (R20.1 billion; 33.5% of total cost), maintenance and repairs (R9.9 billion), and driver wages (R6.3 billion). The South African freight railway's challenge is that it needs a substantial modal shift from road to realise density benefits.

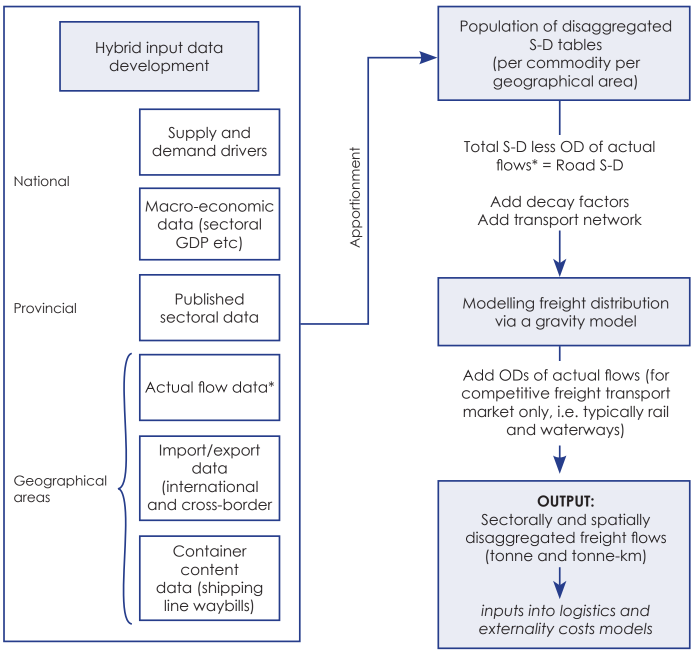
Externality costs

The total externality cost for road freight transport in the province amounts to R13.42 billion, which is 26.6% of current direct road freight transport costs. Road freight transport contributes 93% of the total freight transport externality cost of R14.47 billion, of which 80% is contributed by the four largest cost drivers (i.e., emissions, accidents, noise and congestion). These impact the general population while not being carried by the users of the service. Policy interventions could induce the internalisation of externality costs, and a systemic shift of rail-targetable freight to rail.

[2] "Ring-fenced" freight is freight that is usually part of a specific ring-fenced system that is not impacted by provincial-level strategic interventions, for example iron ore from Sishen to Saldanha. Non-ring-fenced freight refers to the freight that falls outside of this definition.

3 Freight transport intensity is the ratio of freight transport demand (measured in tonne kilometres) and the economic output measured by Gross Domestic Product (GDP). Freight intensity is the quantum of freight transport required to achieve the same output. Freight transport intensity, for instance, for income received from gold mining versus income received from coal mining is very low. Meaning much less freight activity is required to achieve the same income. In a general sense high freight intensity means low returns for many tonne-kilometres. It can be reduced 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).

The process and key data sources that are used to develop the Western Cape Freight Demand Model[1] 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 are the 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). These 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)

The national model was first developed and used in 1998. The model was improved in 2006 to become a complete repeatable model, and has since been updated annually with Transnet sponsorship. The WCFDM was developed for the first time in 2017/18, based on the national FDM, with the objective of adding richer and more refined known data for the province and 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.

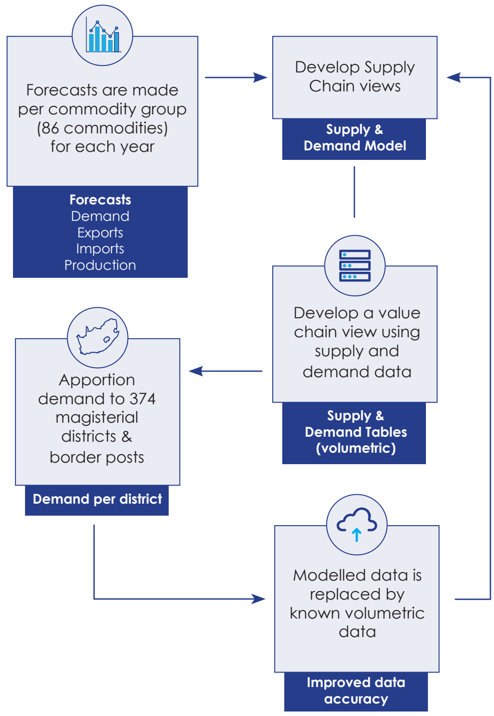


Figure 2: Econometric model

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, by means of gravity modelling.

Gravity modelling is based on the premise that freight flows between geographical districts are determined by supply and demand volumes for each commodity, and by a measure of transport resistance per commodity.

Distance and travel time are the most common measures of transport resistance as an objective, readily-available variable. Road cost components, such as diesel consumption and truck wear-and-tear, also typically have a linear relationship with distance and time. A distance-decay function describes the attraction value between origins (supply) and destinations (demand). The decay factor determines the slope of the decay function and its relative change over distance and time. Distance decay varies from one commodity to another based on many characteristics, including its value, nature and utility.

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

Low value, bulk commodities that generate a transport demand disproportionate to their value tend to have a sharp rate of decay (i.e., they tend not to be transported over long distances), while the impact of distance is smaller for higher-value commodities, thus suggesting low decay parameters (mostly used for manufactured and end-use agriculture commodities, that is, heterogeneous agglomerations with use that is more dispersed over a number of geographical districts).

Figure 3 shows the Flow model.

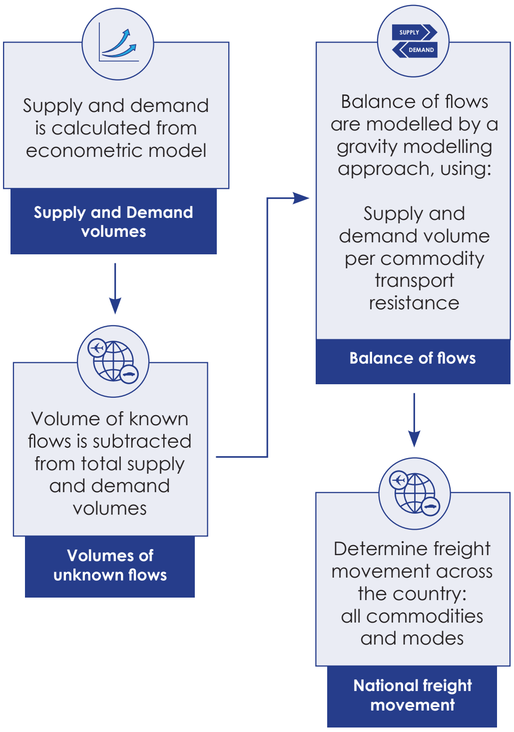


Figure 3: Flow model

The Western Cape Freight Demand Model (WCFDM)

The WCFDM is confined to those Western Cape geographical districts from the national FDM (42 magisterial districts, 3 ports) for which freight either originates, is destined for, or moves within the district. The model is a complete set of origin and destination freight movements, per commodity (currently 86 commodities) and per transport mode (road, rail, and pipeline). A geographic representation of the WCFDM districts is presented in Figure 4.

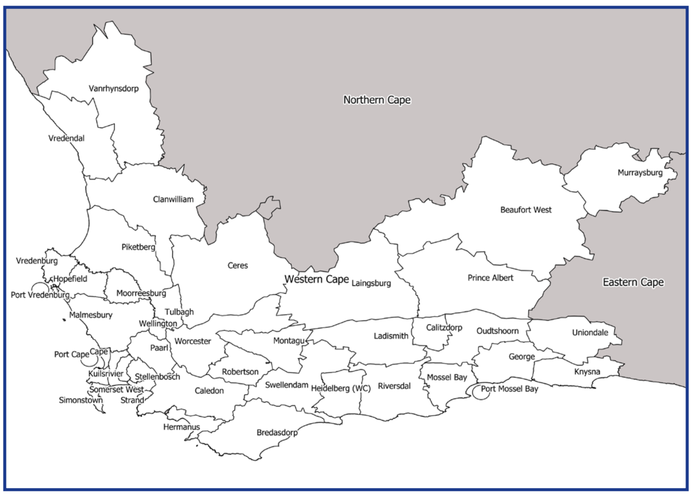


Figure 4: Geographical districts within the Western Cape

Data sources

During the development of the WCFDM, the following data sources were used:

- Inputs from participating Logistics Service Providers (LSP);
- Transnet Freight Rail data;
- Transnet National Ports Authority data – bulk and containers;
- Western Cape specific data: agriculture crops, waste and mining data;
- Publicly available data for industry and businesses.

Figure 5 and the text box below provide a summary and explanation of the datasets used and updated:

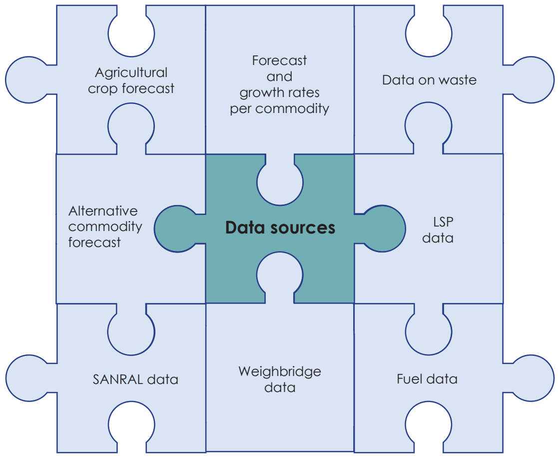


Figure 5: Data Sources

1. Forecasts and growth rates: Revised in line with the national FDM for imports, exports, production, intermediate demand and final demand/consumption in WCFDM.
2. Waste: Data collected and included in the model.
3. Participating Logistics Service Provider (LSP): Company origin-destination 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 WCFDM flows. It largely confirmed the modelled WCFDM 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.

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, Vol. 7 No. 1, pp. 1-7.

Havenga, J.H., Witthoft, I.E., De Bod, A. and Simpson, Z. 2020. *From Logistics Strategy to Macrologistics: Imperatives for a developing World. London. Kogan Page Publishers.*

Havenga, J.H. and Simpson, Z.P. (2018), 'National freight demand modelling: a tool for macrologistics management', International Journal of Logistics Management, Vol. 29 No. 4, pp.1171-1195, https://doi.org/10.1108/IJLM-11-2017-

Of the 838.1m tonnes of freight being moved in South Africa, 150.0 million tonnes (17.9%) of freight have either an origin or destination, or both, within the Western Cape, as shown in Figure 1 (a). This figure is skewed by the iron ore (59.6 million tonnes) and manganese exports (4.9 million tonnes), which are almost entirely destined for the Port of Saldanha. This ring-fenced freight is shown in Figure 1(b). Without the two export commodities that originate outside of the boundaries of the province, 10.5% of all national freight moves through the Western Cape, as shown in Figure 1 (b). The iron ore and manganese export lines account for 7.1% and 0.6% of the national freight, respectively. This highlights that a large portion of freight that moves through the Western Cape does so without contributing significantly to the province's[1] Gross Domestic Product (GDP).

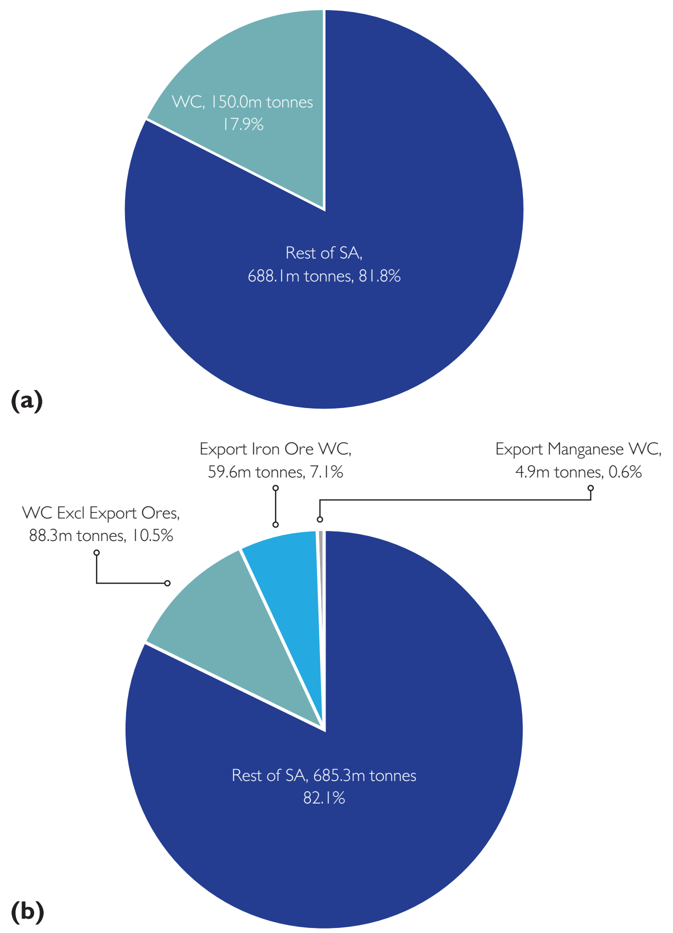


Figure 1: Western Cape freight as percentage of national freight (WC = Western Cape)

Figure 2 shows the total contribution of the Western Cape freight volumes as a percentage of the total national freight volumes, both per tonne and per tonne-km. If the export lines are included in the freight moving in the Western Cape, the results show a very high freight transport intensity[2] in terms of tonne-kms, with 17.9% of the national tonnes accounting for 38.7% of the national tonne- kms.

The difference in the Western Cape percentage share of the national total shows how moving bulk freight over long distances can affect freight intensity measurements. Therefore, in order to conduct a fair analysis of the remaining non-bulk freight, that is, General Freight Business (GFB) freight, the bulk lines (iron ore export, manganese export and pipelines[3], hereafter referred to as "the bulks" or "bulk commodities") have been excluded from the Western Cape freight, considering that they skew the freight intensity. The export coal and conveyor belt coal are excluded from the national freight.

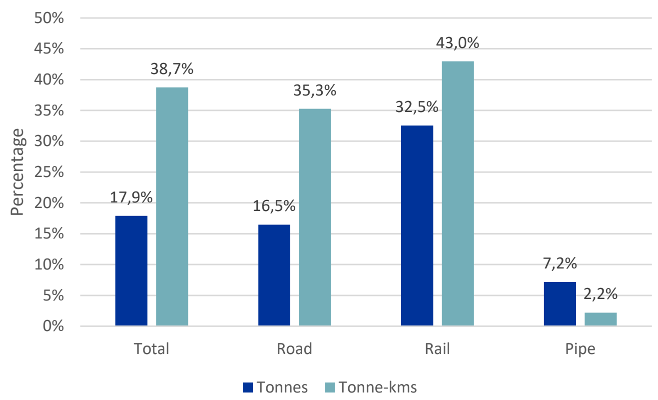


Figure 2: Western Cape volumes as a percentage of South Africa's total freight (2019)

With the bulk commodities excluded from freight flows, Figure 3 shows that the freight intensity in the Western Cape in terms of tonne-kms is still high compared to the intensity based on tonnes. The Western Cape is one of nine provinces, but contributes one in three national GFB tonne-kms (33.1%) and only accounts for 15.4% of the national GFB tonnes.

In addition, rail's contribution is low compared to that of road, especially given the long distances to inland markets. The national FDM indicates that rail's corridor market share is the highest on the Natal corridor (next to the N3), and low on the Cape corridor (next to the N1). Historically, the majority of rail freight developments were concentrated along the Natal corridor, even though it is much shorter than the Cape corridor. Therefore, due to the long distances and less development along the Cape corridor, the Western Cape experiences a lower relative rail market share (with bulk commodities excluded). The Western Cape is therefore in a position where the leveraging of initiatives that encourage modal optimisation and transportation cost efficiencies for GFB traffic will have the greatest positive effect.

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[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 kilometres) and the economic output measured by Gross Domestic Product (GDP). Freight intensity is the quantum of freight transport required to achieve the same output. Freight transport intensity, for instance, for income received from gold mining versus income received from coal mining is very low. Meaning much less freight activity is required to achieve the same income. In a general sense high freight intensity means low returns for many tonne- kilometres. 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).

[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.

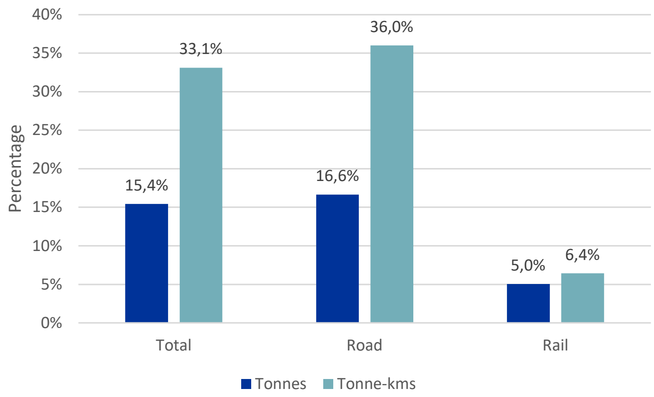


Figure 3: Western Cape GFB volumes as a percentage of South Africa's total GFB freight (2019)

Table 1 shows the Western Cape's overarching freight position. Due to the slightly larger tertiary sector[4] of the Western Cape, the province's contribution to transportable GDP is lower than its contribution to total GDP. Although the Western Cape contributed only 10.9% to the national transportable GDP, it contributed 38.7% of the total tonne-kms, or 33.1% when considering GFB freight.

Table 1: Western Cape's overarching freight position (2019)

	South Africa	Western Cape	%
GDP (R Billions current prices)	5 078	692	**13.6%**
Transportable GDP (Rbn current prices)[5]	1070	117	**10.9%**
Tonnes (Millions)	838	150	**17.9%**
Tonnes (Millions) GFB	681	86	**16.6%**
Tonne-km (Billions)	306	119	**38.7%**
Tonne-km (Billions) GFB	189	60	**33.1%**

The contribution of the Western Cape's mining sector to the total provincial freight in tonnes was 62.2%, which approaches the sector's 65.1% contribution to the total national freight in tonnes, as shown in Figure 4. As described before, the significant role played by the mining sector in the province's freight flow economy is attributable to the provision of an export gateway for iron ore through the Saldanha Bay port. When the bulk exports are excluded, the contribution of the GFB mining tonnes to the Western Cape's total sectoral freight flows declines to 33.6%, with manufacturing (mostly consisting of agro-processing) and agriculture increasing to 47.9% and 18.5%, respectively (compared to the sectoral contribution to total tonnes).

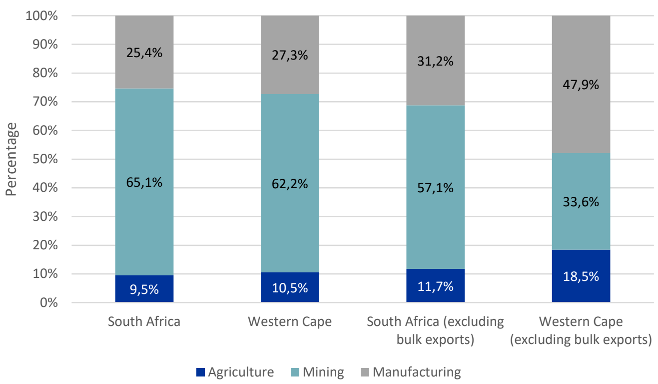


Figure 4: Tonnes per sector as percentage of total tonnes for South Africa and the Western Cape (2019)

Figure 5 shows the percentage contribution of tonne-kms per sector, both nationally and at a Western Cape level and both including and excluding bulks.

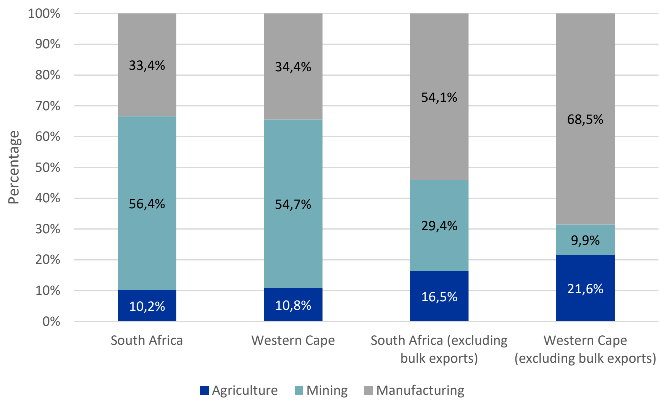


Figure 5: Tonne-kms per sector as percentage of total tonne-kms for South Africa and the Western Cape (2019)

As described above, in 2019 the mining sector contributed approximately two thirds of the freight flow tonnes both nationally and in the Western Cape, while accounting for 56.4% and 54.7% of the tonne-kms respectively. The relatively lower tonne-km contribution is due to the Western Cape's mining activities being relatively shorter haul (mostly the Namaqua Dunes projects) than mining activities in the rest of South Africa. The manufacturing sector freight makes up 25.4% of national tonnes and 27.3% of Western Cape tonnes. This sector's freight makes up 33.4% of national tonne-kms and 34.4% of Western Cape tonne-kms.

The agricultural sector freight makes up 9.5% of national tonnes and 10.5% of Western Cape tonnes; and 10.2% of national tonne- kms and 10.8% of Western Cape tonne-kms.

The discrepancy between tonne-km and tonnes contribution, especially in the manufacturing sector, results from the Western Cape's longer inter-provincial trading distances compared to any other province in South Africa; this requires longer trips for exporting and importing finished goods and processed and unprocessed food.

A comparison between the total tonne-kms per sector and the tonnes shows that, on average, manufacturing and agricultural commodities are being moved over longer distances than mining commodities. This becomes more evident when excluding the bulk exports. The manufacturing sector contributes 54.1% of the national tonne-kms after the bulk exports have been excluded, and 68.5% in the Western Cape. The agriculture sector contributes 16.5% of the national GFB tonne-kms and 21.6% in the Western Cape.

[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] 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.

South Africa's beneficiation is on average more successful in the Western Cape. Manufactured goods constitute 47.9% of the Western Cape's GFB tonnes, while only 31.2% of the national GFB tonnes consist of manufacturing commodities. However, there are significant transport challenges, spatial issues and high logistics costs that impact this strategy in the Western Cape. One of the advantages of beneficiation is that it reduces transport costs relative to GDP (delivered higher value commodities will always attract a lower transport cost percentage than lower value commodities). However, beneficiated commodities in the national context must still be moved to markets and if these markets are relatively further away, transport costs will be relatively higher. This is because these commodities compete with local or imported commodities closer to the market.[6] This implies that greater transport efficiency is required

[6] In practical terms, a tin of preserved food that is moved from the Western Cape to Gauteng has to, for example, compete with locally produced food from Gauteng and Mpumalanga or cheap imports from Durban, all of which are closer.

Highlights

- 17.9% of national freight has either an origin or destination, or both, within the Western Cape.
- 15.4% of all national GFB freight moves through the Western Cape.
- The Western Cape contributed 10.9% to the national transportable GDP; it contributed 38.7% of the total tonne-kms, and 33.1% when excluding the bulks.
- Excluding the bulk exports:
  - The manufacturing sector freight constitutes 47.9% of national tonne-kms and 68.5% in the Western Cape.
  - The agricultural sector freight contributes 16.5% of national GFB tonne-kms and 21.6% in the Western Cape.
- Manufactured goods comprise 47.9% of the Western Cape's GFB tonnes, and only 31.2% of national GFB tonnes.
- The average transport distance of each Western Cape consignment is higher than the national average; this is the highest for any province in South Africa.
- The Western Cape has significant transport and logistics cost challenges and spatial considerations that impact its beneficiation efforts.

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 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. Previously iron ore on the export line, that 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.

Modal split

Total road and rail freight with an origin or destination in the Western Cape in 2019 amounted to 150.2m tonnes and is shown in Figure 1.

The total tonnes per sector are given in Figure 2. The waste data, while not complete, consists of municipal waste, garden waste and construction and demolition waste. The largest concentration of waste generation and transportation occurs within the City of Cape Town, which has a substantial impact on local flows.

The GFB tonnes are shown in Figure 3, in which the dominance of manufacturing is evident. The 2019 data shows a slight decrease in mining activities and a slight increase in manufacturing and agricultural activities from 2018. The road market share of the revised GFB market space for 2018 was also 96%, therefore year on year there has been no change in the modal split.

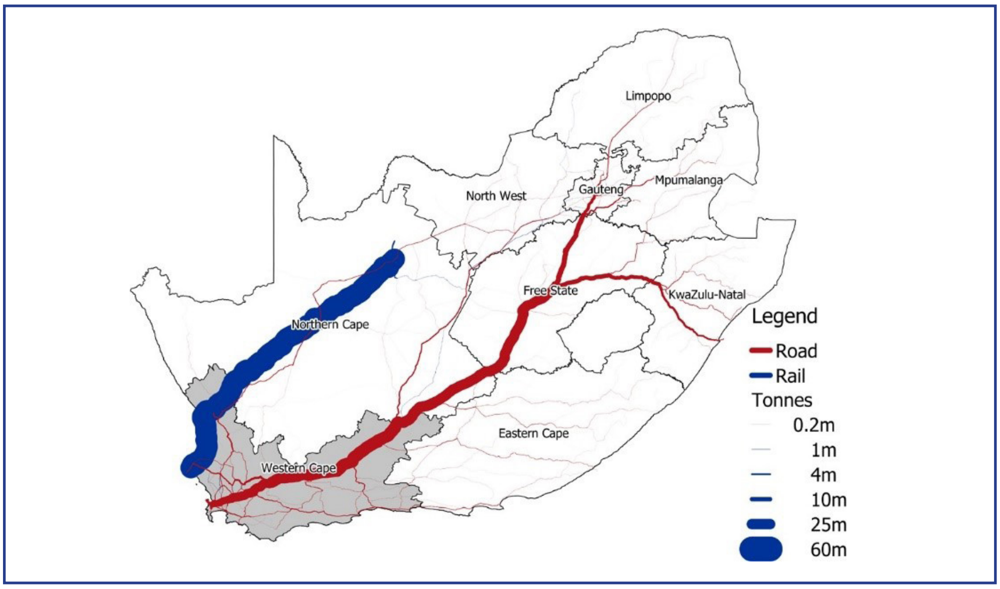


Figure 1: Total freight with an origin or destination in the Western Cape scaled to iron ore export line (2019)

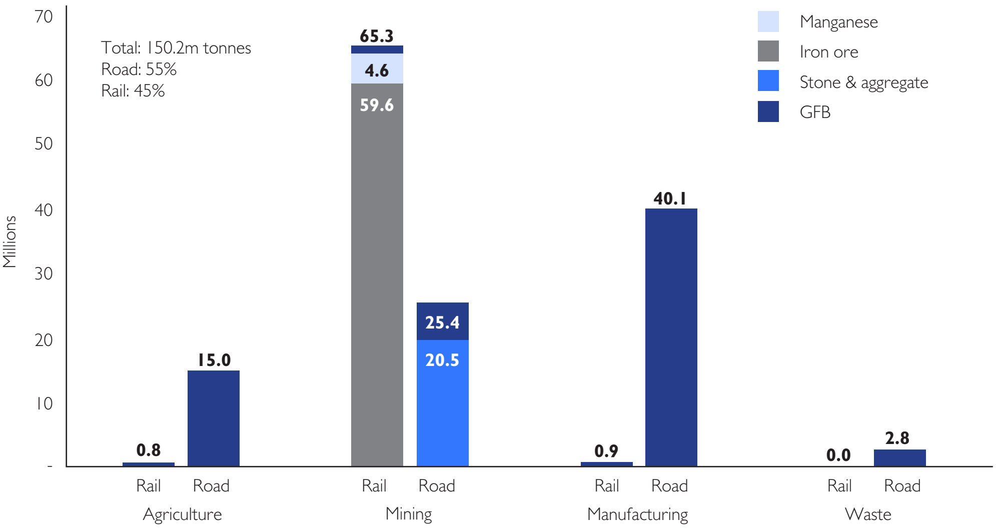


Figure 2: Total road and rail tonnes per sector in the Western Cape (2019)

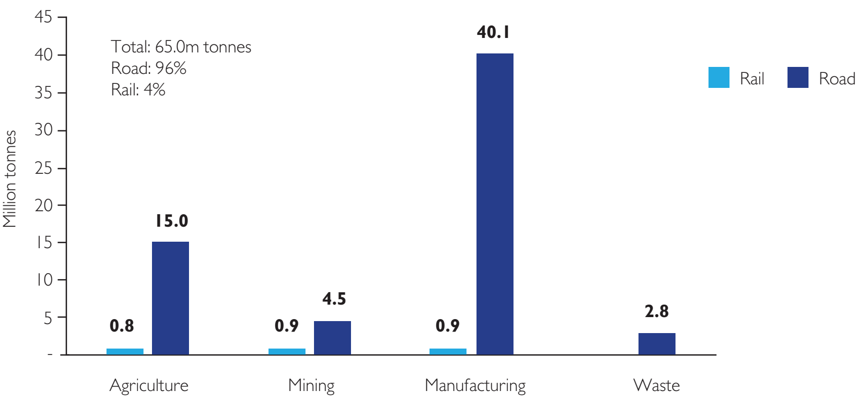


Figure 3: GFB road and rail tonnes per sector (2019)

Figure 4 (same scale as Figure 1) shows GFB rail freight movements that touch the Western Cape.

The largest single commodity of GFB, which was moved on rail was 0.53m tonnes of maize of which 0.36m tonnes were imported through the Port of Cape Town. The contrast with Figure 1 highlights the limited role of rail, once the bulk have been removed.

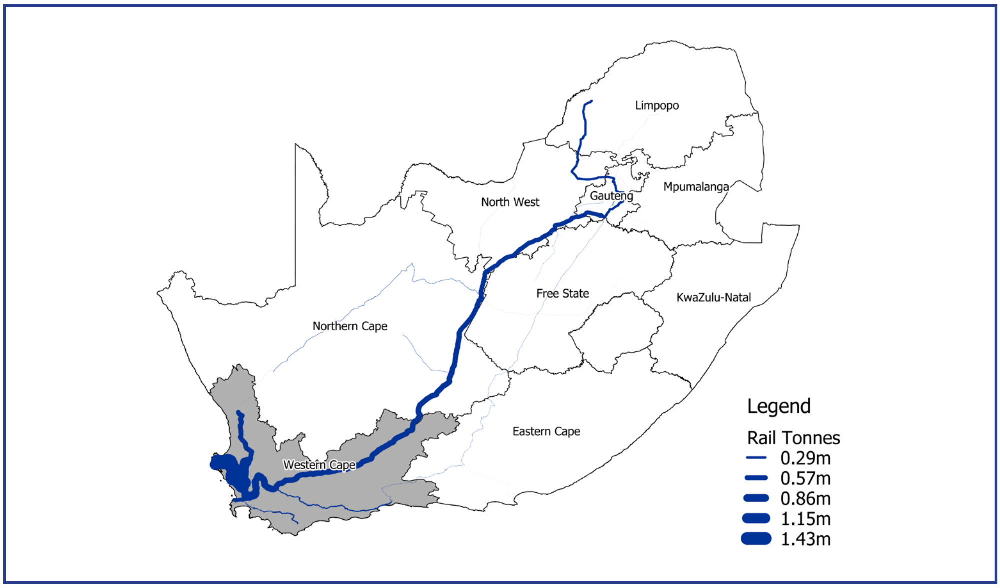


Figure 4: GFB rail freight that touches the Western Cape (2019)

Commodity splits per mode

Freight volumes per commodity per mode for Western Cape-related GFB freight can be seen in Figure 5.

The commodity "other agriculture" mostly consists of unmanufactured agricultural animal feed (namely lucerne and hay).

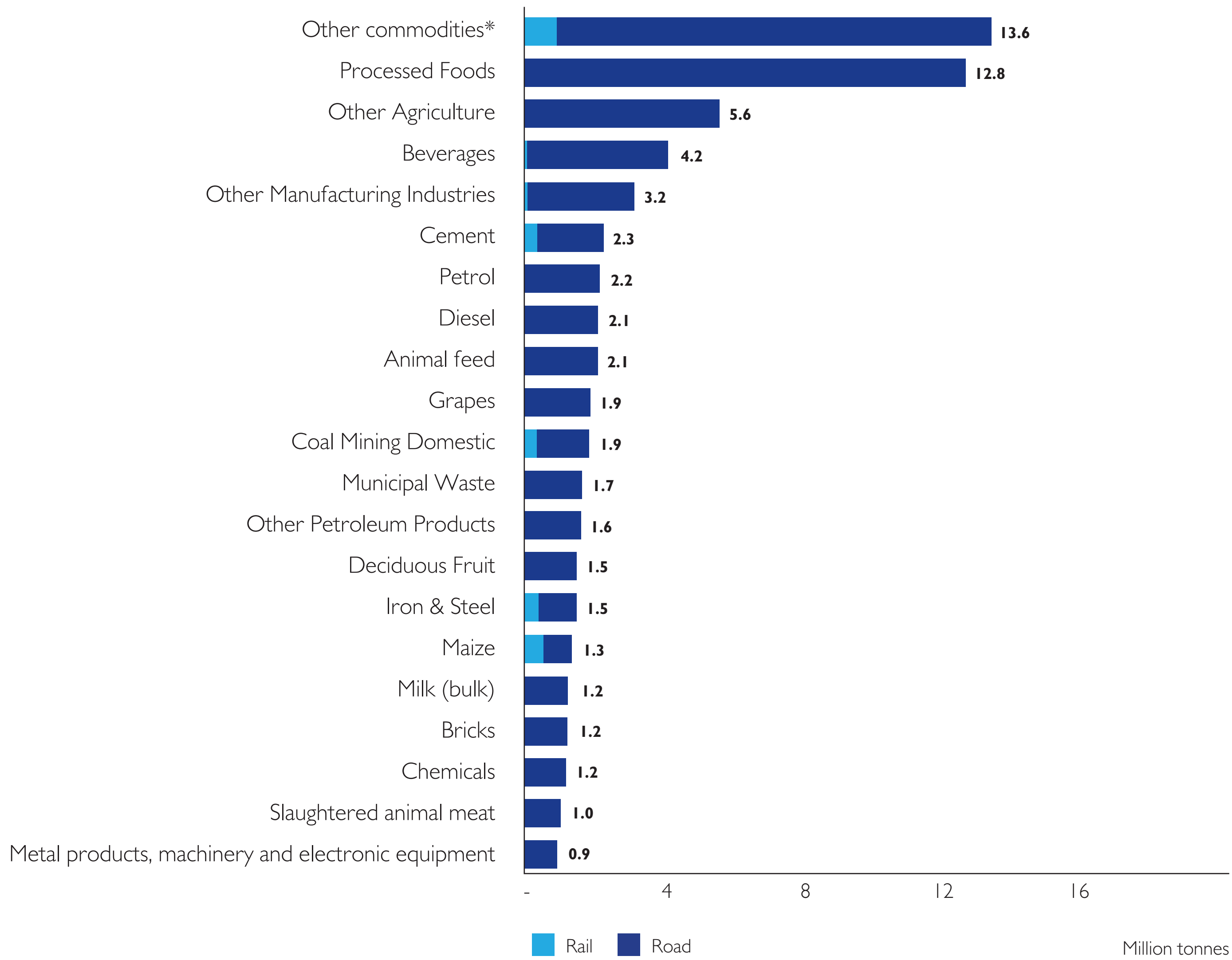


Figure 5: Western Cape related GFB freight volumes per commodity per mode (2019)

* See section 15-1, for detail on "other manufacturing industries" and the grouping "other commodities"

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

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 transportation 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.

Rail tonnes in the Western Cape have been growing faster than national rail tonnes, as can be seen in Figure 6.

Note that it is mostly inter-provincial freight volumes that are growing, as the tonne-kms have been growing faster than tonnes since 2014. The national increase in volumes has been driven by the three major export commodities: iron ore, manganese, and coal. The increase in 2019 is largely driven by an increase in iron ore, manganese and magnetite exports which offset the decrease in coal movements. This highlights that the rail sector is still very much reliant on mineral exports.

Table 1: Rail volumes and market share (2019)

Commodity on Rail	Rail volumes (thousand tonnes)	Rail market Share
Barley	232.9	89.1%
Zircon	120.1	72.0%
Maize	538.3	40.0%
Rutile	70.3	39.7%
Ilmenite (Titanium ore)	318.2	38.6%
Iron & Steel	386.5	25.9%
Gypsum	27.8	18.3%
Coal Mining Domestic	337.9	18.2%
Cement	334.2	14.7%
Fertilizer	44.8	10.1%
Wheat	49.8	5.5%
Limestone	42.3	4.7%
Granite	3.5	4.1%
Grain Sorghum	0.4	2.1%
Other Manufacturing Industries	60.0	1.9%
Beverages	43.3	1.0%
Chemicals	5.8	0.5%
Metal products, machinery and electronic equipment	1.5	0.2%
Diesel	2.3	0.1%

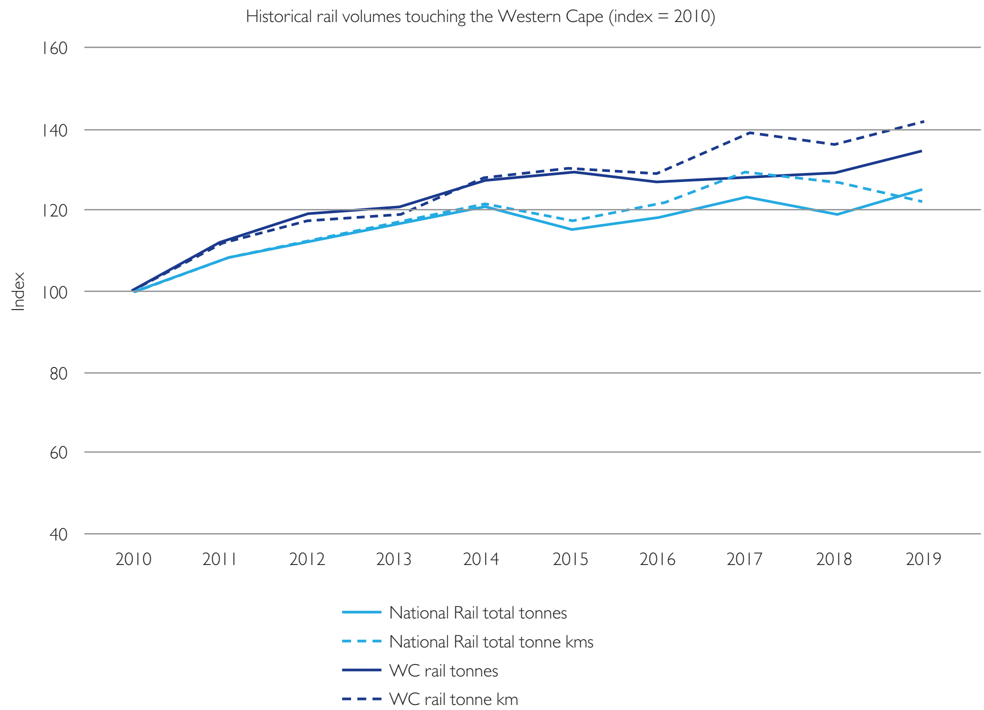


Figure 6: Time series of indexed rail tonnes and tonne-kms from 2010 to 2019 (index = 2010)

From the indexed GFB tonnes (i.e., excluding export iron ore and manganese), it is evident that rail had a further decline in general freight market share (see Figure 7).

In 2015 and 2016, rail lost long- distance volumes, as the tonne-kms increased less than the tonnes for those two years. For the Western Cape, which has the longest average freight travel distance, it would make economic sense to try to increase rail market share on long-distance GFB freight where possible.

The decrease from 2018 continuing to 2019 in the Western Cape's GFB tonnes is attributed to a decrease in market share of iron and steel, domestic coal, gypsum and limestone. This loss in market share was offset by an increase of cement and barley that are intra provincial movements, which also explains the steeper drop in rail tonne-kms: Rail did not retain the long distance freight it gained in 2018. This illustrates that, in the absence of mineral exports, a long-term solution for increased long distance rail volumes is yet to be found. Increases in commodity flows are typically cyclical and do not provide a sufficiently stable market to support capital expansion. Instead, growth in stable, long-distance, densified flows is required to optimise rail's core competencies and justify enduring capital investments.

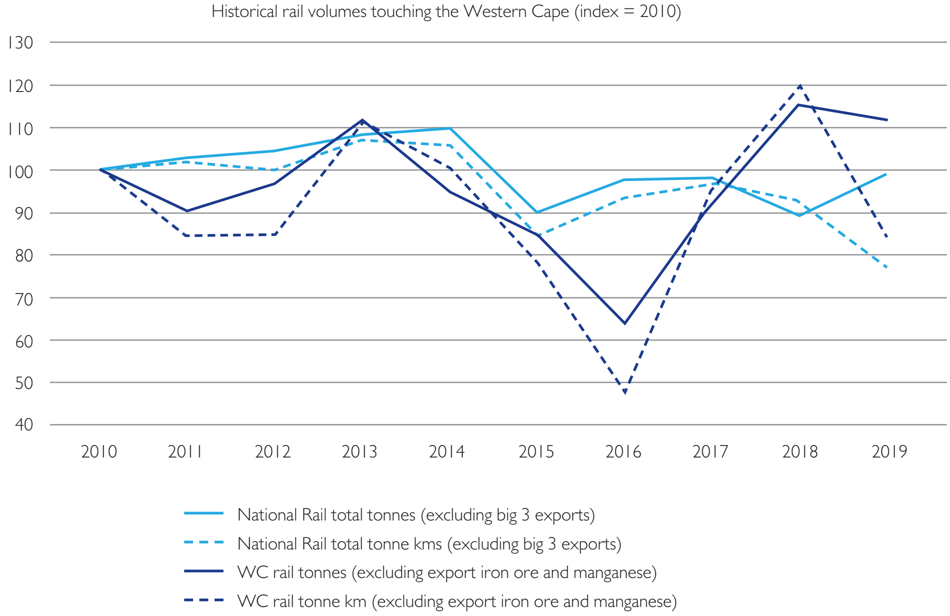


Figure 7: Time series of indexed GFB rail tonnes and tonne-kms from 2010 to 2019 (index = 2010)

Highlights

- Total road and rail freight excluding waste (2019) with an origin or destination in the Western Cape amounted to 150.2m tonnes.
- Modal share in the Western Cape is 55% (road), 45% (rail) for total freight and 96% (road, 4% (rail) for GFB freight.
- The mining sector is dominant due to export iron ore.
- Rail's presence is driven by mining sector (iron ore).
- Rail is used mainly for mining and agricultural commodities – low value, bulk commodities.
- The manufacturing sector is dominant in GFB freight volumes.
- Western Cape opportunities exist for rail on long-distance GFB freight.

The 65 million tonnes of Western Cape General Freight Business (GFB)[1] freight is split between 21.3 million tonnes intra-Western Cape freight, 25.0 million tonnes transported to other provinces and 18.5 million tonnes received from other provinces. There was a slight decrease of 1.5 million tonnes (23.5 million tonnes in 2018) of freight transported to other provinces and a slight increase of 3.4 million tonnes (21.9 million tonnes for 2018) received from other provinces in 2019. These flows are shown per sector in Figure 1. Waste was again 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 and, is thus only an intra-provincial flow. At 13% (2.8 million tonnes), it forms a substantial part of intra- provincial tonnes and is expected to grow, according to the Western Cape Integrated Waste Management Plan 2017-2022.

The Western Cape receives and sends less mining commodities, respectively 1.9 million tonnes and 0.9 million tonnes, compared to 2018. There is a strong and growing manufacturing base in the Western Cape, as manufacturing commodities sent to other provinces increased by 2.3 million tonnes from 2018.

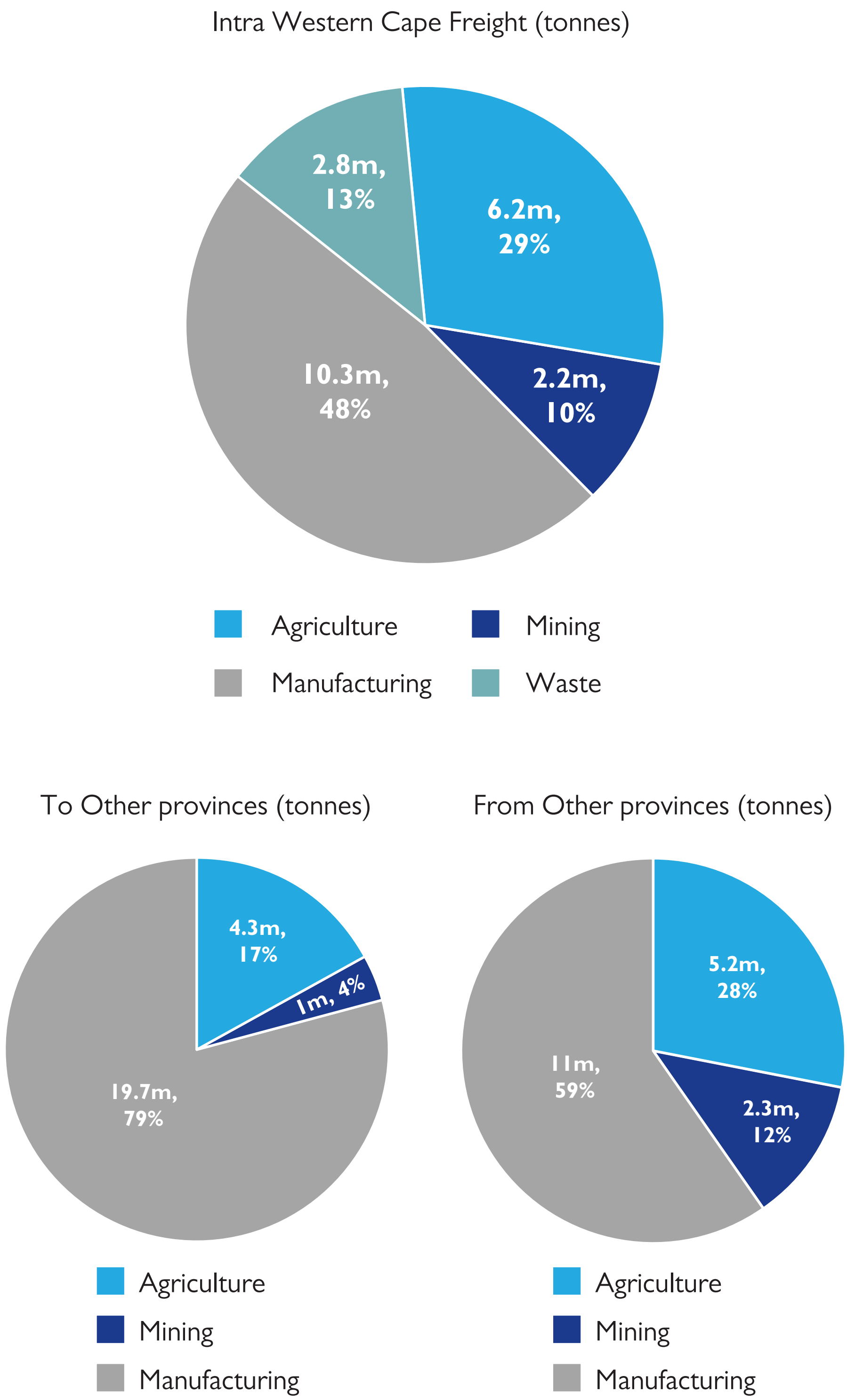


Figure 1: Provincial GFB freight-flows per sector (tonnes 2019)

[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.

An industry breakdown of the Western Cape manufacturing sector is shown in Figure 2 (i.e., the intra-Western Cape manufacturing freight flow tonnes, as well as the manufacturing tonnes flowing to other provinces, to depict the manufacturing base of the province). Of the 30 million manufacturing tonnes that the Western Cape distributes within the province (10.3 million tonnes) and sends to other provinces (19.7 million tonnes), the largest commodity group is processed foods, which contributes 30%, followed by beverages (10%). Provided that there is no structural change to the South African economy, processed foods will continue to be the mainstay of the Western Cape's manufacturing sector.

KwaZulu-Natal is the Western Cape's main GFB trading partner, followed closely by Gauteng. The Western Cape receives 5.3 million tonnes (28.8%) of its GFB freight from KwaZulu-Natal and 3.0 million tonnes (16.3%) from Gauteng. Of all the GFB freight originating from the Western Cape, 5.3 million tonnes (21.3%) are destined for Gauteng and 4.6 million tonnes (18.5%) for KwaZulu-Natal, as shown in Figure 3.

Iron ore on the export line that was used for Saldanha Steel, was previously 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. This adjustment indicates a decline of 1.9 million tonnes received from the Northern Cape, if compared to the previous publication.

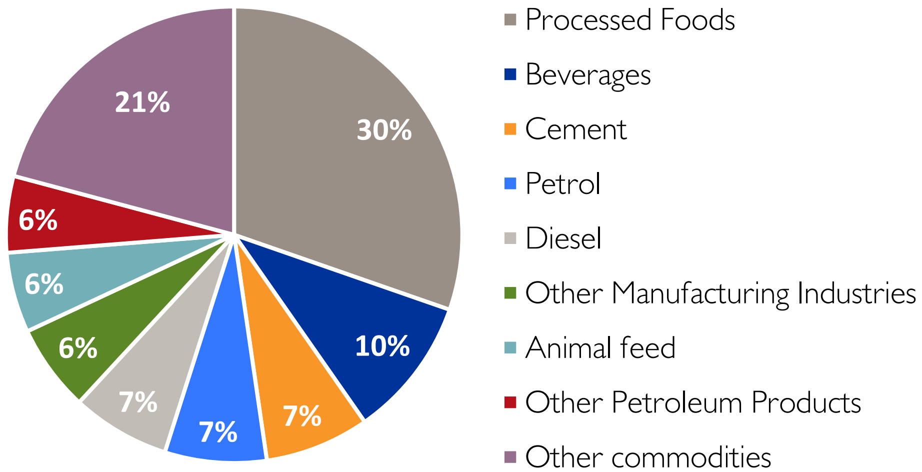


Figure 2: Manufacturing commodities with origin Western Cape (intra-provincial and outgoing, 2019)

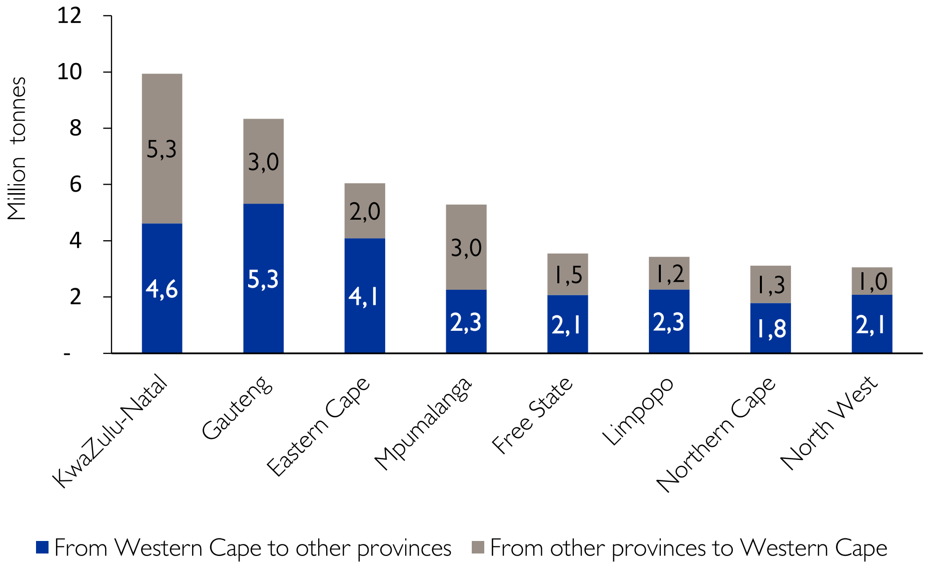


Figure 3: Western Cape inter-provincial GFB freight (2019)

Highlights

- The Western Cape GFB freight (65 million tonnes) is split between intra Western Cape freight (21.3 million tonnes), freight transported to other provinces (25.0 million tonnes) and freight received from other provinces (18.5million tonnes).
- Waste is an intra-provincial flow only and amounts to 2.8 million tonnes (13% of intra-provincial flow).
- Almost half (48.6 %) of intra-Western Cape freight and 78.7% of freight to other provinces are manufacturing commodities, amounting to 30.0 million tonnes.
- The largest commodity group in the Western Cape's manufacturing sector, is processed foods (31.3%), followed by beverages (10.1%).
- KwaZulu-Natal is the Western Cape's main GFB trading partner, followed closely by Gauteng.

In order to determine corridor freight on the N1, N2 and N7, the magisterial 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); and
5. Metropolitan (a combination of the Cape Town Metropolitan area and its peripheral areas).

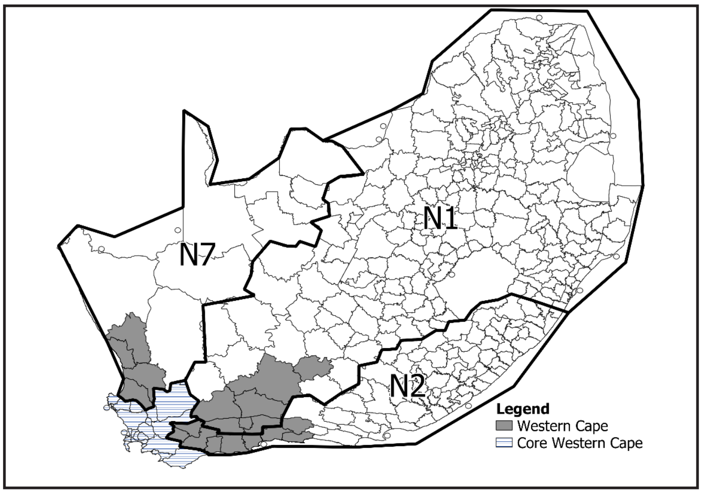


Figure 1: Corridor definitions for Western Cape freight

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.

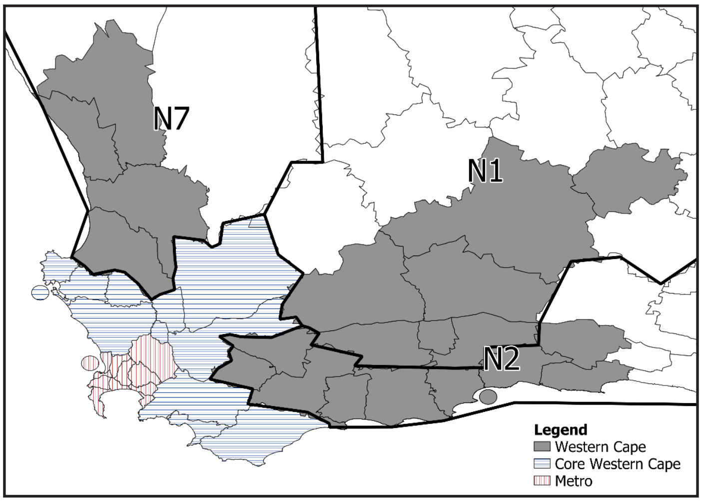


Figure 2: OD pairs for Cape Town Metropolitan freight

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.

Table 1 provides the volumes and percentage split of the General Freight Business (GFB)[1] road and rail freight per zone.

Table 1: GFB road and rail freight (tonnes) per zone (2019)

Zonal Grouping	Road tonnes (million) (% of zone freight)	Rail tonnes (million) (% of zone freight)	Total (million)
N1 Corridor traffic	28.6 (97.8%)	0.6 (2.2%)	29,3
N2 Corridor traffic	8.2 (98.4%)	0.1 (1.6%)	8,4
N7 Corridor traffic	3.3 (76.8%)	1.0 (23.2%)	4,3
Metropolitan traffic	7.8 (97.9%)	0.2 (2.1%)	7,9
Core Western Cape	5.9 (91.5%)	0.6 (8.5%)	6,5
Non-corridor traffic	8.6 (98.6%)	0.1 (1.4%)	8,7
Total	**62.4 (96%)**	**2.6 (4%)**	**65**

The 4.3 million tonnes of N7 corridor freight include what is deemed "ring-fenced" freight, that is, freight that is usually part of a specific ring-fenced system that is not impacted by provincial-level strategic interventions. In the Western Cape's case, the majority of the GFB rail freight on the N7 is transported on the Iron Ore Export Line. Even though the export line follows the N7 quite closely, it cannot really be regarded as GFB for which road can compete.

[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.

The ring-fenced freight has been removed from Table 2. The very low contribution of rail to N1 freight, which is a very long corridor, is an issue of great concern that needs to be resolved.

Table 2: GFB (excluding domestic iron ore and coal) road and rail freight (tonnes) per zone (2019)

Zonal Grouping	Road tonnes (million) (% of zone freight)	Rail tonnes (million) (% of zone freight)	Total (million)
N1 Corridor traffic	27.9 (98.6%)	0.4 (1.4%)	28.3
N2 Corridor traffic	8.2 (98.4%)	0.1 (1.6%)	8.4
N7 Corridor traffic	3.3 (78.3%)	0.9 (21.7%)	4.2
Metropolitan traffic	7.8 (97.9%)	0.2 (2.1%)	7.9
Core Western Cape	5.5 (90.9%)	0.6 (9.1%)	6.1
Non-corridor traffic	8.2 (98.6%)	0.1 (1.4%)	8.3
Total	**60.9 (96.4%)**	**2.3 (3.6%)**	**63.2**

Table 3 shows the tonne-km per zone.

Table 3: GFB (excluding domestic iron ore and coal) road and rail freight (tonne-km) per zone (2019)

Zonal Grouping	Road tonne-kms (billion) (% of zone freight)	Rail tonne-kms (billion) (% of zone freight)	Total tonne-kms (billion)
N1 Corridor traffic	38.8 (98.6%)	0.5 (1.4%)	39.3
N2 Corridor traffic	5.4 (98.8%)	0.06 (1.2%)	5.5
N7 Corridor traffic	1.3 (77.3%)	0.4 (22.7%)	1.7
Metropolitan traffic	0.2 (95.1%)	0.011 (4.9%)	0.2
Core Western Cape	0.4 (88.6%)	0.06 (11.4%)	0.5
Non-corridor traffic	9.4 (98.9%)	0.1 (1.1%)	9.5
Total	**55.6 (98%)**	**1.2 (2%)**	**56.8**

The tonne-kilometre view confirms a slightly smaller rail market share, indicating that longer distance freight is transported by road. This means that a long-distance market exists that can potentially benefit from rail's economies of scale, given that rail operators can provide a competitive service.

Table 4 shows the breakdown of road freight per corridor. Note that 45.8% of Western Cape road freight travels on the N1 road corridor, with an average distance travelled of 1 383 km, a slight decrease from 2018.

Table 4: Freight intensity per zone (2019)

Zonal Grouping	Road tonnes (million)	Percentage on route
N1 Corridor traffic	27.9	45.8%
N2 Corridor traffic	8.2	13.5%
N7 Corridor traffic	3.3	5.4%
Metropolitan traffic	7.8	12.7%
Core Western Cape	5.5	9.1%
Non-corridor traffic	8.2	13.5%
Total	**60.9**	**100.0%**

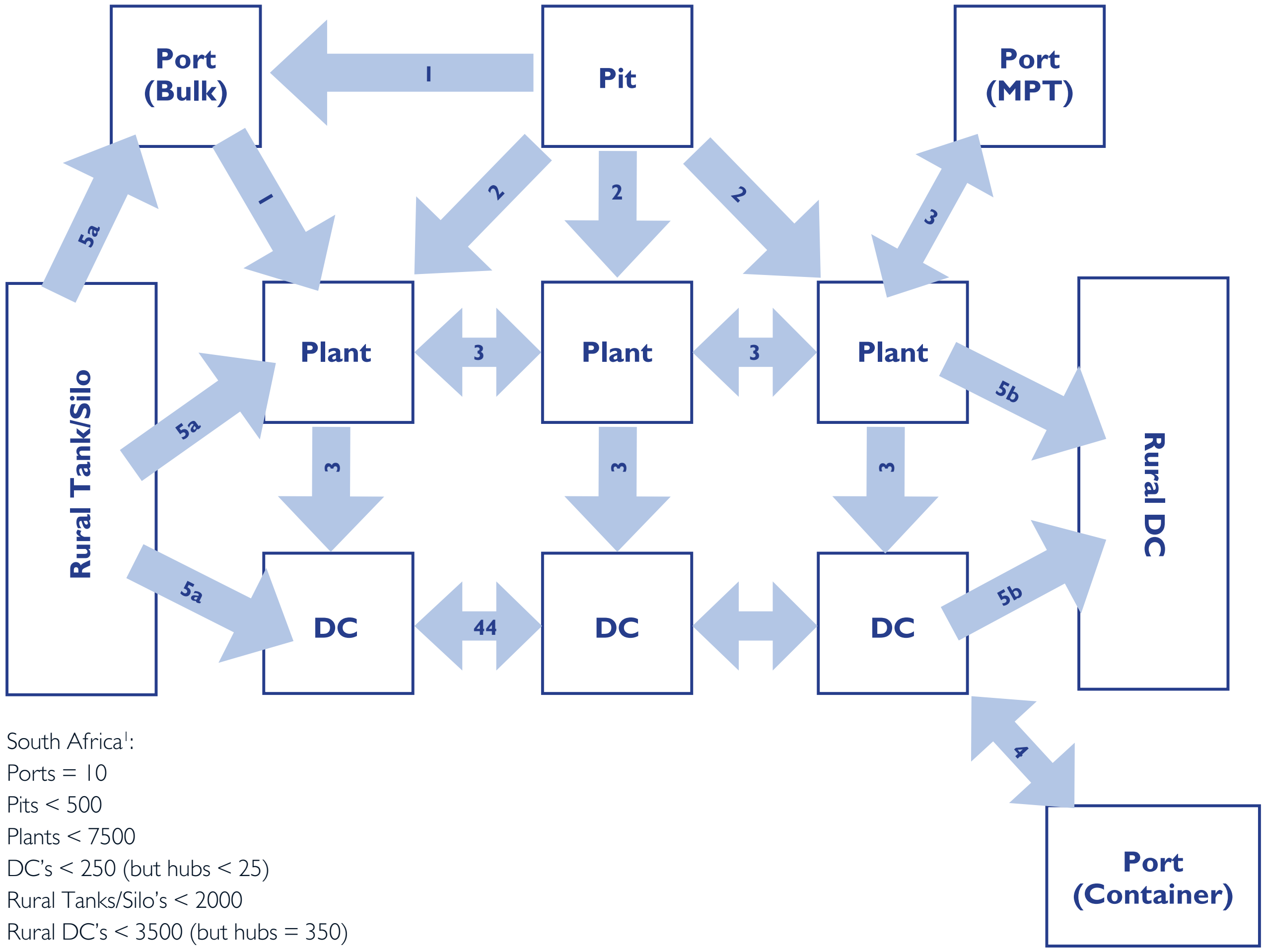
Highlights

- **Rail** has a **3.6%** tonnage **market share** of non-ring-fenced total Western Cape road and rail freight. In terms of tonne-kilometres, this is a decrease from 3.1% in 2018 to 2.0% in 2019.
- Corridor freight is dominated by **road**, with: **98.6% market share** on the **N1 corridor**; **98.4% market share** on the **N2 corridor** and **78.3% market share** on the **N7 corridor**.
- The average travel distance of freight on the N1, N2 and N7 is 1 383 km, 606 km and 416 km, respectively.
- **Modal shift opportunities** exist for long- distance road freight in the Western Cape.

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 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 distribution centre.



South Africa[1]:
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 flows[2]

As depicted in Figure 2, these segments can be summarised in terms of 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 35% of the Western Cape's total transportation cost. Eighty-two percent of the 18% of extraction to exports refers to the handling of iron ore and manganese exports in Saldanha. Beneficiation thereof

[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, Vol. 16 No. 1, pp. 1-21.

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.

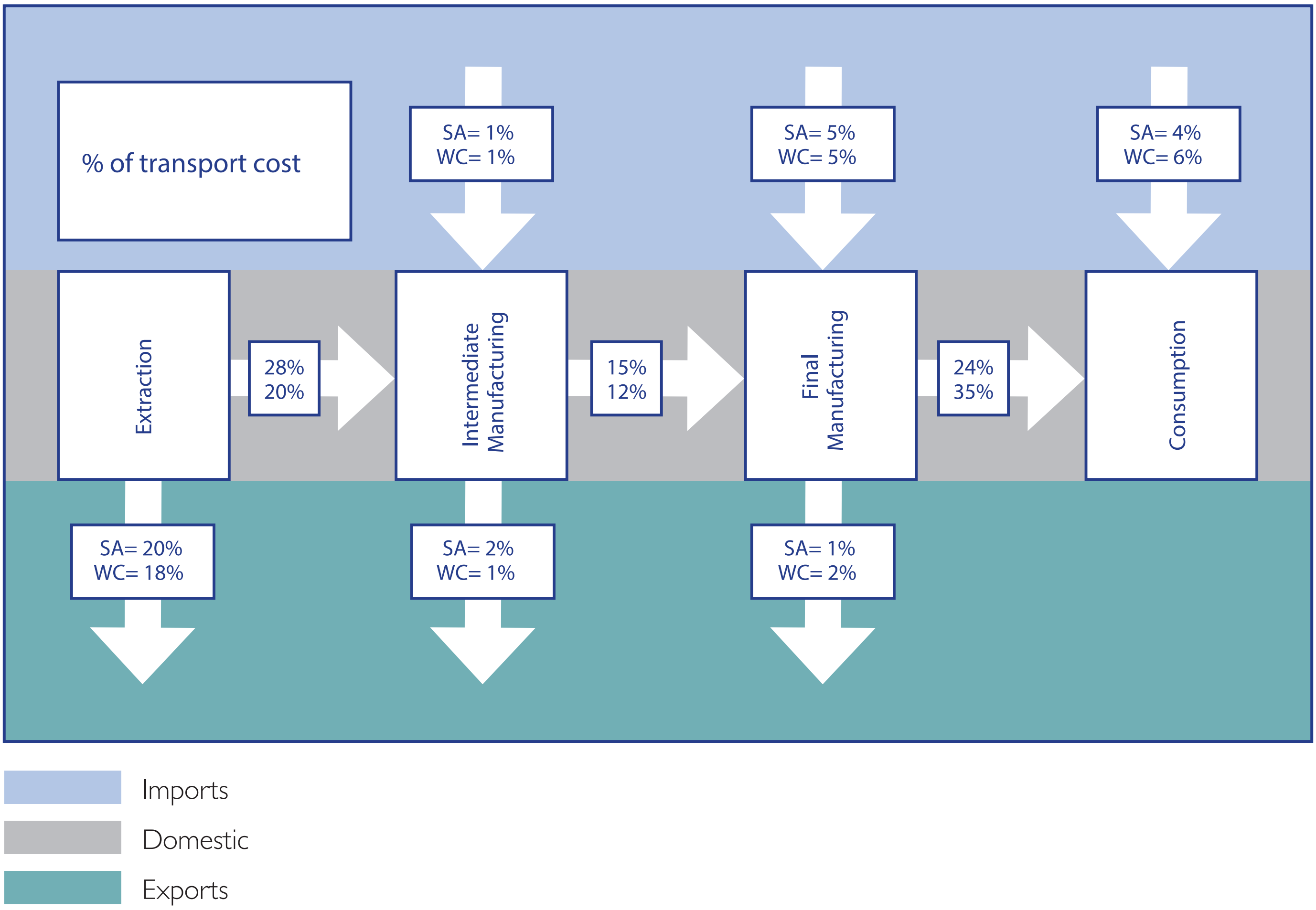


Figure 2: National and Western Cape transport cost per freight flow segment (2019)[2]

Western Cape freight flows informed by economic structure

An analysis of the 2019 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 Figure 3). The data highlights two specific opportunities for rail. 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 into disuse and have large maintenance backlogs. The revival of branch lines are on Transnet's strategic agenda, but progress is slow[4].

The other opportunity is palletisable and containerisable FMCG freight. This 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 owing to the impact on transport costs. The modal shift scenarios identify cost savings, should rail be able to realise these opportunities (see section on "Scenario 1: Modal Shift").

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[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] Transnet's branch lines are reported to comprise approximately 35% (3 928km) of its 20 911 route km network. Only 54% of these branch lines are reported to be active. Transnet. (2020), 'Freight Rail 2020', available at: https://www.transnet.net/InvestorRelations/AR2020/Freight%20Rail.pdf (accessed 30 April 2021).

GAIN GROUP Insight drives growth

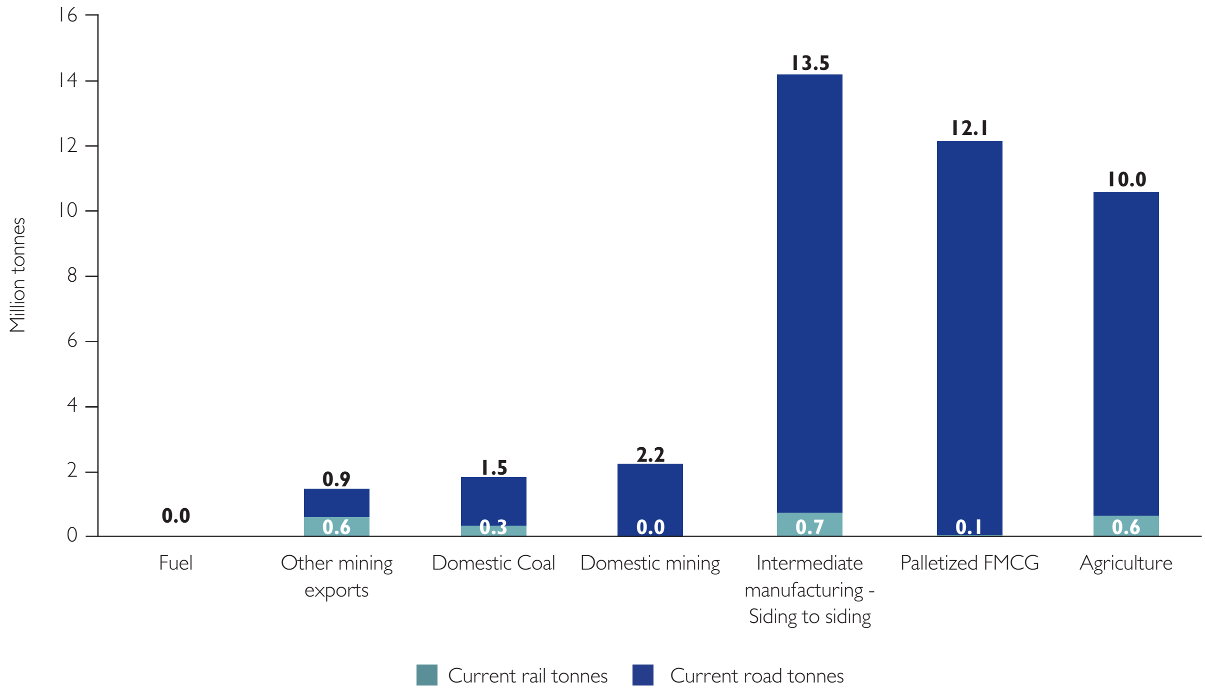


Figure 3: GFB road and rail tonnes per market segment in the Western Cape for 2019

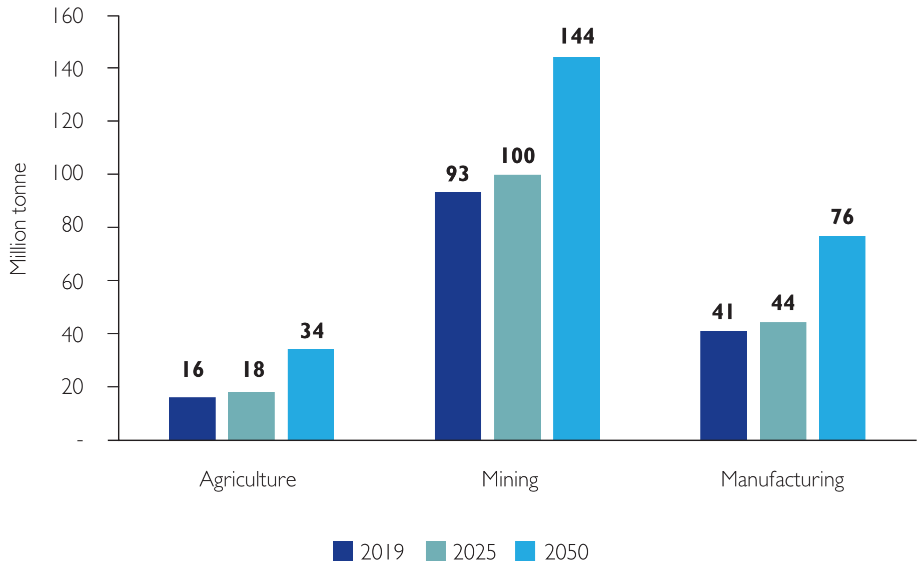
Highlights

- 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 palletisable and containerisable freight, which can be transported through domestic intermodal solutions from private distribution centres through public intermodal terminals.
- The inability of the railway to develop these solutions collaboratively with road to capture the long-distance FMCG freight impacts transport costs, and hence hampers the competitiveness of industries in the Western Cape.

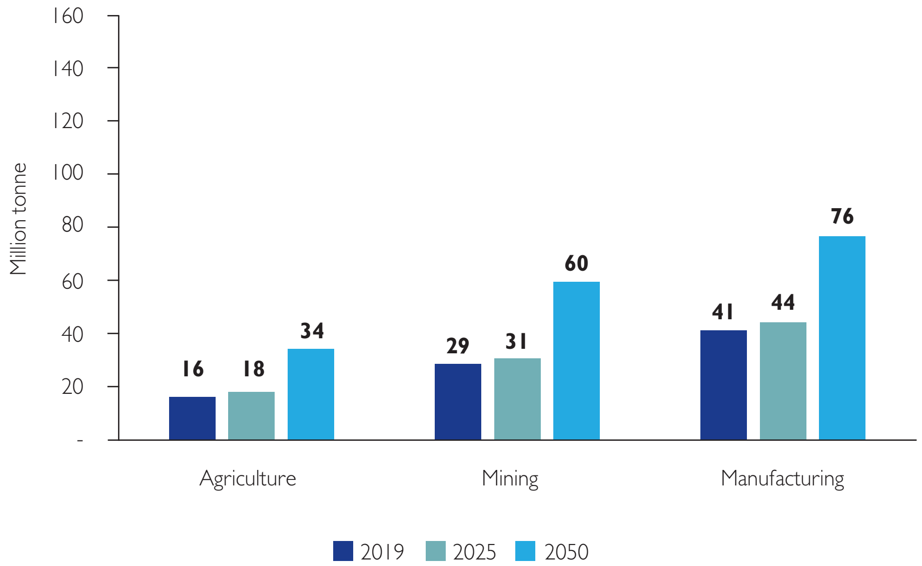
Economic forecast[1]

The WCFDM considered 2025 and 2050 as the forecast years in the analysis. The total tonnes forecast per sector for 2025 and 2050 are given in Figure 1, both with and without the iron ore and manganese export.

This latest long term economic forecast, includes the impact of COVID-19 and results in a more pessimistic view of manufacturing in the long term. Social and economic factors are also believed to be more challenging than before due to the longer term impact of COVID-19.



(a) Total Western Cape

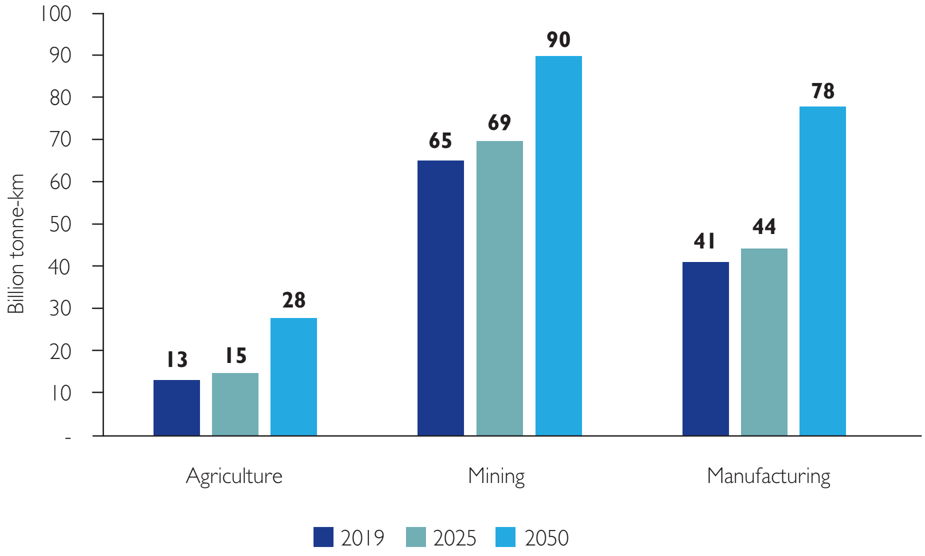


(b) Excluding export iron ore and manganese

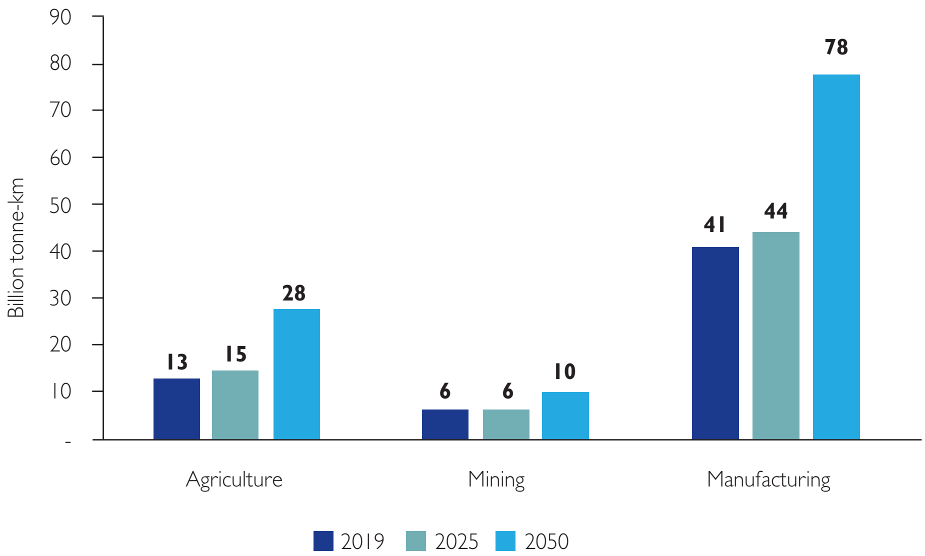
Figure 1: Total Western Cape freight flow forecast per sector (tonnes 2019)

The forecast for mining, when considering GFB, is pre- dominantly driven by sand mining on the West Coast, which is very short-haul and specific. This is evident from Figure 2, which shows that the manufacturing tonne-kms currently far exceed the mining tonne-kms when the export lines are excluded.

As evidenced by Figure 2, manufacturing commodities for the Western Cape are transported over long distances. The forecast also illustrates that there is a ceiling on the export lines[2]. 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) Excluding export iron ore and manganese

Figure 2: Total Western Cape freight flow forecast per sector (tonne-km 2019)

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.

[1] The forecasting work took place during COVID-19 and therefore includes the impact of COVID -19 on the economy in the WCFDM.

[2] Anglo American, estimated a 14-year reserve life for Sishen in its 2018 global reserves report (Anglo American, 2018).

Freight transport cost

The freight transport cost model forms part of the national logistics cost model, which was developed by the research team to quantify the direct[1] 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 economy[2]. For the refinement of the WCFDM, actual road freight transport rates were confidentially received from Logistics Service Providers (LSP) 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 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]. The freight owner incurs road cost by utilising in-house road transport.	Estimated using a well-researched algorithm. (Even the railway service providersfind it difficult to apply activity-based rail costing. Thisis a global phenomenon, due to the very high fixed cost nature of rail business). In-house rail transport is notpossible.
Tariffs	Estimated through fieldwork and interviews in order toadd margins to costs. The freight owner incurs road tariffs by outsourcing road transport.	Precisely available for all consignments in South Africa,but confidential at the detail level. The freight owner incurs railtariffs 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, Vol. 78 No. 4, pp. 460-478.

[3] Data from the Road Freight Association provides detailed fixed and variable cost drivers for the different vehicle classes used in the WCFDM.

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 Transnet[4]. 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 2019 (see Figure 2).

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

Table 2: Cost drivers for road freight transport for 2019

Cost driver	Description
Fuel	The price of fuel is based on the weighted average annual price for 2019, taking cognisance of the different inland and coastal prices, for 500 parts per million (ppm) diesel. Bulk rebates are ignored.
Driver's wage	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.
Repairs and maintenance	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. Premiums are currently set at 7% of the purchase price for vehicles, equipment, and trailers.
Tyres	Tyre life is based on the typical casing life that is obtained in the various operations.
Toll roads	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 licences	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[6].

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

[5] This is based on a confidential interviews.

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

In 2019, road freight transport accounted for 84% of the total estimated freight transportation cost. The main cost drivers were fuel (R20.1 billion; 33.5% of total cost), maintenance and repairs (R9.9 billion), and driver wages (R6.3 billion)[7]. These costs are shown in Figure 1 and Table 3.

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 (see the sections on externality cost).

[7] The model, as was stated, includes actual rail and pipeline tariffs (pipeline tariffs are not shown on the graph, as they are negligible — only 0.02% of total transport costs in the Western Cape).

Highlights

- In 2019, road freight transport accounted for 84% of the total transportation cost.
- The main road freight transport cost drivers were fuel (R20.1 billion; 33.5% of total cost), maintenance and repairs (R9.9 billion) and driver wages (R6.3 billion).
- 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 benefits.

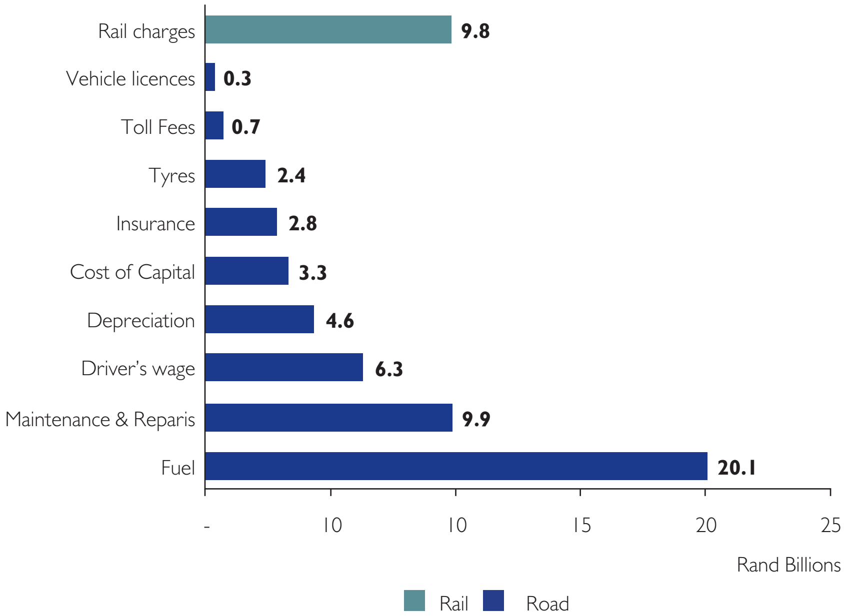


Figure 1: Transport cost components per mode for Western Cape freight (2019)

Table 3: Transport cost drivers

Cost driver	Cost (R bn)	% of total
Fuel	20.1	33.5%
Maintenance and Repairs	9.9	16.5%
Driver's wage	6.3	10.5%
Depreciation	4.3	7.2%
Cost of Capital	3.3	5.5%
Insurance	2.8	48%
Tyres	2.4	3.9%
Toll Fees	0.7	1.2%
Vehicle licences	0.3	0.6%
Rail charges	9.8	16.4%
Total	**59.9**	

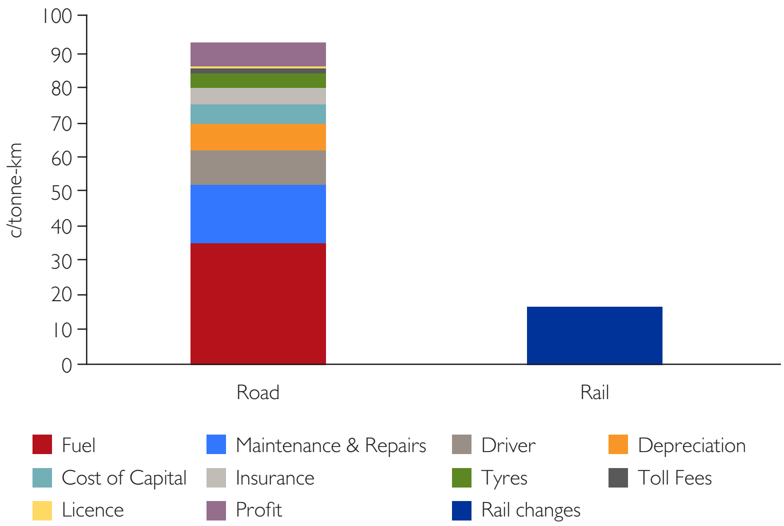


Figure 2: Transport cost in c/tonne-km per mode for Western Cape freight (2019)

Externality cost

The total estimated CO_2 emissions for South Africa are 428 million tonnes[1], of which approximately 26 million tonnes are for freight. In order to have a holistic view of transportation cost, externalities such as emissions need to be taken into account. The externality components are the costs associated with accidents, congestion, emission, 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 model[2] that can be used to estimate these costs. The rates are summarised in Table 1 and are based on the latest available 2018 values.

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

	Road	Rail
Accidents	4.79	0.41
Congestion	2.95	
Emissions	8.97	1.21
Landway	0.87	0.08
Noise	3.24	0.03
Policing	2.29	

Emissions costs include not only CO_2 gasses, but all emissions that are produced by burning fuel. The emissions produced per litre of burnt diesel are given in Table 2.

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

Acronyms[3]	NO_x	PM metro	PM rural*	HC	CO	CO_2**	SO_2
Grams produced, per litre 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

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

	NO_x	PM metro	PM rural*	HC	CO	CO_2**	SO_2
Road tonne-km	0.71	0.03	0.03	0.02	0.11	72.41	0.34
Rail tonne-km (electric)						28.34	
Rail tonne-km (diesel)	0.42	0.02	0.02	0.01	0.06	42.96	0.2
Rail tonne-km (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 CO^2 emissions for South Africa, a cost of R225 per tonne of CO^2 is assumed for 2010, in line with the proposals of the South African National Treasury (2010) and McCarl and Sands (2007)*

[1] https://www.iea.org/data-andstatistics/?country=SOUTHAFRIC&fuel=CO2%20emissions&indicator=Total%20CO2%20emissions

[2] For a detailed methodology of the externality costs model, refer:

Swarts, S., King, D., Simpson, Z., Havenga, J., and Goedhals-Gerber, L. (2012), 'Calculation of freight externality costs for South Africa, *Journal of Transport and Supply Chain Management*, Vol. 4 No. 1 and

Havenga, J.H. (2015), 'Macro-logistics and externality cost trends in South Africa – Underscoring the sustainability imperative', *International Journal of Logistics Research and Applications*, Vol. 18 No. 2, pp. 118–139, https://doi.org/10.1080/13675567.2015.1015509.

[3] Acronyms: **NOx**=Nitrogen oxides; **PM metro**=Particulate matter metro; **PM rural** = Particulate matter rural; **HC**= Hydro Carbons; **CO**= Carbon Monoxide; **CO_2**=Carbon dioxide; **SO_2** =Sulphur dioxide

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.

The total externality costs for road freight transport in the Western Cape amount to R13.42 billion, which is 26.6% of current direct road freight transport costs[4]. Road freight transport contributes 93% of the total freight transport externality costs of R14.46 billion.

The four largest road freight transport externality cost drivers, namely, emissions, accidents, noise and congestion, contribute 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 or next to noisy roads, or commuters travelling on congested routes. Furthermore, tax payers fund the clearing of accidents 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 rail[5].

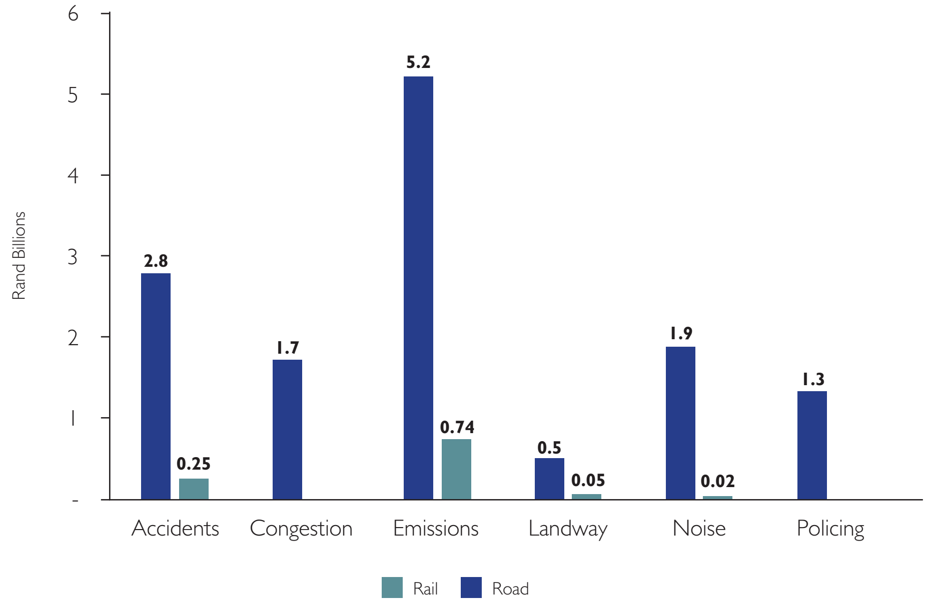


Figure 1: Externality costs for Western Cape freight

Externality cost driver	Road Cost Rbn *(% of driver cost)*	Rail Cost Rbn *(% of driver cost)*	Total Cost Rbn *(% of total)*
Emissions	5.21 (88%)	0.74 (12%)	5.94 (41%)
Accidents	2.78 (92%)	0.25 (8%)	3.03 (21%)
Noise	1.88 (99%)	0.02 (1%)	1.90 (13%)
Congestion	1.71 (100%)	-	1.71 (12%)
Policing	1.33 (100%)	-	1.33 (9%)
Landway	0.50 (91%)	0.05 (9%)	0.55 (4%)
Total	13.42 (93%)	1.05 (7%)	14.47

Table 4: Externality costs for Western Cape freight

Highlights

- The total externality for road freight transport in the Western Cape amounts to R13.42 billion, which is 26.6% of current road freight transport costs.
- Road freight transport contributes 93% of the total freight transport externality cost of R14.47 billion.
- The four largest road freight transport externality cost drivers, namely emissions, accidents, noise and congestion contribute 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.

[4] That is if externality cost is internalised within the road transport cost, it will increase by 26.6%: total direct road cost of R50.3bn plus the R13.42bn total externality cost for road.

[5] Refer to Havenga, J.H. and Simpson, Z.P. (2016), 'Freight logistics' contribution to sustainability: Systemic measurement facilitates behavioural change', Transportation Research Part D: Transport and Environment, Vol. 58. pp. 320-331, https://doi.org/10.1016/j.trd.2016.08.035 for a case study on the internalisation of national externality costs

Scenarios

The WCFDM 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.

Modal shift scenarios

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. To calculate the potential opportunity cost, at current prices, of a shift of freight from road to rail, 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. That is, what is the potential for modal shift, given each of the three baselines.

Assumptions

- Assuming 2019 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 2019 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, N2 and N7, as well as for short distance freight transported locally in the Core Western Cape region.

Results

The modal shift scenario results are depicted in Table 1 to Table 4.

N1 corridor

The key opportunities for modal shift on the N1 corridor are in the siding-to-siding and palletised FMCG segments. The volumes that could be shifted are depicted in Figure 1[1].

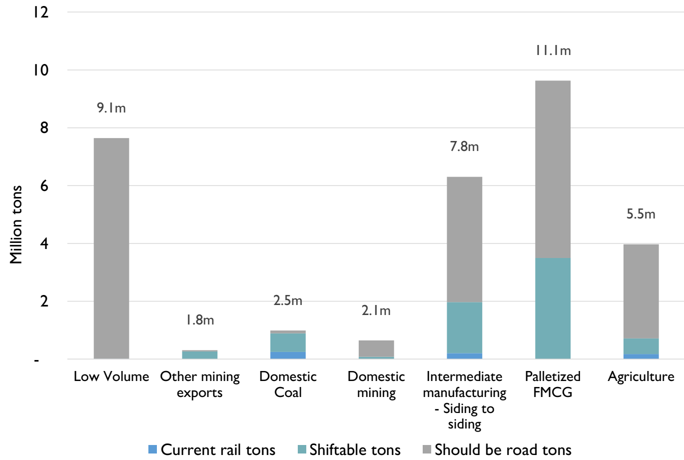


Figure 1: Modal shift opportunity per segment on the N1

Transport costs on the N1 corridor for these segments are currently at a 14.5% premium, compared to costs under a scenario in which all shiftable freight was transported by rail (see Table 1). If rail volumes remain stagnant up to 2050 this premium will be 12.7%.

Table 1: 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)
2019 - Current market share	33.0	14.5%	4.17	354.6
2025 - Stagnant rail volumes	35.3	13.9%	4.31	375.0
2025 - Constant market share	35.3	14.0%	4.34	374.8
2025 - Growth market share	30.8		-	
2049 - Stagnant rail volumes	62.5	12.7%	7.05	649.8
2048 - Constant market share	62.4	12.5%	6.96	636.9
2048 - Growth market share	55.0		-	-

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 depicted in Figure 2.

[1] For this analysis, which focuses on modal shift to rail, the segments in Figure 1 to Figure 4 are sorted according to rail's suitability (including density and number of OD pairs)

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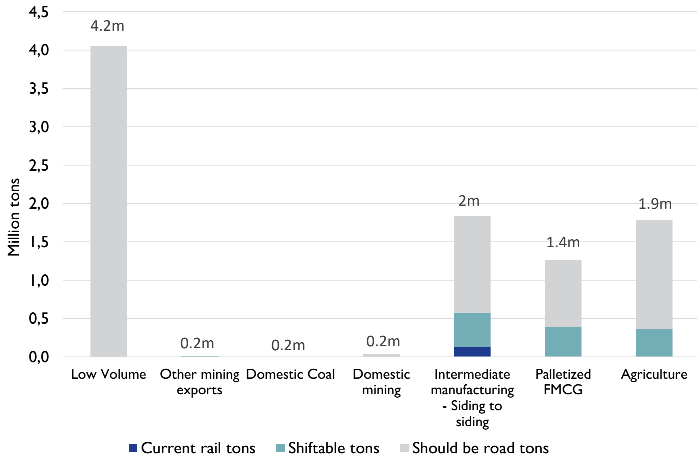

Figure 2: Modal shift opportunity per segment on the N2

Transport costs on the N2 corridor across all segments are currently 5.9% higher than they would be if all shiftable tonnes were transported by rail (see Table 2). If rail volumes remain stagnant this will be 5.4% by 2050.

Table 2: 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)
2019 - Current market share	4.9	5.9%	0.28	31.6
2025 - Stagnant rail volumes	5.6	6.4%	0.34	37.6
2025 - Constant market share	5.6	6.2%	0.33	36.6
2025 - Growth market share	5.3		-	
2050 - Stagnant rail volumes	5.5	5.4%	0.46	56.3
2050 - Constant market share	5.5	5.3%	0.45	55.6
2050 - Growth market share	5.0		-	-

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 depicted in Figure 3.

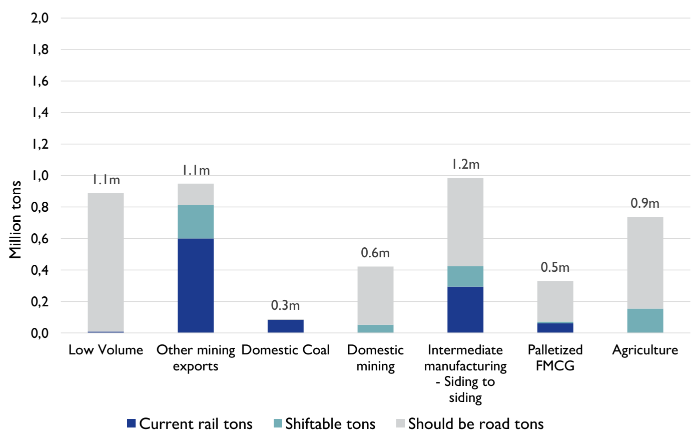

Figure 3: Modal shift opportunity per segment on the N7

Transport costs on the N7 corridor are currently 17.9% higher than they would be if all shiftable tonnes were transported by rail (see Table 3). If rail volumes remain stagnant this will increase to 28.3%, by 2050. If rail market share remains constant this will increase to 13.9%.

Table 3: 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)
2019 - Current market share	1.7	13.0%	0.20	8.4
2025 - Stagnant rail volumes	2.1	19.0%	0.34	13.5
2025 - Constant market share	2.1	15.3%	0.27	11.5
2025 - Growth market share	1.8		-	
2050 - Stagnant rail volumes	4.2	28.3%	0.94	35.4
2050 - Constant market share	3.8	13.9%	0.46	18.2
2050 - Growth market share	3.3		-	-

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 depicted in Figure 4. Due to the low freight transport distances and density outside metro areas, road is currently more competitive for certain commodities than rail in segments such as agriculture and intermediate manufacturing.

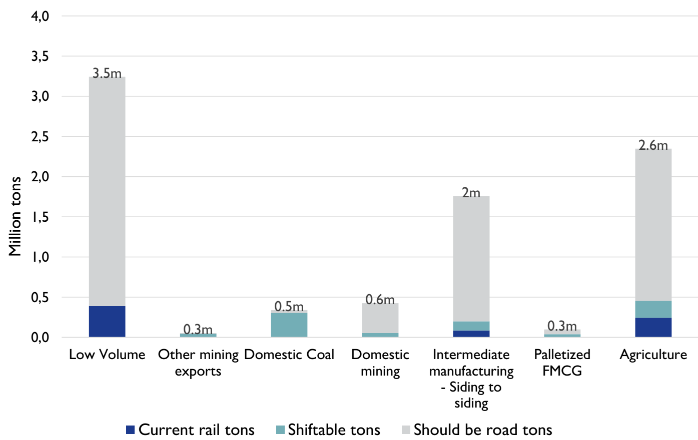

Figure 4: Modal shift opportunity per segment for Western Cape core traffic

Transport costs for the Core Western Cape across all segments are currently 4.0% higher in the absence of modal shift (see Table 4). By 2050 if rail market share remains stagnant this is will be 3.2%, given that rail rates remain relatively high. This is due to the growth in the freight flows in which road is more competitive.

Table 4: Cost and emission savings potential due to modal shift in 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)
2019 - Current market share	0.70	4.0%	0.03	2.1
2025 - Stagnant rail volumes	0.74	2.5%	0.02	2.0
2025 - Constant market share	0.74	2.5%	0.02	2.0
2025 - Growth market share	0.73			
2050 - Stagnant rail volumes	1.45	3.2%	0.05	4.4
2050 - Constant market share	1.43	3.1%	0.05	4.1
2050 - Growth market share	1.41			

Summary

In 2019 the total transportation bill for freight touching the Western Cape was R59.9bn. The combined effect of the modal shift on the three corridors and core Western Cape traffic would have been a reduction of R4.67 billion or 7.8% in transport costs for the Western Cape (the 2019 market share data in the tables above)[2].

Table 5: Summary - cost and emission savings potential due to modal shift in the Western Cape

Freight traffic zone	Shift saving 2018 (Rbn)	% saving on total Western Cape transport bill	CO_2 emission reduction (000' tonnes)
N1	4.17	7.0 %	354.6
N2	0.28	0.5 %	31.6
N7	0.20	0.3 %	8.4
Core Western Cape	0.03	0.1 %	2.1
Total	4.67	7.8%	396.7

Highlights

- As rail traffic becomes dense, it becomes more efficient.
- An estimated 7.8% of the Western Cape's total freight transportation cost could be saved through modal shift at current rail tariffs.
- At current rail volumes, road is more competitive within the WC Core area.
- The largest modal shift opportunity is for the N1 corridor freight. This could potentially save 7.0% of total transport cost.

[2] These results refer to the transport cost saving. Additional investments can be included in a high-level business case.

Western Cape Government

Transport and Public Works

Western Cape Freight Demand Model (WCFDM)
Scenario 2: High Cube Containers

Scenarios

The WCFDM 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.

High Cube Container Scenario

The legal vehicle height stipulated by the South African National Road Traffic Act is 4.3 metres, according to Regulation 224 of the NRTA Regulations. In South Africa the standard flat deck trailer fleet used, combined with the international standard high cube container results in 4.5 metres, breaching this limit. High cube containers could be transported on low-bed trailers which would bring the combined height of the container and trailer to within the 4.3 metres, but that would require trailers to be replaced for this purpose. A new design is required which was not considered for these scenarios.

The financial implications of changing vehicle configurations and the transportation risk of an adjusted legal height limitation, have become important considerations in the conversation between industry and government on Regulation 224.

Most (90%) of South African export fruit is with refrigerated (reefer) containers, in the various sizes of 20 foot (6m), 40 foot (12m), and 40 foot high cube (12m).

Normal **High cube**

The primary difference between a 40ft standard height container and a 40ft high cube container is the difference in height of exactly one foot. This is advantageous for transporting commodities with a low density, as the container will be filled before the regulated axle load can be exceeded.

Three possible transport cost scenarios were considered for the transport of fruit:

1. Allowing high cube containers on flat-deck trailers with current configuration, thereby exempting vehicles transporting high cube containers from complying with current regulations.
2. The legal height restriction is not amended, nor exemption granted, nor is the trailer fleet replaced and industry reverts to standard containers.
3. The legal height restriction is not amended, and industry adapts vehicle fleet to comply.

Results:

1. Regulation 224 gets amended to allow for the transportation of high cube containers on standard deck trailers. This will result in no changes to transport costs.
2. The legal height restriction is not amended, nor exemption granted, nor trailer fleet is replaced, and industry reverts to standard containers

   The additional height gives the high cube container an extra 14.6% of storage capacity. Replacing high cube containers with standard containers, would require more containers for the same freight volume due to the lower container volume available. It was assumed that replacing high cube containers with standard containers would require 14.6% more trips for the same freight.

Table 1 provides a conservative estimate assuming all freight can simply be transferred to standard containers and simply require more trips.

Table 1: Assumptions for industry reverting to standard containers (per year)

Tonne-km of export fruit (deemed high cubes)	1.4 million tonnes
Current transport costs of this freight	R 575 million
Increase in trips	14.6 %
Increase in transport costs due to decrease in transport efficiency	5.3 %
Estimated increase in costs	R119 million

Total transportation bill for freight touching the Western Cape is R60.1bn	
Increase in total transport costs for Western Cape due to high cube restrictions	0.2 %

3. Industry adapts vehicle fleet to comply

   Sufficient information could not be obtained of what it would cost industry to adapt. The complexities for the freight transport industry include truck trailers, road infrastructure, and supply chain equipment. Costs for transporters and facility locations could be very high, and this would require proper in-depth investigation to determine adaptation costs. Cost of vehicles that comply to the height limit with high cube containers on, are costly and their prices vary significantly.

Highlights

1. Exempting vehicles transporting high cube containers from complying with current regulations - This causes no change in costs.
2. Industry reverts to standard containers - This causes a 0.2% (R119 million) increase in costs for fruit exports due to more trips for the same freight.
3. Industry adapts vehicle fleet to comply - This will have definite cost implications, which currently cannot be fully estimated. This includes costs of depots adjusting to handle differ height trucks, as well as trucks being modified or replaced with newer trucks.

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Cape Town Container Terminal

The Cape Town Container Terminal suffers from congestion problems related to inter alia its location in the already-congested Cape Town metropole, as well as the impact of gale-force winds in summer on its operations. The location and surrounding geography of the City of Cape Town, combined with its connectivity to national corridors, makes the city prone to congestion. In 2019 Cape Town was estimated to be the 101st most congested city in the world as drivers lost 154 hours stuck in traffic with an extra 20 minutes spent driving per 30 minute trip in rush hour[1]. Access to the city is limited to only a few routes, with congestion challenges. This congestion spills over into the port, causing longer staging and turnaround times for trucks, which compounds the congestion. Apart from the congestion on land, high wind speeds can cause the container terminal to stop operating and make it unsafe for vessels to enter the port. Wind speeds of 65 km/h are sufficient to delay loading or offloading of containers. In 2019 there were 402 three-hour periods where wind speeds greater or equal to 18m/s were recorded at the port of Cape Town, which could translate into 1206 hours of lost productivity.

Saldanha as a container terminal

A potential solution to the congestion at the port, both on land and past the quay wall, is to move the container terminal operations from the Port of Cape Town to Saldanha. A scenario was developed to quantify the transportation cost implications of such a shift based on 2019 data. It is assumed that all import and export containers that are handled at the Port of Cape Town, will be handled at Saldanha.

Shifting the Cape Town Container Terminal to Saldanha will increase the transport distances for 91% of domestic container freight, with only 9% of freight (predominantly citrus exports from Citrusdal) closer to Saldanha than Cape Town port.

The average distance increase for freight to use the proposed Saldanha terminal is 40km. The distance-related savings for Citrusdal citrus is offset by the increased costs of citrus from more distant regions such as Robertson, Swellendam and Paarl. Overall, citrus would therefore incur increased transport costs.

Deciduous fruit transport costs is most adversely affected due to the much longer distances travelled from Caledon and Ceres to Saldanha, while grapes is the second-worst affected commodity, incurring roughly double the current transport costs to Saldanha from regions such as Worcester and Paarl.

On aggregate, transport cost of containerised import and export freight will increase by roughly 10.1% or R805 million. The break-down per commodity can be seen in Figure 1.

It is further estimated that non-shifted, bulk freight will achieve reduced transport costs of approximately 4% due to the reduced congestion at the Cape Town Container Terminal. This reduced transport cost is achieved by increased efficiency of vehicles able to travel more kilometers. Alternatively stated, vehicles will be able to make more trips from a warehouse than before. While license fees, wages, depreciation, and capital cost remain the same; therefore, resulting in a reduced rate per tonne-km. This increase in efficiency

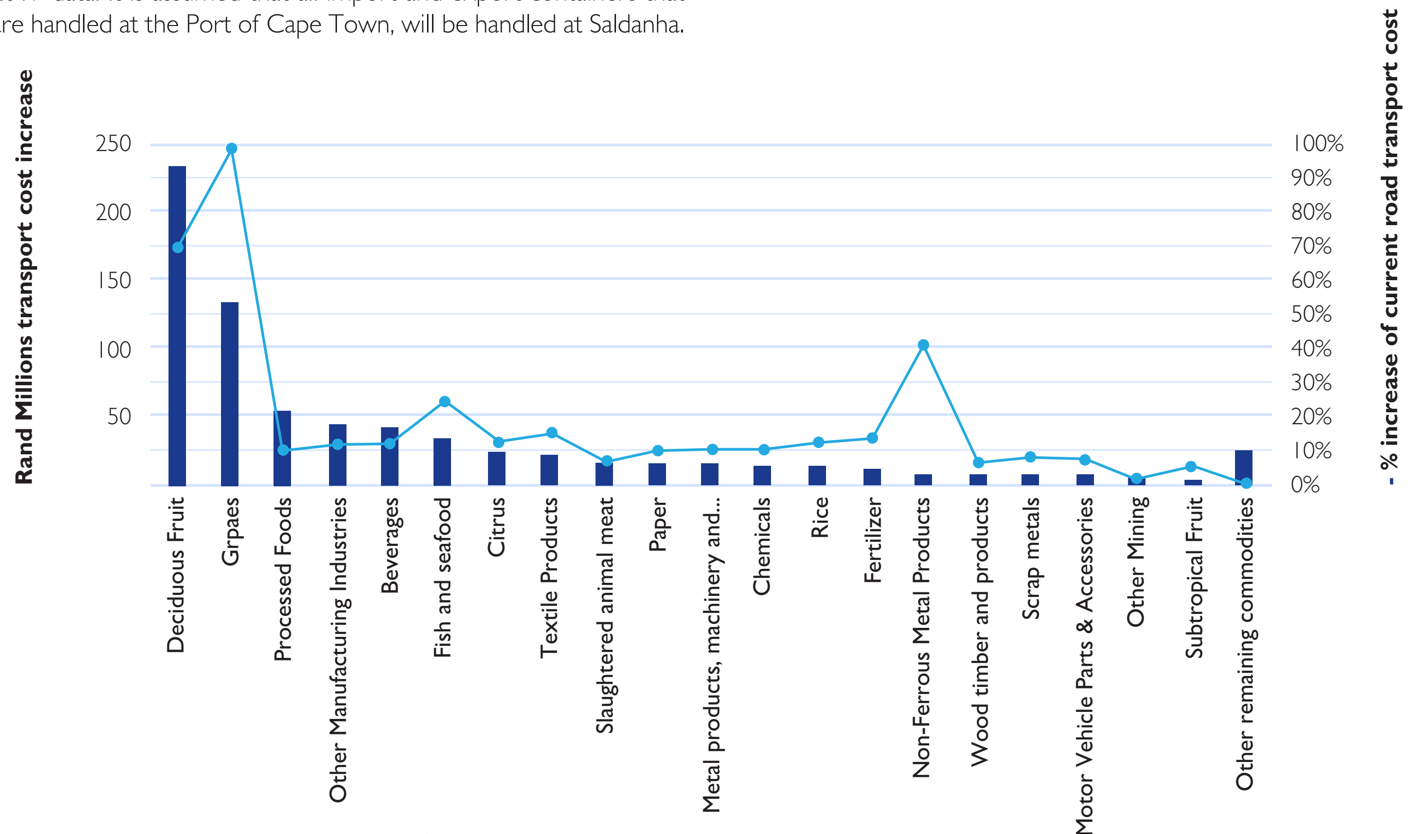


Figure 1: Increased transportation costs of containerised commodities.

[1] 2019 TomTom Traffic index, Cape Town Traffic, [online] https://www.tomtom.com/en_gb/traffic-index/cape-town-traffic.

[2] Windguru Cape Town – Table Bay Harbour, [online] https://www.windguru.cz/32831.

can reduce the transport costs of non containerised import and export bulk freight by R127 million, and transport cost for general metro freight by R57 million.

If the Cape Town Container Terminal operations were moved to Saldanha in 2019, it would have resulted in an estimated net transport cost increase of R621 million. This is just for landside costs considering transport and congestion costs of vehicles, which excludes potential seaside savings (costs due to the delay of ships waiting to enter the Port).

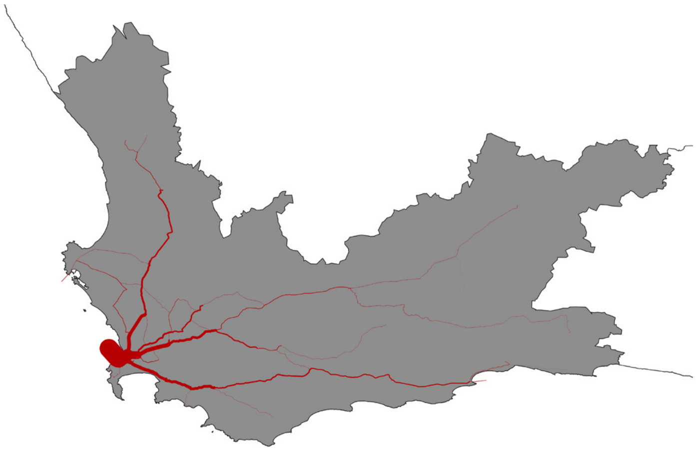


Figure 2: Current Intra-Western Cape freight to and from the Port of Cape Town.

A comparison between Figure 2 and Figure 3 shows the shift in flows based on 2019 volumes if all container operations at the Port of Cape Town was moved to the Port of Saldanha. This results in longer travelling distances pointing to the increase in transportation cost across most containerised freight.

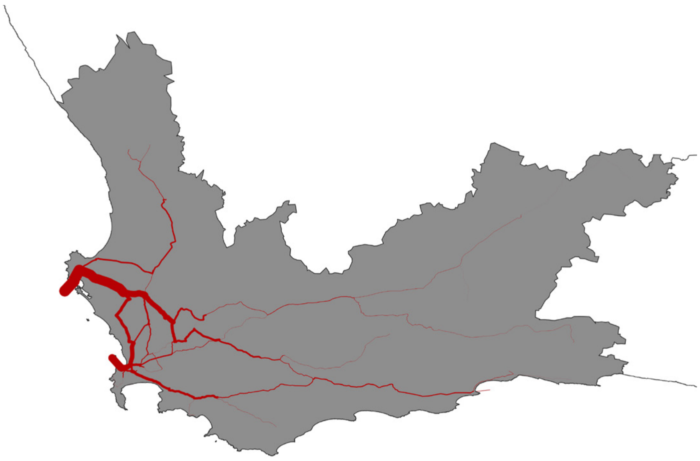


Figure 3: Intra-Western Cape freight flows after container terminal operations are moved to Saldanha.

Further analysis was conducted to evaluate if a freight consolidation center close to the Cape metro (i.e. closer to the origin of the key containerised commodities in Figure 1) would positively or negatively affect the transportation cost associated with terminal operations at Saldanha. It was assumed that an intermodal facility in Kraaifontein (hereafter referred to as Kraaicon) could serve such a purpose and would be a fully operational intermodal facility to facilitate the movement of containers via rail to Saldanha. A container will only be transported via Kraaicon if the current transportation cost to or from Saldanha is more than the transportation cost via Kraaicon. As no rail tariffs currently exist for Kraaicon a range of comparable tariffs for varying levels of density were compared to assess the feasibility of such a solution. It was further assumed that an additional R600 handling cost per tonne would be added to the transportation cost incurred for any containers being transported via Kraaicon to Saldanha due to freight consolidation.

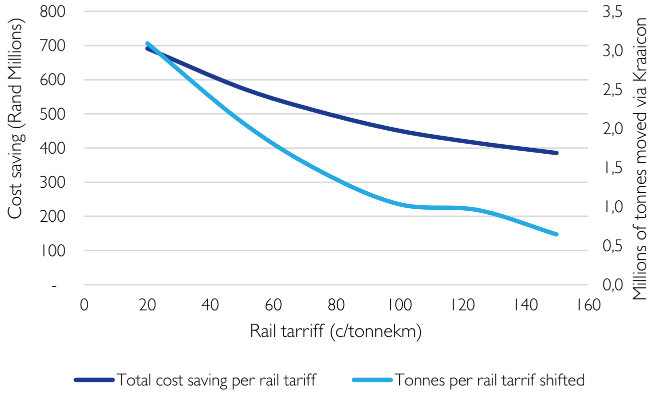


Figure 4: Kraaicon cost saving if all Port of Cape Town container traffic is handled at the port of Saldanha as a baseline.

Figure 4 shows the estimated transportation cost saving of using Kraaicon against the baseline of all containers being handled at Saldanha, as well as the total tonnes in containers that could be transported via Kraaicon at a lower overall transportation cost. The resultant flows can be seen in Figure 5.

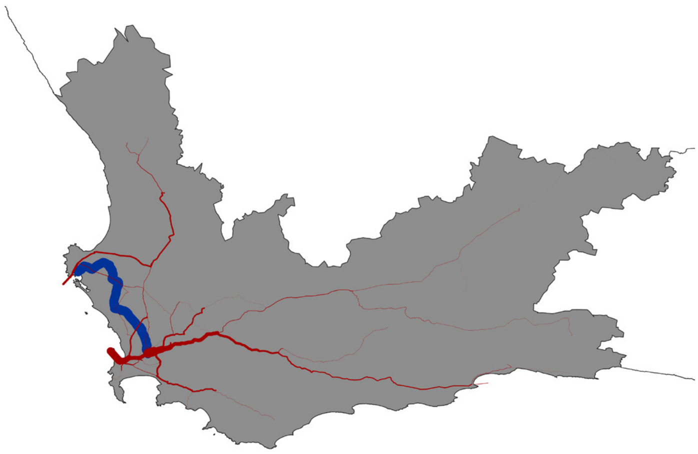


Figure 5: Intra-Western Cape flows where container traffic is moved via Kraaicon (as a potential container consolidation centre) to Saldanha at 50c/tonne-km.

At a rail rate of 50c per tonne-km, consolidating containers at Kraaicon has a potential to attract 2 million tonnes (42%) of the container freight which need to be transported to Saldanha under the shift scenario. This would result in a R578 million transport cost saving relative to transporting the containers directly to Saldanha on road.

The consolidation cost saving should however be brought into perspective against the baseline of using Cape Town compared to Saldanha which led to a R805 million transportation cost increase. Moving container operations to Saldanha via Kraaicon at 50c/tonne-km therefore results in a increase of R229 million transportation cost for containerized traffic compared to the current Cape Town Container Terminal operations. When combined with the bulk and metro transport cost saving, the net transportation cost increase for intra-Western Cape freight if the Cape Town container terminal operations are moved to Saldanha via consolidation at Kraaicon would be R45 million.

Highlights

- Proposed shift to saldanha to mitigate congestion can reduce the transport costs of non containerised import and export bulk freight by R127 million, and transport cost for general metro freight by R57 million.
- Most affected commodity for such a relocation would be deciduous fruit and grapes.
- On aggregate, transport cost of containerised import and export freight will increase by roughly 10.1% or R805 million.
- Consolidating containers at Kraaicon has a potential to attract 2 million tonnes (42%) of the container freight, which would result in a net total increase of only R45 million transport cost, if a rail tariff of 50c per tonne-km is achieved.

COVID-19 and the related lockdown have had an unprecedented impact on the South African economy. To highlight this, StatsSA[1] quoted the following: "this is the biggest annual fall in economic activity the country has seen since at least 1946".

In South Africa both mining and manufacturing experienced a severe decline in 2020, largely due to the hard lockdown in Q2 as well as the initial restriction on trade movements crossing land borders and through ports. Agriculture was seemingly unaffected by COVID-19 as it was declared an essential sector that was allowed to keep operating unimpeded, combined with good rainfall leading to bumper harvests across numerous agricultural commodities.

The impact of COVID-19 bore some resemblance to the impact of the Great Recession of 2008/09, but only when considering the impact from the high of 2006 to the low of 2009 in GDP terms. For a more in-depth sectoral focus, manufacturing value of sales declined by 20% (in inflation-adjusted terms) whilst production volumes declined around 14%[2]. From the historic information analysed, manufacturing sales as well as some of the manufacturing sub-industries (such as textiles and iron and steel products) never recovered to their 2008 levels[3].

The Western Cape Provincial Economic Review & Outlook gave a forecast during 2020, for the economy to contract by nearly 7.0% in 2020, with a more severe impact on the mining and manufacturing sectors than the national figures. However, agriculture in the Western Cape is forecasted to perform better than the national average.

Table 1: Western Cape regional GDP and major sectors growth (2017 to 2021[f])

Year	Agriculture	Mining	Manufacturing[4]	Services[5]	GDP
2017	10.8%	1.7%	-0.0%	1.1%	**1.2%**
2018	-7.9%	-1.9%	0.9%	1.2%	**0.8%**
2019	-9.9%	-1.5%	-0.6%	1.0%	**0.4%**
2020[f]	18.3%	-25.1%	-15.4%	-6.3%	**-6.9%**
2021[f]	-7.2%	14.4%	9.3%	3.4%	**3.8%**
Average Weighting (2017-2021[f])	*3.7%*	*0.2%*	*14.8%*	*81.3%*	***100.0%***

Source: StatsSA[6], 2021 and Western Cape PERO 2020[7] (forecast years indicated by[f])

The forecasted contraction in agriculture in 2021 is attributable not only to the normalising of crop production in 2021, but also to the lagged impact of the notable contraction in the manufacturing sector in 2020.

Covid's impact was not only a demand side issue, i.e., contraction in mining and manufacturing that reduced the demand for transport services (albeit the demand for agricultural transport increased) but also uncovered important supply side issues, i.e., the way in which transport is supplied during times of crisis. It would have been expected that relative transport costs for when transport is required should decline, due to lower demand and decreased congestion (in this case the removal of a passenger fleet had a profound effect in the relative ease of movement of vehicles that were allowed to move).

Lack of clarity or uncertainty around the classification of essential and non-essential goods caused massive uncertainty, increasing the bullwhip effect[8] at a time the economy couldn't afford it and made it difficult for transporters to provide an efficient and effective service. Free flow traffic conditions was one of the few positive side-effects of lockdown. This could have been exploited but suffered from stoppages at roadblocks where overly bureaucratic processes, uneven application of confusing regulations and in some cases law enforcement errors and poor communication caused long delays, adding to transport costs.

Although the Western Cape has no direct borders with neighbouring countries, freight destined for and originating in the Western Cape were severely compromised at border posts by long delays and an impossible administrative burden. The situation became so bad that truck drivers died whilst in these queues[9]. At ports, initially, items classified as "non-essential" clogged up an already compromised port system.

Transport equipment, such as empty containers were often in the wrong place at the wrong time with huge costs incurred for repositioning or unavailability.

During the middle of the hard lockdown about half of purely domestic freight were considered essential and for total freight (including exports and imports) about one third of freight moved by truck in South Africa were considered to be essential. Not considering bulk export lines, about one quarter of seaport freight were considered essential. These conditions caused a significant revenue loss for transporters that could have been better if these conditions did not exist.

[1] Statistics South Africa, GDP: Quantifying SA's economic performance in 2020
[2] P3041.2 - Manufacturing: Production and sales, January 2021
[3] P3041.2 - Manufacturing: Production and sales, January 2021, inflation-adjusted using CPI
[4] Including "Electricity, gas and water"
[5] Including "Taxes less subsidies on products"
[6] Statistics South Africa, P0441 - Gross Domestic Product (GDP), 4th Quarter 2020
[7] Western Cape Provincial Economic Review & Outlook 2020, Table 2.5 adapted
[8] Inventory fluctuations or inefficient asset allocation as a result of transport supply changes
[9] https://www.news24.com/news24/southafrica/news/4-truck-drivers-have-died-while-queuing-at-the-beitbridge-border-post-rfa-20201224

Western Cape Freight Demand Model (WCFDM)
Waste data gathering and analysis process

Waste Overview

The WCFDM freight flows are derived from economic activity, specifically activities that contribute to the transportable GDP[1]. Although waste does not contribute to the GDP, it still needs to be transported and disposed of. This results in additional transportation costs that must be accounted for.

Waste is generated during the extraction and manufacturing activities, as well as after the final consumption of goods. A portion of the transportable GDP will end up in landfill.

The WCFDM waste data is a combination of reported WC Department of Environmental Affairs and Development Planning (DEA&DP) and City of Cape Town waste data. The major waste streams are displayed on the right.

The City of Cape Town (CoCT) is the largest waste generating area in the Province and is responsible for 76% of the Province's municipal waste handling of 1.6m tonnes in 2019.

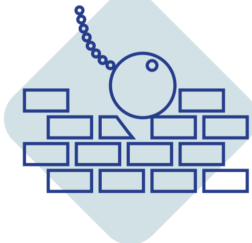
The data processing methodology for the three largest waste streams for the CoCT are discussed below.

1. GW01 – Municipal waste

Figure 1 shows the approximate catchment areas for each waste facility within the City of Cape Town Municipality and Figure 2 the waste collection and transfer process.

GW[2]01 Municipal waste
(also including GW99 other waste)

W20 Organic or garden waste



GW30 Construction and demolition waste

[1] The transportable GDP consists of the extraction of raw materials and manufacturing, also referred to as the primary and secondary economic sectors, respectively.

[2] GW = General waste

Figure 1: Catchment areas for the various refuse transfer stations and landfills in the CoCT Municipality.

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 WCFDM, waste OD flows were generated based on the intersection of each WCFDM 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.

2. GW30 – Construction and demolition waste

Figure 3 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 4.

3. GW20.01: Garden waste

There are various flows of organic waste. This waste has the same catchment as municipal waste. Some of it ends up in landfills (this is already included in municipal waste, sometimes separated as GW20.02 "food waste"). Most of this waste is GW20.01 (garden waste) that is separated at source (e.g. 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, and transports all the garden waste to its composting site just outside Paarl.

4. Provincial waste

Apart from the CoCT, there are 24 other municipalities within the Western Cape that are served by 61[3] waste facilities that reported handling Municipal, Garden and Construction and Demolition Waste. The same methodology that was used for the City of Cape Town Municipal waste assignments to WCFDM districts was applied to the rest of the Province.

[3] The increase from 60 (as stated in 2018 WC FDM report) to 61 is due a refinement based on more detailed data, and not due to a new/additional facility.

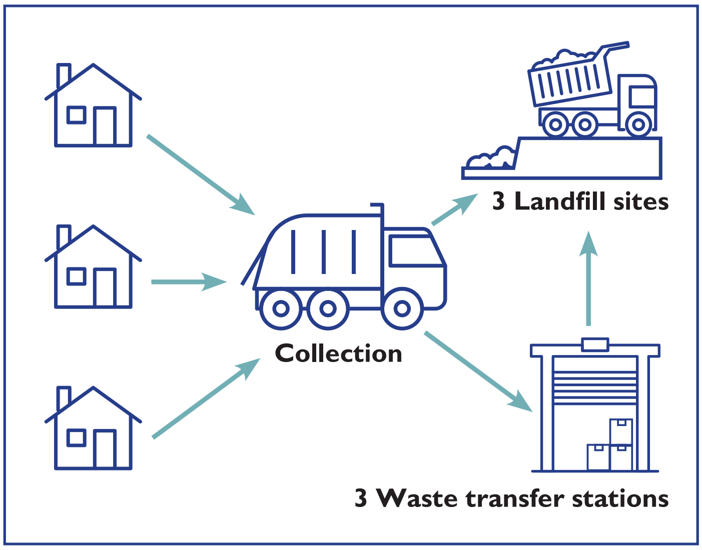


Figure 2: The waste collection and transfer process

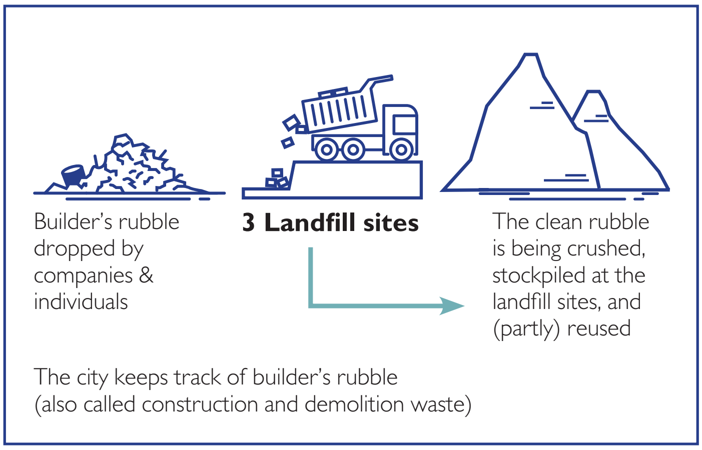


Figure 3: GW30 – Construction and demolition waste.

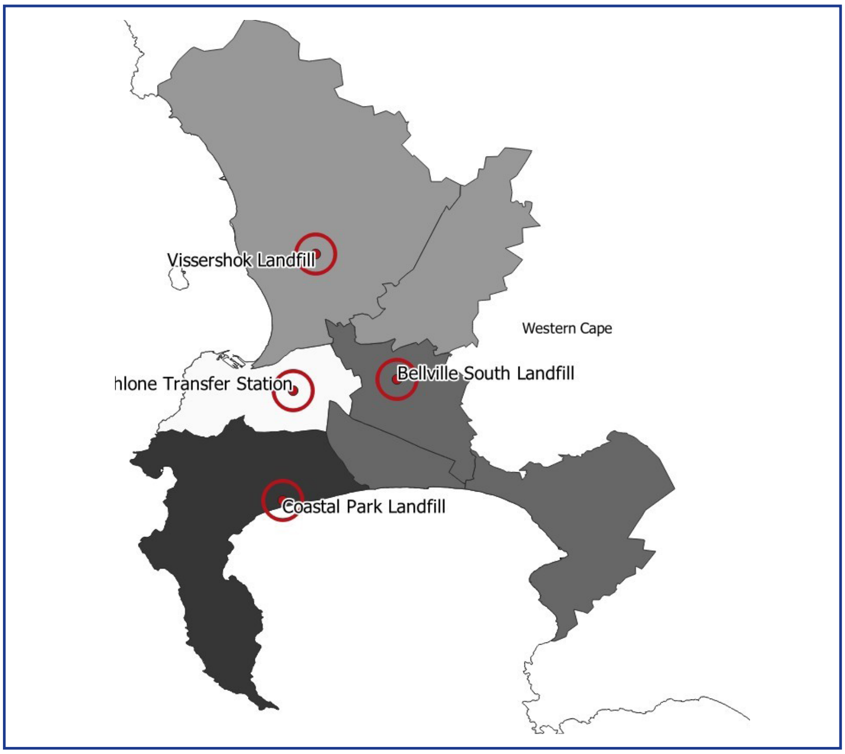


Figure 4: Catchment areas of industrial builder's rubble flow dropped off directly at landfill sites. This can come from anywhere in Cape Town, and it could go to any of the 3 landfill sites where it is stockpiled.

Western Cape Government

Transport and Public Works

Western Cape Freight Demand Model (WCFDM)
Detail on "Other manufacturing industries" and the grouping "Other commodities"

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 (2019)

Commodity	Million tonnes 2019	Percentage contribution
Processed Foods	9.09	30.3%
Beverages	2.99	10.0%
Cement	2.22	7.4%
Petrol	2.16	7.2%
Diesel	2.09	7.0%
Other Manufacturing Industries	1.85	6.2%
Animal feed	1.71	5.7%
Other Petroleum Products	1.62	5.4%
Other commodities:		
Bricks	1.21	4.0%
Iron & Steel	1.01	3.4%
Slaughtered animal meat	0.48	1.6%
Metal products, machinery and electronic equipment	0.44	1.5%
Fertilizer	0.37	1.2%
Textile Products	0.35	1.2%
Paper	0.34	1.1%
Wood timber and products	0.31	1.0%
Chemicals	0.30	1.0%
Scrap metals	0.27	0.9%
Gas	0.23	0.8%
Pharmaceutical Products	0.19	0.6%
Soya bean products	0.15	0.5%
Non-Ferrous Metal Products	0.15	0.5%
Recycled paper	0.14	0.5%
Jet fuel	0.13	0.4%
Printing and Publishing	0.09	0.3%
Motor Vehicle Parts & Accessories	0.06	0.2%
Transport Equipment	0.02	0.1%
Pulp of wood and paper	0.01	0.0%
Motor vehicles and trucks	0.003	0.0%
Tobacco Products	0.001	0.0%
	29.99	100.0%

Other manufacturing industries consist of manufactured goods that can be classified by the following (HS2) 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.

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