Confidential

Going beyond the Infrastructure Funding Gap: A South African Perspective

Transport Sector Report

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Acronyms

ABS	Antilock braking systems
AUC	African Union Commission
BAC	Blood alcohol content
BASA	Bilateral air service agreement
BAU	Business-as-usual
BRT	Bus rapid transit
CBRTA	Cross Border Road Transport Agency
CO2	Carbon dioxide
CoGTA	Department of Cooperative Governance and Traditional Affairs
COVID-19	Coronavirus disease 2019
CRG	Constrained, rationalised, gravel surface
CRS	Constrained, rationalised, sealed surface
CSIR	Council for Scientific and Industrial Research
CUG	Constrained, unrationalised, gravel surface
CUS	Constrained, unrationalised, sealed surface
DBSA	Development Bank of Southern Africa
DCT	Durban Container Terminal
DMRE	Department of Mineral Resources and Energy
DoT	Department of Transport
DPE	Department of Public Enterprises
DPME	Department of Planning, Monitoring and Evaluation
ERT	Expanded rapid transit
FIFA	International Federation of Association Football
FSNC	Full-service network carrier
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GOE	Gigawatt-hours of energy
GoSA	Government of South Africa
GPRS	General Packet Radio Service
GRA	Global Roadmap of Action Toward Sustainable Mobility
CSIR	Council for Scientific and Industrial Research
GSM	Global Sustainable Mobility
GTF	Global Tracking Framework
GTS	Green Transport Strategy
HDM-4	Highway Development and Management Model 4
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
IEA	International Energy Agency
iRAP	International Road Assessment Programme
IRF	International Road Federation
IPTN	Integrated public transport network
IRPTN	Integrated rapid public transport network

IRT	Improved rapid transit
ITDP	Institute for Transport and Development Policy
ITF	International Transport Forum
LCC	Low cost carrier
LPI	Logistics Performance Index
LSCI	Liner shipping connectivity index
LUT	Land-use and transport planning
NATCOR	Natal Container Corridor
NATMAP	National Transport Master Plan
NLTA	National Land Transport Act
NLTTA	National Land Transition Transport Act
NMT	Non-motorized transport
NPC	National Planning Commission
NT	National Treasury
O&M	Operations and maintenance
PAP	Prototype Action Plan
PBC	Performance-based contract
PM2.5	Particulate matter 2.5
PPP	Public-private partnership
PRASA	Passenger Rail Agency of South Africa
PRE	Provincial Regulatory Entity
PTNG	Public Transport Operating Grant
RAI	Rural Access Index
RAMS	Road Asset Management System
RBT	Random breath testing
ReCAP	Research for Community Access Partnership
RTMC	Road Traffic Management Corporation
RTR	Rapid Transit to Resident Ratio
SAA	South African Airways
SAATM	Single African Air Transport Market
SADC	Southern African Development Community
SAMSA	South African Maritime Safety Authority
SANRAL	South African National Roads Agency Ltd
SDG	Sustainable Development Goal
SEP	Strategic equity partner
SOE	State-owned enterprise
SSA	Sub-Saharan Africa
SuM4All	Sustainable Mobility for All
Stats SA	Statistics South Africa
TFR	Transnet Freight Rail
TNPA	Transnet National Ports Authority
TPT	Transnet Port Terminals
TRSA	Taxi Recapitalisation South Africa
UMIC	Upper-middle income country

UA	Unconstrained access
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
UNECE	United Nations Economic Commission for Europe
TNPA	Transnet National Ports Authority
TEU	Twenty Foot Equivalent Units
WB	World Bank
WHO	World Health Organization
YD	Yamoussoukro Decision

Executive Summary

South Africa is committed to the attainment of the Sustainable Development Goals (SDGs), the Paris Climate Agreement, and the African Union's Agenda 2063 (African Union Commission 2013) to achieve a prosperous society based on inclusive growth and sustainable development. This ambition is embodied in the National Development Plan: Vision 2030 (NPC 2012) which is the country's blueprint for economic growth and development. A key focus of South Africa's commitment is to tackle vulnerabilities in the transport and mobility system. This reflects the research which has shown a clear correlation between countries' progress on the SDGs and the quality of their transport systems. But progress is hampered by the fact that whilst most sectors can rely on the SDGs framework to set country goals to be achieved by 2030, the transport sector does not have dedicated SDGs.

Sustainable Mobility for All (SuM4All) is an advocacy platform established in 2017 and hosted by the World Bank for international cooperation on transport and mobility issues. As part of its work, SuM4All has developed a Global Tracking Framework for Transport (GTF) (SuM4All 2020b) that provides a comprehensive framework to diagnose transport and mobility issues based on data and evidence. Drawing on the GTF data, SuM4All has developed the Global Sustainable Mobility (GSM) Index score that allows for a ranking of 183 countries in terms of their aggregate performance in universal access, efficiency, safety, and green mobility—the four policy goals that define sustainable mobility. Using the GSM Index, in 2022 South Africa was ranked in the 88th position relative to 183 countries. This ranking places South Africa third amongst Sub-Saharan African countries—behind only the Small Island Developing States of Mauritius and Seychelles.

Against this background, the Development Bank of Southern Africa (DBSA) has partnered with the World Bank to advance the debate on the priority policy actions and infrastructure funding needs to progress towards the attainment of the SDGs in South Africa. This study has three objectives:

i. Assess the performance of South Africa's transport system in delivering sustainable mobility as defined by four policy goals: universal access, efficiency, safety, and green mobility;

ii. Estimate the infrastructure funding needs for reducing the universal access and safety gaps between 2022 and 2030 under different scenarios; and

iii. Identify and propose a coherent set of policies from the SuM4All Catalogue of Policy Measures (SuM4All 2022) that could improve the performance of South Africa's transport system in delivering sustainable mobility.

The Methodology

Conceptually, "sustainable mobility" is framed around the achievement of four global policy goals: Universal Access, Efficiency, Safety and Green mobility**.** This vision recognizes that transport generates private and socio-economic benefits (access to opportunities), as well as negative externalities (e.g., traffic fatalities, greenhouse gas (GHG) emissions, air, and noise pollution). The methodology is inspired by the World Bank's *Beyond the Gap* report (Rozenberg & Fay 2019) and adapted to reflect the innovative approach developed by the SuM4All partnership. It combines the power of data and comparative analysis to diagnose transport and mobility issues, through the power of scenario analyses and global policy knowledge*,* to lay out a menu of policy options, which are then further refined through country-level analysis and engagement to select the most impactful policy measures to achieve sustainable mobility.

The analytical framework consists of the following steps:

a. *Identify objectives* – to measure the performance of a country's transport system against the four global policy goals that define sustainable mobility;

b. Identify metrics to measure transport system performance – by using the Global Tracking Framework for Transport, the Global Sustainable Mobility composite scores, and new metrics developed for this study to compile a wide-scope diagnostic of the country's transport system, and identify areas of strength and weakness through sustainability gaps measured in terms of differences between the country's performances and relevant peers' performances on each of the four policy goals[1];

c. *Produce a priority-oriented country action plan* – to identify possible options to close the gaps, generating a prototype action plan (PAP) as the empirical basis to conduct an in-depth policy-by-policy analysis;

d. *Identify exogenous factors* – to take into account uncertainties that can influence the cost and success of investments; and

e. *Estimate the cost and impact of policies to reduce the biggest gap areas for the country as identified by the diagnostic* – by undertaking a high-level estimation of the total costs, including capital and

[1] Regional Peers include all Sub-Saharan African countries; income group peers include all upper middle-income countries – see annex D for list of income group peers used for benchmarking in this paper.

operations and maintenance, of selected infrastructure measures to close that gap, to highlight the trade-offs that policy makers face when choosing among different policies.

The Findings

Universal Access

The universal access goal is intended to capture the ambition that transport connects all people and communities to economic and social opportunities, taking into account the needs of diverse groups, including the poor, those in vulnerable situations, including women, children, the elderly, and persons with disabilities, across geographical locations. The attainment of SDG target 11.2[2], by focusing on urban access, and SDG target 9.1[3], by focusing on rural access, should be the main targets to facilitate the attainment of the universal access objective. While both SDGs acknowledge that transport should "leave no one behind," there is no internationally quantified target for these objectives.

Urban Access

The key findings pertaining to urban access are:

- ***South Africa has an urban access gap of 92%, based on the length of the rapid transit lines per million people.***
- ***Since most South African households use minibus taxis as their means of transport, measures to improve accessibility should also address the quality of service provided by informal modes of transport.***
- ***Affordability of transportation is a major impediment to job seeking and income generation amongst the lowest income households.***
- ***The decline in quality of service of public transport has had important impacts on quality of life, affecting the poorest the most.***
- ***Access to opportunities and amenities is largely dictated by where people live and the transport services that they can access.***

[2] SDG 11.2: By 2030, provide access to safe, affordable, accessible, and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons.
[3] SDG 9.1: Develop quality, reliable, sustainable, and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all.

Relative to the best performing countries in the world, South Africa has an urban access gap of 92%, based on the length of the rapid transit lines per million people. The metric used to express this gap is the rapid transit to resident ratio (RTR) which compares a country's urban population in cities with more than 500,000 people to the length of rapid transit lines that serve them. South Africa's RTR is 3.1 kilometres per million people, which is derived from the 49.2 and 31.5 kilometres of operational rapid transit routes in Gauteng (Johannesburg and Tshwane) and Cape Town, respectively[4].

The RTR metric offers a snapshot of rapid transit infrastructure coverage in relation to population. To qualify as rapid transit for the calculation of the RTR, public transportation must meet a set of specific criteria (see ITDP 2019). As a result, Metrorail lines do not qualify because of the poor service levels on offer at the time of estimation. Minibus taxi (paratransit) services, which provide transport to most public transport users also do not meet the set criteria and hence do not qualify for the RTR. Only operating bus rapid transit (BRT) corridors in Johannesburg, Tshwane, and Cape Town qualify, which explains the overall low RTR for South Africa.

Most South African households use minibus taxis as their means of transport, so measures to improve accessibility should also address the quality of service provided by informal modes of transport. Of all public transport users, 66.5% use minibus taxis (paratransit), 23.6% use buses and 9.9% use trains. Walking is the primary means of transport for the poor. Countrywide 41.7% of people walk all the way to their destination—an estimated 17.41 million South Africans. Provinces with the lowest rate of people walking all the way to their destinations are Gauteng, where 29.5% of people walk to their destination, 31.5% in Western Cape and 40.9% in KwaZulu-Natal. Among public transport modes, minibus taxis were the most expensive public transport mode of travel for workers, with average monthly travel costs of R960, followed by buses (R745) and trains (R581). Eleven percent of urban respondents in the National Household Travel Survey (StatsSA 2014) indicated that they walk all the way to work because public transport is too expensive.

Furthermore, affordability of transportation is a major impediment to job seeking and income generation amongst the lowest income households. This is reinforced by the predominance of the minibus taxi (generally the most expensive mode of public transport) and the decline of the commuter rail services (generally the lowest cost public transport option), with serious consequences for the country's

[4] This ranks South Africa in position 58 out of 140 countries in the world. The RTR of the best performing country in 2019 is 95.8 kilometres per million people (Norway).

transformative agenda. In 2020, 30.8% of households identified travel cost as the most important element in making transport choices. Metropolitan municipalities reflect that on average 56% of households spend more than 10% of their household income on transport. Across all modes of transport, workers' average travel cost has increased between 2013 and 2020.

The decline in quality of service of public transport has also had important impacts on quality of life, affecting the poorest the most. Overall, between 2013 and 2020, the average travel time to work has increased across all transport modes, with a significantly larger increase for public transport modes. By 2020, train users travelled for 107 minutes (74 minutes in 2013), bus travellers for 84 minutes (74 minutes in 2013) and minibus taxi users travelled for 63 minutes (50 minutes in 2013) each morning to get to work, while those who travelled by car needed on average just over 40 minutes (38 minutes in 2013).

Access to opportunities and amenities is largely dictated by where people live and the transport services that they can access. Many workers dependent on public transport live more than one kilometre from a minibus taxi rank, bus stop or train station. At a national level, 11% of workers live 1 kilometre or more from the first available public transport access point (which is usually the minibus). Only 40.9% of workers using train services have access within 1 kilometre (approximately equivalent to a 15-minute walk).

Rural Access

The key findings pertaining to rural access are:

- ***The provincial and local road network in South Africa is in an overall poor condition, with the majority of maintenance concerns pertaining to the unpaved rural road network.***
- ***Only 23.7% of the rural road network qualifies as all-weather roads, meaning that there are an estimated 4,473,245 out of 10,533,011 people (42.5%) in rural areas who live beyond 2 kilometres of an effective all-weather road.***
- ***658,323 people, or 6.3% of the rural population, are completely isolated from the road network.***
- ***The Rural Access Index (RAI) scores are particularly low in the Free State (23.6%), Eastern Cape (31.9%), and Northern Cape (44.5%) provinces.***

The provincial and local road network in South Africa is in an overall poor condition, with the majority of maintenance concerns pertaining to the unpaved rural road network. By 2020 the proclaimed road

network was approximately 328,550 kilometres[5], including some interurban highways. This equates to 43.8% of the total road network. The ownership and management of roads is shared by the South African National Roads Agency (SANRAL) which has jurisdiction over national roads (highways), the 9 provincial road departments, and the 44 district municipality road departments. Provincial road departments currently manage the largest share, 75.4%, of the rural road network, followed by district municipality road departments with 19.1%, while SANRAL's share comprises 5.5% of the rural network.

Paved roads comprise only 18.8% of the total rural road network, while the remaining 81.2% is unpaved, consisting of a combination of gravel and earth roads. About 84.2% of the paved road network was in a fair, good, or very good condition. However, as of 2020, only 9.7% of the unpaved road network was in good or very good condition. This outcome falls far short of the Department of Transport's chosen performance indicator, that no more than 10% of the road network should be in a poor and very poor condition (DoT 2017b).

The RAI is among the most important global indicators for measuring people's transport accessibility in rural areas where the majority of the poor live. The metric is conceptually simple—it measures the share of the rural population who live within 2 km of an all-season road—and is included in the SDGs as indicator 9.1.1.

Based on the latest globally comparable data from 2016, South Africa's RAI is 74%, which yields a rural access gap of 32.5%. This reflects South Africa's distance from to the best performing countries for this indicator, which are Czech Republic, Singapore, Barbados and Luxembourg. When comparing South Africa to the best upper middle-income country (that is Lebanon), the gap is reduced to 25.8%. However, using the most up to date data on the South African rural roads network, which was collected for this study from the national Department of Transport and provincial Roads Departments, which allows one to classify the roads as all-weather or not all-weather roads[6], and the latest population data, the RAI for South Africa is even lower, with a score of 57.5% in 2020-21.

[5] Excludes some rural roads managed by the North West province and those in the 12 district municipalities not captured in the national Department of Transport's Road Asset Management System (RAMS).

[6] An all-weather road is a road of sufficient construction and firmness for vehicles and equipment to traverse during normal inclement weather, including expected rain, snow, and freezing temperatures, irrespective of the season. Typically, this refers to paved or constructed unpaved roads. This is a more stringent requirement than an all-season road, which is generally defined as a classified or un-classified road that will not be closed for more than two consecutive days and not more than two weeks per year in total. All-weather roads are by default also all-season roads, but all-season roads are not necessarily also all-weather roads.

Close to 4.5 million people in rural areas live beyond 2 kilometres of an effective all-weather road. A significant share, 85.3% of these isolated rural citizens, do live within 2 kilometres of a road, but the road falls short of the all-weather standard. Close to 6% of the rural population, are completely isolated from the road network. This underlines the inadequacies in asset management that are exacerbating the relatively low RAI score, as opposed to limitations in network coverage.

There is also significant variation across the different provinces: The RAI scores are particularly low in the Free State (23.6), Eastern Cape (31.9), and Northern Cape (44.5) provinces. The Western Cape (62.6), Limpopo (62.6), Mpumalanga (62.7), and Gauteng (63.6) provinces are in line with the national average RAI. Whilst KwaZulu-Natal province exceeds the average with an RAI of 84.

Efficiency

The key findings pertaining to efficiency are:

- ***In the Southern African Development Community (SADC) region, 80% of freight and 90% of passenger traffic movements respectively, are made by road.***
- ***On a scale of 1 to 7, in which 7 is the best in the world, South Africa's quality of railroad infrastructure is 3.55, exceeding that of Sub-Saharan Africa at 2.4 and the upper-middle income countries (UMICs) at 3.***
- ***On a scale of 1 to 7, in which 7 is the best in the world, the quality of roads in South Africa is 4.42, compared to the average rating of roads in Sub-Saharan Africa at 3.38 and UMICs at 3.73.***
- ***The national road network, although overall in good or very good condition, is ageing and shows a downward trend in condition and there is considerable variability in the management quality and condition of the low-category roads across provinces.***
- ***The rail system, with the singular exception of the heavy bulk lines, fails to provide an efficient and cost-effective service.***
- ***South Africa's ports are comparatively expensive, inefficient, and unreliable. The 2021 World Bank Container Port Performance Index ranks the Durban Port 349th out of 351 global ports.***
- ***On a scale from 1 to 7, with 7 being the best in the world, the quality of air transport infrastructure in South Africa is 5.6.***

The efficiency policy goal captures the ambition for transport systems to be predictable, reliable, timely and cost-effective. Specifically, the efficiency policy goal embodies the movement of transport vehicles of all types through terminals and transport infrastructure worldwide, along various routes, either under one

mode of transport or a combination of modes, in a timely and least-cost manner to transport goods and users, and without undue constraints arising from unreliable and unpredictable operating, administrative, documentary, legal, regulatory, and institutional frameworks. South Africa has an overall efficiency gap of 36.6% relative to the best performing country in the world[7]. The quality of South Africa's domestic land-based transport infrastructure is better than that of other countries in the region and those with similar incomes. On a scale of 1 to 7, in which 7 is the best in the world, South Africa's quality of railroad infrastructure is 3.55, exceeding that of Sub-Saharan Africa (SSA) at 2.4 and the UMICs at 3. On a similar scale, the quality of roads in South Africa is 4.42, compared to the average rating of roads in SSA at 3.38 and UMICs at 3.73. A mode-specific breakdown of network efficiency performances follows.

Road network: Freight transport in South Africa, with the exception of the bulk movements, is predominantly road based. In the SADC region, 80% of freight and 90% of passenger traffic movements respectively, are made by road. South Africa scores relatively well in terms of the road connectivity index[8], ranking seventh in the world and higher than the average in SSA and UMICs by a factor of 1.5. However, the quality of that network is both variable, and declining overall. The national road network, although overall in good or very good condition, is ageing and shows a downward trend in condition. There is considerable variability in the management and condition of the low-category roads across provinces, which comprise the majority of the road network.

Rail network: South Africa's rail network ranks eleventh in the world at 22,387 route-kilometres and 30,400 track-kilometres. The country transports more goods by rail than any other country in SSA. The railroad density—kilometres of railroad per square kilometre—is higher than the average in SSA by a scale factor of 3.5 and marginally higher than the average in UMICs by a scale factor of 1.2. The specialized coal and iron ore lines realize large economies of density, although in the former case, there is a significant risk of stranded assets in the medium to longer term[9].

[7] South Africa has a Logistics Performance Index (LPI) of 3.38 (out of a max of 5). This ranks South Africa in position 31 out of 165 countries in the world. The best performing country in the world is Germany with an LPI of 4.2 out of 5.

[8] The road connectivity index is defined as average speed and straightness of a driving itinerary connecting the 10 or more largest cities that together account for at least 15% of the economy's total population (World Economic Forum, 2019).

[9] The potential for rail to contribute to South Africa's achievement of sustainable transport goals is high. However, this is realized for freight lines that enjoy high economies of density, such as coal and iron ore lines. With the global shift towards decarbonization, export markets for the former are expected to decline resulting in increased risk of stranded freight rail assets. This is because, in addition to cost considerations, the rail system's efficiency and

However, the rail system, with the singular exception of the heavy bulk lines, fails to provide an efficient and cost-effective service. In addition to the cost, the rail system is a major concern, with frequent operational breakdowns owing to theft, vandalism, and power outages, increasing numbers of signal failures, and inadequate maintenance resulting in temporary speed restrictions, all of which consume capacity. This has been exacerbated by inadequate investment in recent years to firstly ensure the network stays at its design capacity, and secondly, extends the capacity to meet current and projected demand.

Maritime Transport: South Africa is better connected through its ports than most countries in SSA and the UMICs. South Africa's 2020 liner shipping connectivity index (LSCI) is 40.1. This is greater than the average in SSA at 14.7 and the group of UMICs at 28. South Africa's LSCI places the country among the top three leading countries in Africa over the past decade based on this indicator (behind Egypt and Morocco). The LSCI ranks Cape Town and Durban as the better connected out of the six major South African ports and East London and Richards Bay as the least connected, a ranking that has remained broadly static throughout 2011–2019 (UNCTAD 2020).

But South Africa's ports are comparatively expensive, inefficient, and unreliable. The spatial and operating efficiency is poor, the inter-modal connectivity and service with rail, except for the bulk movements, is also poor, and there have been limitations in management, maintenance, and investment in recent years for both ports and rail. Port operational delays are worse than regional or income comparators. The 2021 World Bank Container Port Performance Index ranks the Durban Port 349th out of 351 global ports. South Africa has poor port performance in terms of vessel turnaround time. The annual number of ports calls in South Africa is close to 9,000. The median time spent in ports (expressed as number of days) is 1.87, above the average in the region of 1.85 days and income group of 1.25 days.

Air transport: On a scale from 1 to 7, with 7 being the best in the world, the quality of air transport infrastructure in South Africa is 5.6 (SuM4All 2020a). This value exceeds the average rating in both SSA and the group of UMICs rated 3.6 and 4.4 respectively. In 2019, South Africa's air connectivity index is 63.5 (on a scale of 0 to 100), well above the average for SSA at 23.58 and the UMICs at 53.45. This ranking places South Africa as the best performing country in Africa and positions it 37th out of 139 countries.

reliability are major concerns, and operational breakdowns due to theft, vandalism, and power outages, increasing numbers of signal failures, and inadequate maintenance resulting in temporary speed restrictions, all of which consume capacity.

Safety

The key findings pertaining to safety are:

- ***South Africa has an exemplary maritime and aviation safety record, recording zero ship losses for the third consecutive year in 2021, and ranking first on the continent in terms of aviation safety, and 33rd globally.***
- ***In the last decade, there has been a marginal reduction in the annual number of road crash fatalities from 13,967 in 2010 to 12,503 in 2019.***
- ***Road crash rates cost an estimated 3.5% of gross domestic product (GDP) in 2017.***
- ***Men suffer disproportionately (77% of total fatalities are men, 83% of which are in their most productive years 15-64 years old) and pedestrians represent around 39% of total fatalities.***
- ***The quality of South Africa's rail infrastructure is threatened by theft, vandalism, maintenance issues, and near-total abandonment of branch lines.***
- ***Security challenges on railways are mounting rapidly. In 2019/20 occurrences of security-related incidents per million train-km increased by 193% year on year.***
- ***A lack of non-motorised infrastructure impacts on pedestrian and cycling safety. 93% of carriageways surveyed by the International Road Assessment Programme (iRAP) have no adjacent footpaths, 92% have no pedestrian crossings, and 100% of undivided rural roads have vehicle speeds greater than 80 km/h.***

The safety policy goal seeks to drastically reduce fatalities, injuries, and crashes (SDG target 3.6: "*By 2020, halve the number of global deaths and injuries from road traffic accidents*"). South Africa has a safety gap of 71.4% relative to the best performing country in the world[10]. This is lower than the gap of the median country in SSA (75.9%) but higher than that in the median UMIC (45.9%).

Safety is central to sustainable mobility, but South Africa has a mixed record on transportation safety. While its maritime and aviation safety record is exemplary, the same cannot be said for rail and road safety. Some 14,000 vessels transit around South Africa each month, yet South Africa recorded zero ship losses[11] for the third consecutive year in 2021. The outcome is due in large part to continuous work by the South African Maritime Safety Authority (SAMSA), to ensure that all stakeholders observe applicable maritime safety, security and pollution legislation and regulations. During 2021, SAMSA responded to 275 alerts and saved 411 lives through its Maritime Rescue Co-ordination Centre which monitors the coast

[10] South Africa has a Mortality caused by road traffic injuries of 25.9 per 100,000 people. This ranks South Africa in position 143 out of 183 countries in the world. The best performing country in the world is Maldives with a Mortality caused by road traffic injury of 0.9 per 100,000 people.
[11] Ship losses refers to vessel sinkings and covers all vessels that navigate through South Africa's territorial waters.

from a safety and security perspective and tracks the implementation of international standards for navigation aids. Similarly, South Africa's record on aviation safety is well regarded globally. The International Civil Aviation Organization (ICAO) has ranked South Africa first on the continent in terms of aviation safety and 33rd globally. South Africa had no fatal accidents on scheduled commercial flights with aircraft over 5.7 tons in the last five years. Operators from South Africa had no fatal accidents outside of the country during that same period.

Unfortunately, road and rail safety performances are not as impressive. In the last decade, there has been a marginal reduction in the annual number of road crash fatalities from 13,967 in 2010 to 12,503 in 2019 (ITF 2019) bringing the fatality rate to 21.3 deaths/100,000 people which was still above the global average of 17.4 deaths/100,000 people. Road crash rates remain high, costing an estimated 3.5% of GDP in 2017. Most fatalities caused by road crashes involve motorized vehicles and pedestrians. A diagnostic carried out for Southern Africa countries (World Bank 2021) highlights that in South Africa, speed and drunk driving are major contributors to road traffic crashes. Speed limits in the country are higher than the globally recommended safe system speeds and 58% of fatalities involve a driver over the legal blood alcohol content (BAC) limit. Men suffer disproportionately (77% of total fatalities are men, 83% of which are in their most productive years 15-64 years old) and pedestrians represent around 39% of total fatalities. Implementation of measures among the six pillars of the United Nations Decade of Action with effective leadership, governance, and improved data and knowledge management, are critical if the country is to reach the SDG target of reducing fatalities by 50% by 2030.

With respect to rail, the quality of South Africa's rail infrastructure is threatened by theft, vandalism, maintenance issues, and sheer abandonment of branch lines. This makes the rail environment unsafe for commuters as well as the general public in South Africa. The 2019/20 State of Safety Report highlights increasing long-term trends in both safety and security-related incidents. The occurrences of security-related incidents per million train-km increased dramatically by 193% (compared to 106% since 2010/11). This has impacted rail infrastructure and the efficiency of freight and passenger rail.

With respect to Non-Motorized Transport, as mentioned previously, pedestrian fatalities remain a large component of road crash fatality rates, with provinces having larger urban populations recording higher numbers of pedestrian fatalities (Arrive Alive 2022). Ninety three percent of carriageways surveyed by iRAP have no adjacent footpaths, 92% have no pedestrian crossings, and 100% of undivided rural roads have vehicle speeds greater than 80 km/h, which leads to unacceptably high risks for pedestrians.

Green Mobility

The key findings pertaining to green mobility are:

- ***South Africa has an air quality gap of 20% when compared to other countries in the region or at a similar level of income.***
- ***South Africa is the 14th largest emitter of GHGs in the world, contributing 1% to global emissions.***
- ***In 2016 the transport sector constituted 19% of energy demand in South Africa, second only to the industrial sector (52%).***
- ***Carbon emissions are driven by a reliance on road-based transport and spatial inefficiency. Spatial inefficiency is underpinned by the legacy of racial segregation policies that have shaped the urban form, and the heavy reliance of the industrial sector on road-based transport.***
- ***Owing to a highly carbon intensive electricity grid (823 grams of CO_2 per Kilowatt hour), South Africa is among the top 5% of countries for which electrifying mobility will increase transport sector emissions.***

South Africa has an air quality gap of 35.5% relative to the best performing country in the world[12], however, this gap is 20% when compared to other countries in the region or at a similar level of income. On overall emissions, South Africa is the 14th largest emitter of GHGs in the world, contributing 1% to global emissions. In terms of CO_2 emissions from road transport relative to GDP, South Africa has a value 0.063 kilogram per dollar, which is higher than emissions in the region (0.053) and that of countries in the same income group (0.057).

South Africa's transport system is energy and carbon-intensive in comparison with countries in the region or with similar levels of income. According to the Department of Mineral Resources and Energy, in 2016 the transport sector constituted 19% of energy demand in South Africa, second only to the industrial sector (52%)[13]. Transport contributes 13% of GHG emissions in South Africa, and it ranks in the 70th percentile against the best performing country in the world on transport related GHG emissions per capita[14]. Carbon emissions are driven by a reliance on road-based transport and spatial inefficiency. Spatial inefficiency is underpinned by racial segregation policies that have shaped the urban form of cities, and the heavy reliance of the industrial sector on road-based transport increases transport emissions.

[12] South Africa ranks in position 109 out of 183 in the world on this indicator, with Ethiopia being the best performing country.
[13] The industrial sector includes iron and steel, chemical and petrochemical, non-ferrous metals, non-metallic minerals, mining and quarrying, paper, pulp and print, construction, and other non-specified subsectors.
[14] Best performing country on the GHG indicator is Democratic Republic of Congo.

86% of total transport emissions come from road transport (equivalent to 8% of GHG emissions). The road sector consumes about 79% of all liquid fuel, followed by international civil aviation at 13%. The rail and maritime sectors produced 4.84 metric tons of CO_2 more than the average country in the SSA region but lower than the average UMIC (IRF 2017).

The electrification of South Africa's transport system is increasing[15], but its source of energy still depends heavily on fossil fuels for electricity generation via coal. Owing to a highly carbon intensive electricity grid (823 grams of CO_2 per Kilowatt hour), South Africa is positioned among the top 5% of countries for which electrifying mobility will increase transport sector emissions. However, the government's Integrated Resource Plan for the electricity sector estimates that renewables will make up about 40% of South Africa's electricity production share by 2050, which will improve the potential for emission reductions of increased electrification of the transport sector.

Policy Recommendations

Building on the sustainability gap in the diagnostic that identified universal access and safety as having the largest gaps, the selection algorithm was applied to the catalogue of policy measures for these two goals, which generated a Prototype Action Plan for South Africa. This PAP consists of a set of high-level policy measures that are tailored to the state of the country's transport system. While those measures are expected to have an impact in terms of universal access and safety, they will contribute to more than one policy goal to achieve sustainable mobility, and thereby accelerate progress towards the achievement of the SDGs and the Paris Climate targets.

However, policy measures in the PAP are high level, and do not have the level of specificity and granularity needed to guide decision making and implementation. Moreover, they do not take specific political realities or micro-local context into consideration. The generated PAP is thus just a starting point which requires further customization and refinement through engagement with local experts and other relevant stakeholders. This further engagement refined the generated PAP to one that is more practically aligned with the specific needs of the context, and led to the country action plan per se.

The South Africa Action plan toward sustainable mobility considers three priority policies.

[15] Around 1,000 electric vehicles had been sold in South Africa by early 2022 (African Business 2021, Statista 2022). In July 2021, the first two electric busses were introduced in Cape Town for services (Business insider South Africa 2021).

Priority 1. Optimize the utility of existing transport infrastructure assets. Priority should be given to the optimized use and better management of existing transportation network assets, before investing in new or expanding existing ones.

Measures should aim to untie existing policy knots that relate to institutional misalignment and address obstacles that prevent the execution of existing policy commitments. South Africa, by and large, has sound policies, plans and a vision that illustrates its commitment to tackling vulnerabilities in the transport and mobility system. However, South Africa's transportation system is falling behind in many areas and, while policies exist, they are either poorly implemented or not implemented at all. Institutional barriers, challenges with intergovernmental coordination, and a lack of capacity within implementing departments, prevents the translation of such policies into action.

Considering the extensive investment required in transport infrastructure, public-private partnerships and strategic planning are recommended. A focus on integrated land use and transport planning as a central function of local government and strengthening intergovernmental systems to ensure planning alignment across departments, is identified as the first step to ensuring that social services are developed and situated in those areas that increase access to progressively realize constitutional rights.

Priority 2. Invest to expand transport infrastructure assets once the utility of existing infrastructure has been maximized. When the reach of existing infrastructure is no longer adequate, and on a case-by-case basis, consider new investments. Through robust frameworks for project prioritization, supported by feasibility assessments, consider new investments that integrate insofar as possible with existing transport services for both passengers and goods.

Priority 3. Support a Paris-aligned and resilient transport system. All policies and investments in the action plan should be geared towards improving the quality of South Africa's transport system to ensure it is resilient and aligned with the Paris Agreement goals.

Depending on South Africa's own objectives, policy actions should be prioritized so that they will not only help to reduce the gaps around each goal but also maximize impact, by selecting measures that generate greater co-benefits. The following is a high-level summary of policy actions on the four sustainable mobility goals, a more detailed discussion can be found in section 5 of this report, and the link between findings and recommendations and the institutions with primary and secondary responsibility can be found in Annex C.

1. Urban Access: Focus on measures that will not only increase RTR, but also increase accessibility, affordability, support decarbonization of transport, and enhance safety: (i) simplify institutional structure, (ii) restore commuter rail services, (iii) integrate rail with expanded BRT and formalized minibus taxis, (iv) strengthen coordination of land use and transport planning, incorporating transit-oriented development policies, (v) improve non-motorized transport (NMT) infrastructure, especially for pedestrians and cyclists in particular along higher order roads.

2. Rural Access: Focus on measures that will increase accessibility, resilience and safety of existing infrastructure and improve efficiency in the use of funds: (i) rationalize the network and seal rural roads in densely populated areas, (ii) introduce design standards that provide for NMT and safety in densely populated areas and a review of road access management policies to adjust to the realities of pedestrians on higher order roads, (iii) enhance asset management practices at the provincial and municipal levels, ensuring adequate funding and capacity of road departments, (iv) implement contractual modalities that create jobs and enhance cost-efficiency.

3. Efficiency: Focus on measures that will promote shifts towards more efficient and greener freight modes and support better safety: (i) enhance intermodal connectivity between ports and rail, (ii) shift freight from road to rail and enhance the reliability of rail services, (iii) expand the capacity and efficiency of port operations, (iv) increase private sector participation through capital mobilization and operations of ports and rail, (v) reducing barriers to trade and supporting investments that enable regional integration.

4. Safety: Focus on measures that will increase the safety of all road users: (i) increase commitment to road safety, (ii) systematize the use of road safety audits and invest in safer infrastructure for drivers, pedestrians and cyclists, (iii) amend policies and strengthen enforcement to reduce drunk driving, increase use of seatbelts and helmets, and reduce speeds, (iv) improve vehicle safety standards.

5. Green: Focus on measures that will incentivize shifts to greener modes: (i) manage urban development to limit sprawl and gradually transforming cities towards a more sustainable future, (ii) promote policies that support shifts from private cars to public transport and non-motorized transport, (iii) enhance climate resilience of transport infrastructure and climate efficiency of road-based modes, prioritizing maintenance and preservation of rural roads to ensure their resilience to severe climatic events and lower the operational impact of their use, (iv) promote a shift from road to rail along with the development of a holistic green freight strategy for Transnet.

Infrastructure Funding Needs

To improve universal transport access and safety, South Africa needs to spend R1.3 trillion in capital and operating and maintenance in the 2022–2030 period under the preferred scenario, which amounts to 2.3% of GDP per year, on average[16]. The preferred scenario combines a rural policy to rationalize the rural roads network and seal roads, improving access and safety, with an urban policy to improve the quality and safety of existing rapid transit systems and condition of urban roads, and increase the safety of high traffic roads. Under a less ambitious policy scenario that keeps the current length of the rural roads network and level of quality and safety of rapid transit systems, improving the condition of urban roads and safety of high traffic roads, the funding needs amount to R1 trillion in the 2022–2030 period, which amounts to 1.7% of GDP per year, on average. Under a more ambitious scenario that adds to the preferred scenario the expansion of the rapid transit network, the funding needs amount to R1.5 trillion in the 2022–2030 period, which represents 2.6% of GDP per year, on average.

[16] The estimate assumes a baseline socioeconomic pathway and GDP is at constant 2020 prices. Two other pathways are also considered in the report, but the differences between the three pathways are small because of the relatively short period of time and the small differences in GDP growth.

1 Introduction

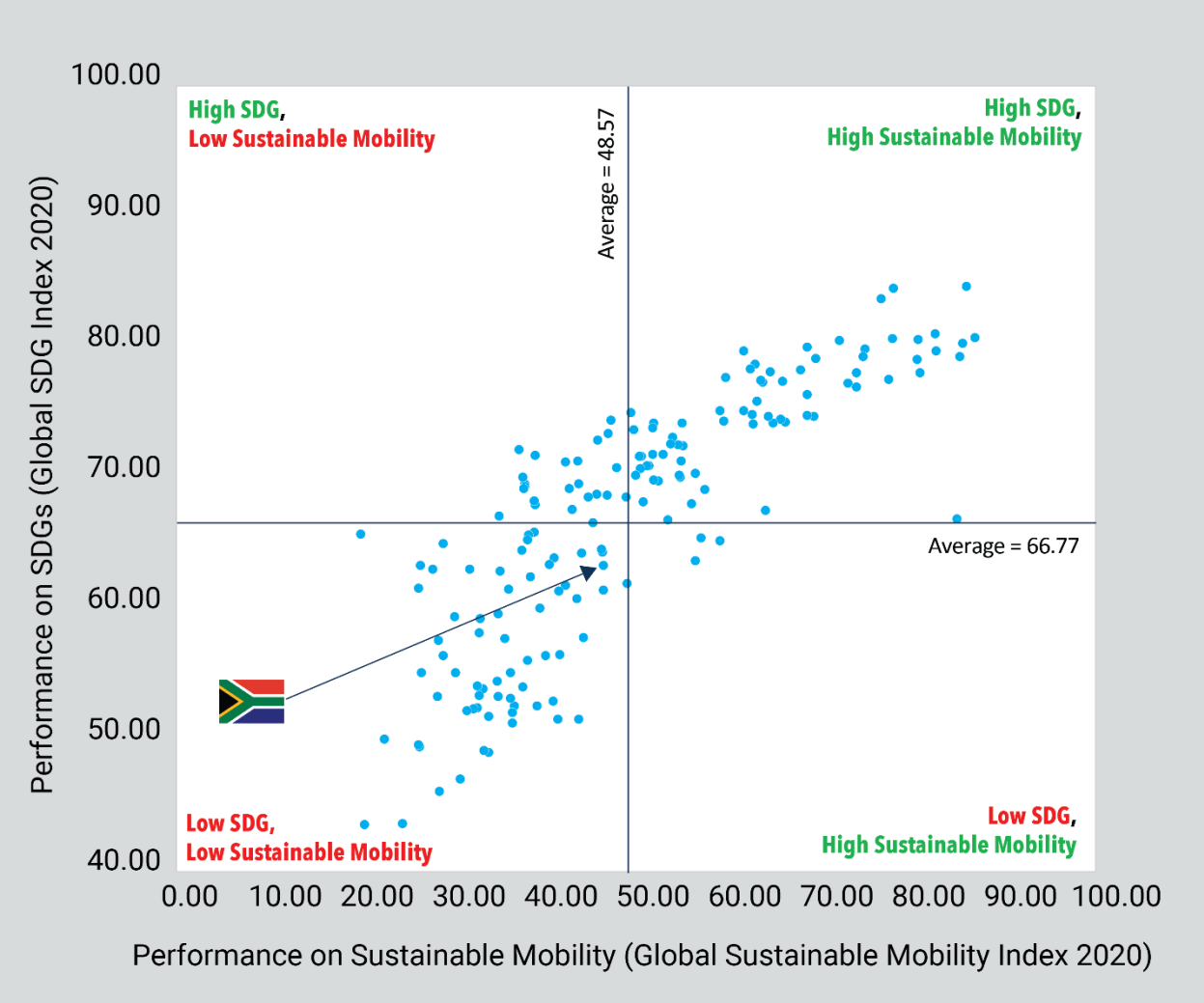
1.1 The Background and Objectives

South Africa is committed to the attainment of the Sustainable Development Goals (SDGs), the Paris Climate Agreement, and the African Union's Agenda 2063 (African Union Commission 2013) to achieve a prosperous society based on inclusive growth and sustainable development. This ambition is embodied in the National Development Plan: Vision 2030 (NPC 2012) which is the country's blueprint for economic growth and development.

In 2019, South Africa took stock of progress in the attainment of the SDGs (including climate progress) in its Voluntary National Review (DPME 2019). Whilst South Africa has made progress towards the attainment of the SDGs, there remains a considerable distance to the attainment of SDG objectives. According to the Global SDG Index 2020 (Sachs et al. 2022) which tracks countries' performances on progress towards the 17 SDGs, South Africa ranks 110th (or in the bottom one third of all 166 countries being monitored). This underscores the need for greater commitment to achieving the country's objectives in this respect.

A key focus of South Africa's commitment should be to tackle vulnerabilities in the transport and mobility system[17]. Recent research shows a clear correlation between countries' progress on the SDGs and the quality of their transport systems (Vandycke & Fabian 2020). On average, countries with the highest scores in support of the SDGs tend to be those that have more resilient and sustainable transport systems in place, while those that have made the least progress against the SDGs generally score poorly in terms of the quality of their transport system (Figure 1.1). This underlines the centrality of addressing fundamental weaknesses in the transport and mobility system if South Africa wishes to make considerable progress towards, and eventually attain, the SDG targets.

[17] Mobility system is broader than the transport system, for example, the mobility system includes considerations about land planning, environment, affordability, and quality of transport options, among others, while the transport system does not.



Source: SuM4All, Forthcoming a.

Figure 1.1: Global SDG Index and Global Sustainable Mobility Index Score, 2020

Sustainable Mobility for All (SuM4All) is an advocacy platform established in 2017 and hosted by the World Bank for international cooperation on transport and mobility issues. It comprises more than 55 public organizations and private companies, including bilateral and multilateral development partners, multilateral development banks, United Nations (UN) organizations, inter-governmental organizations, and civil society with a shared ambition to transform the future of mobility. As part of its work, SuM4All has developed a Global Tracking Framework (GTF) for Transport that provides a comprehensive framework to diagnose transport and mobility issues based on data and evidence. It is an attempt to quantify the gap between countries' actual performances and their ambitions. Drawing on the GTF data, SuM4All has developed the Global Sustainable Mobility (GSM) Index score that allows for a ranking of 183

countries in terms of their aggregate performance in universal access, efficiency, safety, and green mobility—the four goals that define sustainable mobility. Using the GSM index[18], South Africa ranks 88th relative to 183 countries. This ranking places South Africa third amongst Sub-Saharan African (SSA) countries—behind only the Small Island Developing States of Mauritius and Seychelles.

Against this background, the Development Bank of Southern Africa (DBSA) has partnered with the World Bank to advance the debate regarding infrastructure funding needs to achieve the SDGs in South Africa, with the focus being on spending better and implementing the right policies. Both institutions recognize the vital contribution that such a study would make because of the importance of exploring how multiple investment and policy choices would play out according to multiple objectives (the level of ambition the Government seeks to achieve) and metrics for success. Ultimately, the study aims to enable responsible investment decision-making and inform the DBSA's, and other stakeholders', strategic perspectives on investment and policies for accelerating progress towards the SDGs and development.

This study has three objectives:

i. Assess the performance of South Africa's transport system in delivering sustainable mobility as defined by four goals: universal access, efficiency, safety and green mobility,

ii. Estimate the infrastructure funding needs for reducing the universal access and safety gaps between 2022 and 2030 under different scenarios,

iii. Identify a coherent set of policies to improve the performance of South Africa's transport system in delivering sustainable mobility.

1.2 The Scope of the Study

While most sectors can rely on the SDGs' framework to set country goals to achieve by 2030 in those sectors, the transport sector does not have a dedicated SDG. However, transport plays a critical role in enabling other SDGs and achieving growth and development. For example, global progress in reducing greenhouse gas emissions (SDG 13) cannot be realized without decisive action on energy (SDG 7) and one of the largest energy-consuming sectors is transport. Countries cannot provide food security (SDG 2) or

[18] The GSM index score is a composite index score for sustainable mobility which is calculated for each country in the world as the average performance scores on universal access, efficiency, safety, and green mobility. The value of the GSM index ranges between 0 and 100 (SuM4All 2020a).

healthcare (SDG 3) without providing reliable and sustainable transport to ensure access to these resources. Mobility is at the heart of access to many essential services and opportunities. Young people cannot attend schools (SDG 4), women cannot be assured of opportunities for employment and empowerment (SDG 5), and people with disabilities and elderly people cannot maintain their independence and dignity without safe transport that is accessible itself and that enables access to all that people need (SDG 9 and 11). Personal security for all passengers is critical. Goals of biodiversity (SDG 15) and ocean health (SDG 14) also have significant intersections with the promotion of smart, sustainable mobility practices across regions and modes of transportation. Finally, strengthening the means of implementation (SDG 17) of the SDGs with coherent policies, is also central for transport.

For that reason, this study relies on a shared vision for transport from the international transport community around the concept of "sustainable mobility.” Conceptually, "sustainable mobility" is framed around the achievement of four global policy goals that are conceptually linked to the SDGs as shown in Figure 1.2:

Source: SuM4All, 2017

Figure 1.2: Global SDGs and Sustainable Mobility Goals

- **Universal Access**. Connecting all people, including the most vulnerable communities to economic and social opportunities, accounts for distributional considerations for transportation services. This goal ensures that everyone's individual travel needs of access to those opportunities are met. It reflects concerns for social inclusivity achieved by providing universal access to transportation services.

- **Efficiency.** Optimizing the predictability, reliability, and cost-effectiveness of the transport system, as well as avoiding travel time losses due to congestion or poor organization of traffic flows. This goal seeks to ensure that transport demand is met adequately, at the least possible cost for providers and for users.

- **Safety**. Drastically reduce fatalities, injuries, and crashes (in line with SDG target 3.6[19]). This goal aims to improve the safety of mobility across all modes of transport by avoiding fatalities, injuries, and crashes from transport mishaps across all modes of transportation, thus averting public health risks and social and economic losses associated with unsafe mobility.

- **Green mobility**. This goal seeks to reduce the greenhouse gas emissions and carbon impact, noise, and air pollution associated with the transportation of goods and people.

This vision of sustainable mobility recognizes that transport generates private and social benefits (access to opportunities), as well as negative externalities (e.g., traffic fatalities, emissions, air and noise pollution). If current public and private transport decisions go unchecked, they will affect the options that may become available for society in the future. This vision is fully consistent with that underpinning the SDGs and specific SDG targets (Box 1).

[19] SDG target 3.6 aims to halve the number of global deaths and injuries from road traffic accidents.

Box 1: SDG targets and the four important dimensions of transportation and mobility systems

Universal (equitable) Access

SDG target 9.1 addresses the need to develop quality, reliable, sustainable, and resilient infrastructure, and focuses on affordable and equitable access for all. SDG target 11.2 addresses the need for access to safe, affordable, accessible, and sustainable transport systems for all, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities, and older persons. SDG target 5.1 and target 5.2 aim to end all forms of discrimination against all women and girls everywhere and eliminate all forms of violence against all women and girls in the public and private spheres, including trafficking and sexual and other types of exploitation respectively. While SDG target 5.5 ensures women's full and effective participation and equal opportunities for leadership at all levels of decision making in political, economic, and public life.

System Efficiency

SDG target 7.3 aims at doubling the global rate of improvement in energy efficiency, and SDG target 12.c aims at rationalizing inefficient fossil fuel subsidies. SDG target 12.3 aims at halving per capita global food waste and reducing food losses along production and supply chains. Similarly, SDG target 9.4 aims at, among others, upgrading infrastructure to make it sustainable, with increased resource use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes. In addition, SDG target 17.14 aims at strengthening country level mechanisms to enhance policy coherence for sustainable development.

Safety

SDG target 3.6 is specifically dedicated to road safety and aims to halve the number of global deaths and injuries from road traffic accidents by 2030. In addition, SDG target 11.2 refers to improving road safety in cities, notably by expanding public transport.

Green Mobility

Green transport is an integral part of the SDGs, and filters into many SDG targets. SDG target 13.2 aims at integrating climate change measures into national policies, strategies, and planning, and SDG target 13.1 aims to strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries. SDG target 7.3 aims to double the global rate of improvement in energy efficiency, which will have a direct impact on greenhouse gas (GHG) emissions and other pollutants. Similarly, SDG targets 3.9 and 11.6 relate to air pollution—addressing illnesses or deaths and pollution's environmental impacts on cities, respectively. SDG 3.4 relates to noncommunicable diseases such as cancer, heart disease, and stroke, all linked to air pollution, noise, and lack of walking and cycling. The transport sector plays a pivotal role in the achievement of these targets.

Source: SuM4All, 2022.

1.3 The Methodology

The methodology is inspired by the World Bank's *Beyond the Gap* report (Rozenberg & Fay, 2019) and adapted to reflect the innovative approach developed by the SuM4All partnership. It combines the power of data and comparative analysis to diagnose transport and mobility issues, with the power of scenario

analyses and global policy knowledge, to lay out policy options, and country engagement to select the most impactful policy measures to achieve sustainable mobility.

The analytical framework consists of the following steps:

a. Identify objectives

Assessing infrastructure investment and policy needs must begin with a vision about what transport is meant to achieve along several dimensions and using multiple metrics. As previously discussed, this study relies on a shared vision for transport from the international transport community around the concept of "sustainable mobility" measured by 4 policy goals: universal access, efficiency, safety and green mobility. Hence, the objective is to measure the performance of a country's transport system against those broad policy goals that define sustainable mobility, with the understanding that achieving sustainable mobility is essential to accelerate progress on the SDGs and the Paris targets.

b. Identify the metrics to measure transport system performance

By using the GTF, the GSM composite scores, and new metrics developed specifically for this study, it became possible to compile a wide-scope diagnostic of South Africa's transport system and identify areas of strength and weakness in terms of sustainability, using data and comparative analysis. In the GTF, each country is classified according to its performance into one of four groups (A-D). Countries clustered in group A are considered top performers, while all countries clustered in group D are low performers on a given goal (SuM4All, 2020a, pp. 6-9).

The diagnostic establishes sustainability gaps in South Africa's transport system (measured in terms of differences between country performances and relevant peers' performances on each of the four goals).

c. Produce a priority-oriented country action plan

Given the sustainability gaps, a prototype action plan (PAP) is generated, which consists of the 30 most impactful policy measures for the country. Policy measures refer to the means of intervention by governing authorities in markets or society to promote certain policies in order to accomplish goals or to solve problems. The PAP is generated by applying a selection algorithm to the catalogue of policy measures (Box 2).

Box 2: Catalogue of Policy Measures

The catalogue consists of 194 policy measures that have been used and tested around the world in support of sustainable mobility. This catalogue was derived out of an intensive crowdsourcing effort in the production of the Global Roadmap of Action Toward Sustainable Mobility (GRA), which involved more than 50 international organizations interested in building a repository of shared policy knowledge on transport and mobility. In 2020, the catalogue was expanded to add a few policy measures geared specifically to respond to the COVID-19 crisis and potential future pandemics.

The catalogue is structured into four toolboxes and 22 thematic areas, while specifying a set of attributes to each policy measure (e.g., goal impact, country group relevance, resilience scores, mode of transport, and type of traffic-freight or passenger). The four toolboxes are:

- **Regulatory and institutional toolbox** - it includes 77 policy measures related to plans and strategies for the transport sector, cooperation and coordination across transport stakeholders, regulations (for cross-border transport, transport services, vehicles and vehicle use, use of data), procurement and contracts, as well as capacity building.
- **Engineering and technology toolbox** - it includes 70 policy measures related to the design, provision and maintenance of transport infrastructure and transport services, the setting of technical standards, asset construction, and safeguards.
- **Economics and finance toolbox** - it includes 32 policy measures related to financing, pricing, taxes and subsidies, innovation policy and cost-effectiveness.
- **Communications toolbox** - it includes 15 policy measures related to stakeholder consultations and public campaigns to influence behavioural change, such as product labelling, and knowledge management.

For each policy across the toolboxes, scores and attributes were assigned to ensure adequate coverage of the most important measures based on country relevance and circumstances. These scores and attributes are:

Scores and Other Attributes.

1. **Goal Impact Score**. Each measure is assigned a score to proxy its impact on a goal. The values vary from zero (no impact), to 1 (some impact), or 2 (high impact). The scores were sourced collectively and reviewed extensively by SuM4All experts from different organizations involved in the process to minimize subjectivity. Given the very generic description of measures and the wide diversity of situations, a finer scale of impact scores would not make sense. Some policy measures may have an impact on more than one policy goal, indicating synergies between goals. For example, “applying market-based pricing to street parking” is considered very important for universal access (rating of 2) and for green mobility (rating of 2).
2. **Country-relevance Score**. This score proxies the relevance of that measure for each group of countries according to their distance to the targets in each policy goal. The score varies from zero (not relevant) to 1 (somewhat relevant), or 2 (very relevant). For example, the policy measure “Expand the all-weather road network” is assigned a score of 2 for the groups of countries that perform poorly on universal access rural (country group D), and a score of zero for country group A.
3. **Resilience Score**. This score proxy resilience of each policy measure on two risk factors: (i) pandemics and (ii) extreme weather events. For each of the two risk factors identified, each policy measure is rated based on their potential to (a) preserve a decent level of operationality during crises and (b) to support

a quick recovery to operational levels, ranked from 1 (low potential) to 4 (high potential) respectively. For example, "adopting a build back better principle for reconstruction" is rated 4 (high potential) to support a quick recovery to full operationality for both extreme weather events and pandemics, as it will create more resilient systems through the implementation of well-balanced disaster risk reduction measures, including the physical restoration of infrastructure and institutional strengthening.

4. **Mode of Transport**. This attribute refers to the mode of transport applicable to a given policy measure.
5. **Type of Movement**. This attribute specifies whether the policy applies to passenger traffic, freight, or both.

Source: SuM4All, 2019 and 2022.

This stage then leverages the PAP and the assessment of cost and impact of policies as the empirical basis to conduct an in-depth policy-by-policy analysis and country engagement with local stakeholders and experts to generate the country action plan towards sustainable mobility. This resultant action plan classifies policy measures into priority areas.

d. Identify exogenous factors

There are external factors, somewhat out of the control of decision-makers, that can challenge decision-making because they influence the success and cost of policy options. Some of the most common uncertainties are population and gross domestic product (GDP) that affect future demand, costs, and fiscal resources, future environmental stress, and the political environment. Some of these uncertainties can be considered in the next step.

e. Estimate the cost and impact of policies to reduce the universal access and safety gaps

To highlight the trade-offs that policy makers face when choosing among different policies, this step undertakes a high-level estimation of the total costs, including capital and operations and maintenance, of selected infrastructure measures in the area with the largest gap: universal access (urban and rural) and safety. The cost estimates are based on the best publicly available data on capital and operations and maintenance (O&M) costs, and on the conditions of existing assets. This step also estimates the impact of the different policies on the objectives and metrics identified in points (a) and (b) above. The models and data used are described in Annex A and B, respectively.

2 The Transport and Mobility Landscape in South Africa

2.1 The Commitment of the South Africa Government

South Africa's commitment to tackle vulnerabilities in the transport and mobility system is borne out of a series of plans, policies and programs developed in the last decade. The country's National Development Plan is guided by the need to respond to the entrenched spatial patterns that exacerbate social inequality and economic inefficiency and calls for "the development of economic infrastructure as the foundation of social and economic development" (NPC 2012). In response to the COVID-19 pandemic, the Economic Reconstruction and Recovery Plan–2020 reiterates the need for infrastructure investment: "Infrastructure investment, delivery and maintenance will play a leading role in South Africa's economic reconstruction and recovery. A large-scale infrastructure program will boost aggregate demand, assist in reviving the construction industry and contribute to employment creation" (GoSA 2020). This plan recognizes the imperative to attract private sector investment in the delivery of infrastructure as part of building broad-based public–private partnerships (PPPs).

In support of the National Development Plan goals, the Department of Transport (DoT) developed the National Transport Master Plan (NATMAP) 2050 and the Green Transport Strategy (GTS) for South Africa: 2018–2050 to create a "virtuous cycle of expanding opportunities" and improved urban mobility. The government has also unveiled infrastructure investment plans which included improving the country's roads, railways, and ports. South Africa's revised White Paper on National Transport Policy 2021 (DoT 2022) determined that a key policy objective was to reduce household expenditure on public transport. If met, this would have a significant impact on accessibility given that according to the General Household Survey of 2017, 56% of urban households in the country, currently spend more than 10% of household income on transport (Ross & Townshend 2019).

The DoT has also produced several mode-specific policy and strategy documents including the White paper on National Civil Aviation Policy (DoT 2017c), the Comprehensive Maritime Transport Policy for South Africa (DoT 2017d), the White paper on the National Rail Policy (DoT 2022a), and the Draft Roads Policy (2017). The Public Transport Strategy 2007 (DoT 2007) provides the strategic underpinning and mandate to the three spheres of government for the implementation of the integrated rapid public transport network (IRPTN).

The 2019–2024 Medium Term Strategic Framework (DPME 2020) consolidates the medium-term objectives set out in the NATMAP 2050 (DoT 2016). With respect to public transport the policy framework:

(i) targets the expansion of integrated public transport networks in cities and support for transit-oriented development; (ii) calls for the rightsizing of the previously unaffordable bus rapid transit specifications and technical norms and standards; and (iii) improved services levels. Private sector participation will help modernize the urban rail network and system and upgrade Metrorail (passenger rail services). These positions are reinforced by the Public Transport Strategy 2007 (DoT 2007) and the White Paper on the National Rail Policy (DoT 2022a).

South Africa has also developed strategies road safety and made commitments on emissions. The National Road Safety Strategy 2016–2023 (DoT 2017a) highlights the vital role of driver behaviour as a key factor contributing to road fatalities.

Several attempts have been made by the DoT to introduce policies to reduce transport emissions, including a 2017 draft GTS up to 2050. The objectives of the GTS include: (i) enabling the transport sector to contribute its fair share to the national effort to combat climate change in a balanced fashion, taking into account the DoT and the sector's primary responsibility of promoting the development of efficient, integrated transport systems to enable sustainable socio-economic development; (ii) promoting behavioural changes towards sustainable mobility alternatives through information, education and awareness-raising; (iii) engaging the low carbon transition of the sector to assist with aligning and developing policies that promote energy efficiency and emission control measures in all transport modes; (iv) minimizing the adverse effects of transport activities on the environment; and (v) facilitating the sector's just transition to a climate resilient transport system and infrastructure. While the GTS warns that the country's transport emissions are set to roughly triple by 2050, it does not set any reduction targets.

All these efforts, plans, and vision illustrate the commitment of South Africa to tackle vulnerabilities in the transport and mobility system. However, it is also widely recognized that South Africa's transportation system is falling behind on many grounds and, while policies exist, they are either poorly implemented or not implemented at all. Institutional barriers, challenges with intergovernmental coordination and lack of capacity within implementing departments prevent the translation of such policies into action.

2.2 The challenges facing the Transport Sector in South Africa

South Africa has a well-developed transport infrastructure, and while some areas of its transport system continue to function well, even ahead of global standards, other elements of its networks are in severe decline, and in some cases, such as with passenger rail, in outright collapse. This suggests that capacity

for the management of transport network industries and investment into its maintenance and development is not evenly distributed across transport modes and geographies, and while South Africa continues to invest in strengthening its transport infrastructures, the pace of decline appears to be increasing in those parts of the system where regular necessary investment and competent management has been lacking.

Notwithstanding the lack of investment, development in the transport sector has also been hamstrung by policy inertia and leadership instability, a situation that has been worsened by a complicated structure of authority, some of which is centralized nationally in state owned enterprises (SOEs), while elsewhere it has been devolved to provincial and local governments. For example, key institutions such as the passenger and freight rail companies have seen frequent and disruptive changes in management and boards, while there have been six ministers of transport and at least 10 directors general (both acting and permanent) in the last decade.

Sectoral mandates are also quite fragmented. Oversight for passenger rail—managed the SOE Passenger Rail Agency of South Africa (PRASA)—and rail safety regulation—managed by the Railway Safety Regulator, another SOE, rests with the DoT, while oversight of freight rail—managed by a subsidiary of the SOE Transnet—rests with the Department of Public Enterprises (DPE), although the DoT retains the policy mandate for rail. The DoT also oversees the SOEs Airports Company South Africa and Air Traffic and Navigation Services, whereas the DPE oversees the national carrier South African Airways (SAA), with the DoT having mandate over aviation policy. Roads are managed across all three spheres of government: National roads through the SOE South African National Roads Agency Limited (SANRAL), provincial roads through provincial administrations, and municipal roads through local government. Large ports are managed by Transnet National Ports Authority (TNPA), reporting to the DPE, while small harbours are managed by the Department of Public Works and Infrastructure. The DoT oversees the Ports Regulator and the South African Maritime Safety Authority (SAMSA).

This helps to contextualize the varied performance across the network infrastructures in South Africa. Some organizations are well capacitated, managed, and resourced, and provide a high standard of management of the assets under their control, while other organizations have weak systems of governance, a dearth of technical expertise, unfunded mandates, management instability, and have contributed to poor outcomes overall. For instance, South Africa's national roads are of a world class standard with SANRAL considered to be a global leader on several issues, notably for pavement

management systems, and for the design and delivery of complex public-private partnerships. On the other hand, especially in the historically rural provinces, roads are in a severe state of decline, while wealthier provinces tend to have networks that are in better condition. In the rail sector, while major ore lines boast superlatives such as the longest production trains in the world on the Sishen–Saldanha iron ore export line, the passenger rail network is in a state of near-total collapse despite vast sums of money being allocated yearly for its maintenance and development.

In South Africa, lack of access to transport and mobility resources entrenches existing gender inequities and hinders women's development. While inadequate access to healthcare, restricted social engagement, and poor education, are among the outcomes of transport poverty experienced by both men and women, women already start at lower levels in all these dimensions. This undermines policy direction to empower women and girls (Jennings et al. 2020, Jennings & Arogundale 2021, Lucas 2019, Porter et al. 2020). There is a lack of policy specificity on issues related to gender in transport. South Africa's post-1994 transport policy direction commits the country to pay attention to transport user's needs, and to redress inequity. However, they do not specifically focus on gender. Even the recently published White Paper on National Transport Policy 2021 (DoT 2022), makes no mention of the gendered nature of the challenges in the sector.

Transport infrastructure and services are not gender neutral. Women have different, often overlooked, transport and mobility needs that stem from the fact that they are often primary caregivers both for the young and the elderly, and they are, unfortunately, also vulnerable. These realities impact on travel choices – women often make more trips with more transfers than men, and often need to travel during interpeak times, also tending to limit their travel to daylight hours. Women are often accompanied by children or by elderly relatives, and more frequently need travel with baggage. These factors mean that transport costs tend to be higher for women, because of their domestic or family responsibilities, a cruel irony when considering that women also tend to earn less than men. Meaningfully addressing women's mobility needs will be very relevant for enhancing their accessibility to economic opportunities and services and boosting economic development in general in the country.

3 The Diagnostic Approach to the Sector

3.1 Introduction

To overcome the lack of SDGs dedicated to transport, the approach adopted in the diagnostic was to utilize the four global policy goals of Sustainable Mobility for All: universal access, efficiency, safety, and green mobility. These goals are used to diagnose and benchmark country performance regarding sustainable mobility.

The diagnostic relies on global indicators from the GTF for Transport, primary and secondary data and comparative analysis with peer group countries to conduct a sustainability gap analysis. This is intended to identify comparative strengths and weaknesses in a country's transport and mobility systems. The diagnostic benchmarks South Africa's performances against a range of comparators, including the best performing country in the world, in SSA, and among upper-middle income countries (UMICs) (the list of UMICs is in Annex D).

Under the GTF each policy goal is associated with a principal indicator or a single metric along with a list of supporting indicators (Table 3.1). The selection of the best principal indicators is the outcome of a long deliberation process among international transport organizations, in the absence of transport-dedicated SDGs and associated targets. Performances are measured using global indicators to proxy the four policy goals of universal access, efficiency, safety, and green mobility.

Table 3.1: Global indicator framework for sustainable mobility

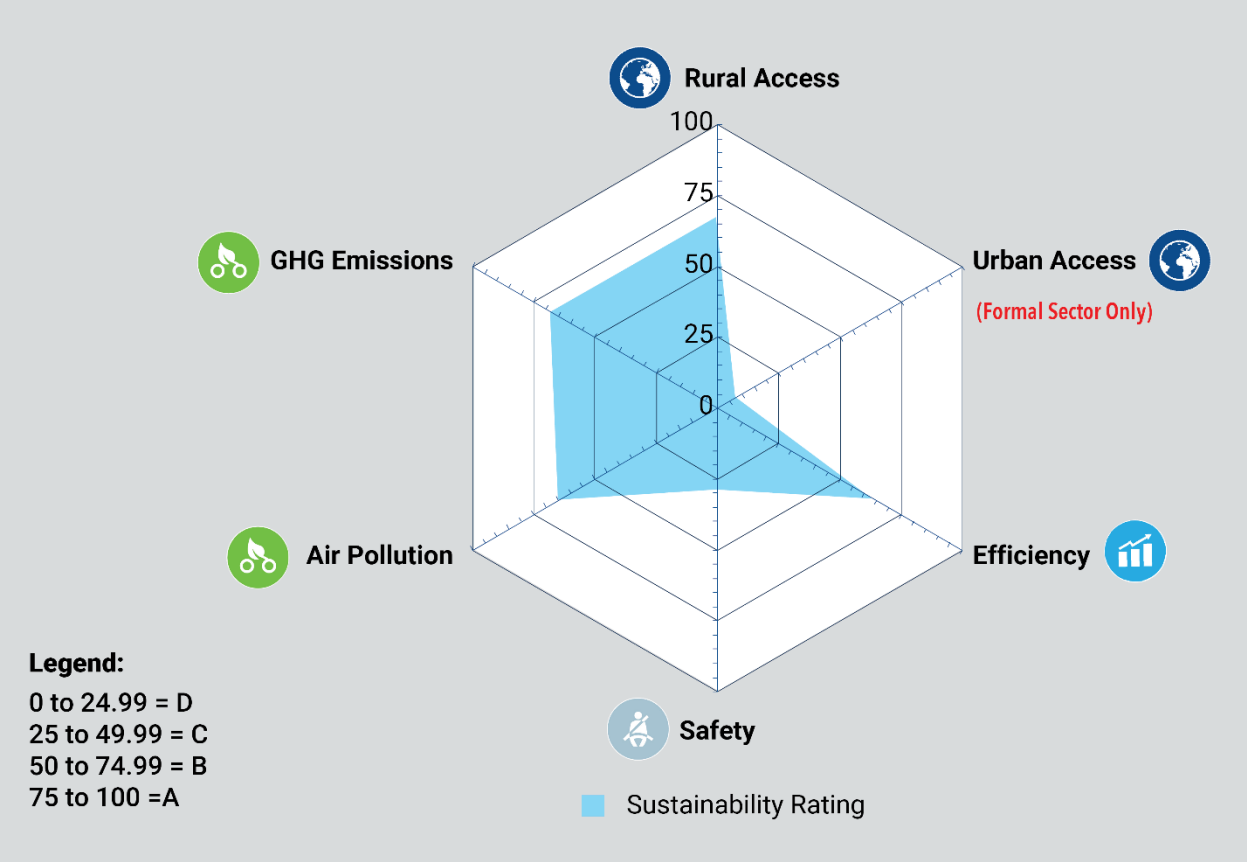
Policy Goal	Sub-goal (where applicable)	Principle indicator (units)	Aspirational target	Data Source	Relevant SDG Indicator
Universal Access	Urban	Rapid transit to resident ratio (km/million)	>40	ITDP	SDG 9.1 SDG 11.2 SDG 3.4
	Rural	Rural access index (percentage)	100	ReCAP	
	Gender	Female workers in transport (percentage)	50	ILO	
Efficiency		Logistics performance index (Value 0-5)	5	WBG	SDG 7.3 SDG 12c SDG 12.3 SDG 9.4 SDG 17.14
Safety		Mortality caused by road traffic injury (per 100,000 people)	0	WHO	SDG 3.6 SDG 11.2
Green Mobility	GHG Emissions	Transport-related GHG emissions per capita (tons of CO2 per capita)	<0.3	IEA	SDG 13.2 SDG 13.1 SDG 7.3
	Air Pollution	PM2.5 air pollution annual exposure (ug/cu.m)	<10	Global Burden of Disease study	
	Noise Pollution	Number of urban dwellers exposed to excessive noise levels	Data not available yet	Data source not available yet	

Source: SuM4All, 2019.

While benchmarking is useful for identifying challenges at a broad level, these can mask significant spatial heterogeneity. The benchmarking relies on global indicators, national statistics, and published data (e.g., administrative data from secondary sources produced by a range of organizations, and published survey

data). To capture country-specific features the benchmarking was complemented with more granular sub-national analyses using existing and new metrics developed for this study.

The sustainability gap analysis suggests that the two biggest issues to address in South Africa are accessibility and safety, even though there is room for improvement on both efficiency and green mobility as well (Figure 3.1). The remainder of this section presents the evidence supporting the sustainability gap analysis and the findings from a deeper analysis that it was done to understand the drivers of the outcomes in the country benchmarking and sustainability gap analysis.



Source: SuM4All, Forthcoming a.

Figure 3.1: South Africa's sustainability gap analysis against global benchmarks

3.2 Universal Access

The universal access policy goal is intended to capture the ambition that transport connects all people and communities to economic and social opportunities, taking into account the needs of diverse groups,

including the poor, those in vulnerable situations, women, children, the elderly, and persons with disabilities, across geographical locations.

The attainment of SDG target 11.2, by focusing on urban access, and SDG target 9.1, by focusing on rural access, should be the main targets (to be achieved by 2030) to facilitate the attainment of the Universal Access objective. While both SDGs acknowledge that transport should "leave no one behind," there is no internationally quantified target for this goal.

3.2.1 Urban Access

South Africa has a Rapid Transit to Resident Ratio (RTR) of 3.1 km/million people. South Africa's RTR is derived from the 49.2 and 31.5 kilometres of operational rapid transit routes in Gauteng (Johannesburg and Tshwane) and Cape Town, respectively. The RTR metric offers a snapshot of rapid transit infrastructure coverage in relation to population. To qualify as rapid transit for the calculation of the RTR, public transportation must meet a set of specific criteria (Box 3). As a result, Metrorail lines do not qualify for the RTR because of the poor service levels on offer at the time of estimation. Minibus taxi (paratransit) services, which provide transport to most public transport users, also do not qualify for the RTR. Only operating bus rapid transit (BRT) corridors in Johannesburg, Tshwane, and Cape Town qualify for the RTR metric, which explains the low RTR for South Africa.

Box 3: Rapid Transit to Resident Ratio (RTR)

The RTR compares the length of rapid transit lines (including rail, metro, and BRT) with a city or country's urban population (cities with over 500,000 people). This metric offers a snapshot of how transit infrastructure compares to population. Because RTR considers the population of a city or country, it shows a more meaningful picture of transit quality than a simple measurement of transit length.

For a corridor to qualify as rapid transit it must meet the following criteria:

1. BRT and Light Rail Transit (LRT) must meet the "BRT Basics" definition in the BRT Standard (a section of road, or contiguous roads at least 3 kilometres (1.9 miles), dedicated lanes for transit vehicles, and one or multiple routes)
2. BRT and LRT corridors must have five essential elements (dedicated right-of-way, busway alignment, off-board fare collection, intersection treatments; and platform-level boarding.)
3. Metro is defined as any rail-based transit mode that features grade separation, off board fare collection, regular station spacing, frequent service and capacity-oriented.

RTR is a useful metric, but it must be considered critically and in context, especially at the city level. Some cities with high RTR numbers do not have transit systems that serve all residents equitably and effectively. For example, a city may have a high RTR, but if the rapid transit corridors serve only wealthy enclaves, low-density districts, or fail to travel to important destinations like job centres, then the high RTR number can conceal the poor quality of actual service. RTR should always be supplemented with an understanding of the geographical relationship between transit and population within a city.

As a result, South Africa ranks in position 58 out of 140 countries in the world. The sustainability gap is typically computed comparing a country's performance relative to the best and least-best performing countries. For indicators where there are significant outliers in the distribution of observations minimum and maximum sustainability thresholds are used to derive the gap analysis (SuM4All 2019). In the case of the RTR, a sustainability threshold of 40 kilometres per million people was used in lieu of the best performing country (Norway with 95.83 km/million people) for comparison, because the distribution of observations has significant outliers. The result of this comparative analysis is that South Africa achieved a score of 8% on urban access, that is an urban access gap of 92%, reflecting the actual achievement of South Africa on urban access, in terms of distance relative to the sustainable threshold in 2018-2019.

Despite significant expenditure on public transport in South Africa since 1994, institutional capabilities have remained limited and outcomes for urban mobility unsatisfactory. Apartheid spatial policies, and a strong orientation towards private car usage during the country's defining period of urban growth has resulted in a highly dispersed urban form with significant negative spill overs. Enhancing access for all in South African cities requires capable, strategic urban planning and management with an integrated approach towards land use and mobility, ensuring that people are located closer to jobs and essential services and that public transport receives priority over private motoring. Effective mobility solutions, especially in the country's metros, will require a combination of transport modes able to service the wide variety of travel demand patterns encountered in major urban centres. However, in South Africa, the planning, implementation, and management responsibility for public transport remains fractured across the spheres of government due to an uncoordinated policy approach.

The commuter rail network has a long history in South Africa, with the oldest lines having been developed in the mid-nineteenth century. However, the network was significantly expanded from the 1950s to the 1980s specifically to support travel from newly developed townships. In fact, many large, purpose-built townships (Soweto, Mabopane, Khayelitsha, Tembisa, Mitchells Plain) were planned with a commuter rail line as the central feature, often centrally located in the urban planning scheme. These rail services were further supported by commuter bus services, many of which are still in operation today by the same companies (Putco, Golden Arrow). Over time, as populations grew and the demand for services outgrew the ability of the state to provide them, the minibus taxi industry developed largely organically (as is still the case), to cater to unserved demand, eventually dominating the market with over 70% of the modal share.

Historically, the rail services have been managed at national level and are still managed by PRASA today. Commuter bus contracts, originally managed centrally by the DoT were devolved to provincial governments in the early 1990s, and the responsibility to manage the regulation of minibus taxis was similarly setup as a provincial function. More recently, BRT services were introduced in some cities, with planning, operational funding, contracting and oversight located at municipal level.

Arguably this is one of the biggest problems facing urban transport in South Africa, having different institutions – and particularly different spheres of government – responsible for different modes or services. Under these circumstances, each institution tends to line up behind its own favoured technology to compete for resources, with inevitably sub-optimal results. Instead, effective solutions require well

capacitated city-wide urban government institutions that facilitate the emergence of a mixture of appropriate transport services that are able to integrate and compete in an overall optimal manner. These institutions must also be able to integrate the management of land use and mobility so as to optimize access across the city.

South Africa has made some fundamental strides since 1994 in creating the constitutional and legislative framework for appropriate urban transport governance, and building a program aimed at strengthening metropolitan governments as the key locus of responsibility for public transport. However, while significant capacity has been built in some instances where none existed before, especially through the BRT program, overall progress in building institutional capabilities at both city and national level has been patchy and slow. Moreover, the devolution polices underpinning much of national transport policy development since the 1996 White Paper have not been implemented. Most public transport resource allocation in South Africa provided by the fiscus still tends to be supply/modally driven rather than overall demand/solution driven.

In his 2007 State of the Nation address, President Mbeki announced that "Our program in the social sector for this year will also include... implementing detailed plans for passenger rail and road transport including the Bus Rapid Transit System in the Metros and recapitalization of Metrorail." Consequently, efforts to improve the quality of public transport in urban South Africa since 2010 have been focused along these two fronts: the development of BRT systems and the revitalization of passenger rail services, all underpinned by the 2007 Public Transport Strategy and Action Plan (DoT 2007).

This call to action, spurred on in no small part by the massive investment drive leading up to the 2010 FIFA World Cup Soccer tournament, found realization through the IRPTN program that was launched in twelve urban centres across the country. Participating cities were required to develop IRPTNs aimed at implementing high-quality networks of car competitive public transport services that are fully integrated, have dedicated right of way, and are managed and regulated by a capable transport authority.

IRPTNs were to comprise Metrorail priority corridors (in those cities with existing commuter rail services) and BRT systems that were supposed to be integrated into a seamless network offering a standardized high quality of service for users. In this regard, the priority rail corridors, as identified in the Consolidated Regional Passenger Rail Plan of 2006, needed to be upgraded to meet a rapid rail standard and the road-based component of the IRPTN would need to attain a BRT level of service (notionally informed by the Institute for Transportation and Development Policy's (ITDP) "gold standard" for BRT (ITDP 2016)). To

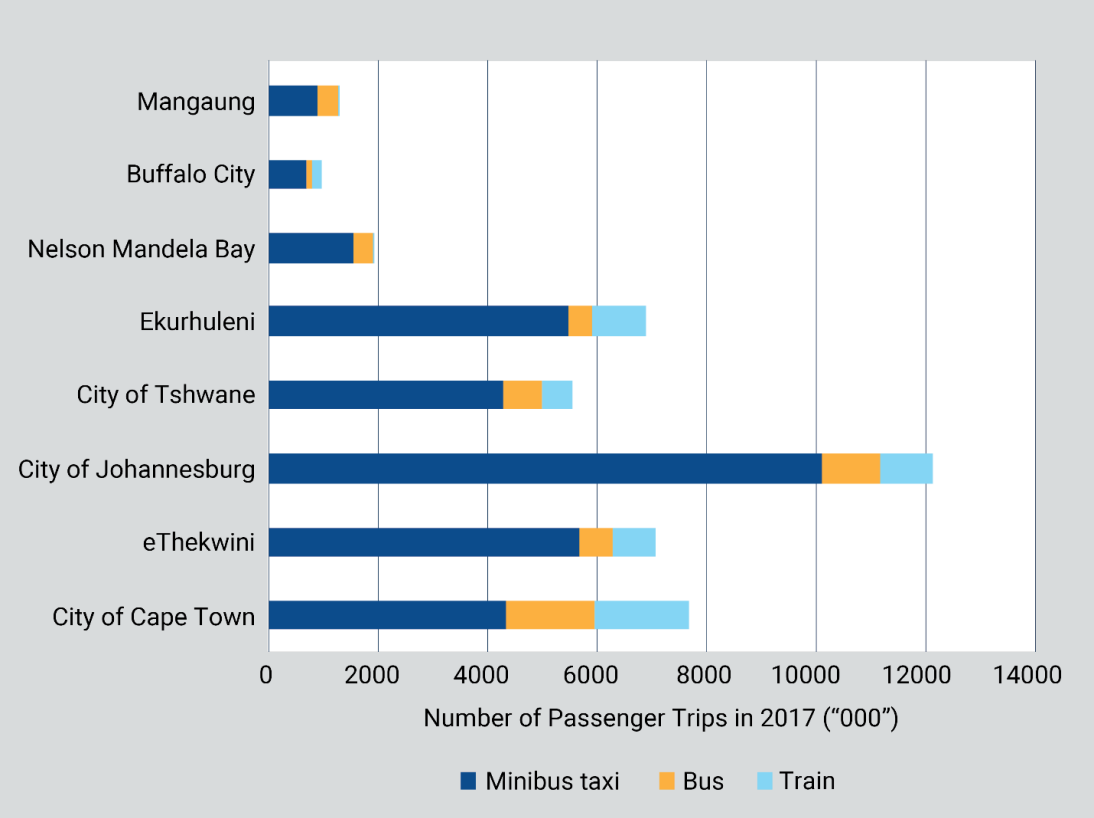
support this, the National Treasury established a Public Transport Network Conditional Grant to support participating cities to develop public transport infrastructure and operations that link to their spatial and transport plans. In parallel, a set of major investments in new passenger trains, signalling systems, station upgrades and fare system technologies was initiated within PRASA to bring effect to the revitalization of Metrorail services.

Over the following 14 years, some progress has been made towards the improvement of public transport, albeit far from the ambitions of the original strategy. Three cities have operational BRT systems (Johannesburg, Cape Town and Tshwane) while several others have built infrastructure and even piloted the services but have not yet managed to launch their first phases. The three cities where services are in operation have struggled to expand operations beyond the first phase.

The situation is now, unfortunately, even more dire for Metrorail services. Service quality has been in steady decline since 2010 and collapsed entirely during the lockdowns imposed in response to the COVID-19 pandemic. Massive multibillion Rand investment programs targeting rolling stock and station renewal and signalling system upgrades that were launched shortly after 2010, have seen only piecemeal implementation and have been plagued by delays and governance challenges.

Most South African households use minibus taxis as their means of transport, suggesting that measures to improve accessibility should also address the quality of service provided by these other modes of transport. Of all public transport users, 66.5% use minibus taxis (paratransit), 23.6% use buses and 9.9% use trains (Figure 3.2)[20]. Walking is the primary means of transport for the poor. Countrywide 41.7% of people walk all the way to their destination—an estimated 17.41 million South Africans. Provincially, 29.5% of people walk to their destination in Gauteng, 31.5% in Western Cape and 40.9% in KwaZulu-Natal (Stats SA 2021).

[20] Metered taxis are frequently used by middle-to-high income earners and tourists. Low-income earners use metered taxis mostly in emergency situations. Metered taxis represent 10% of the total taxi fleet.



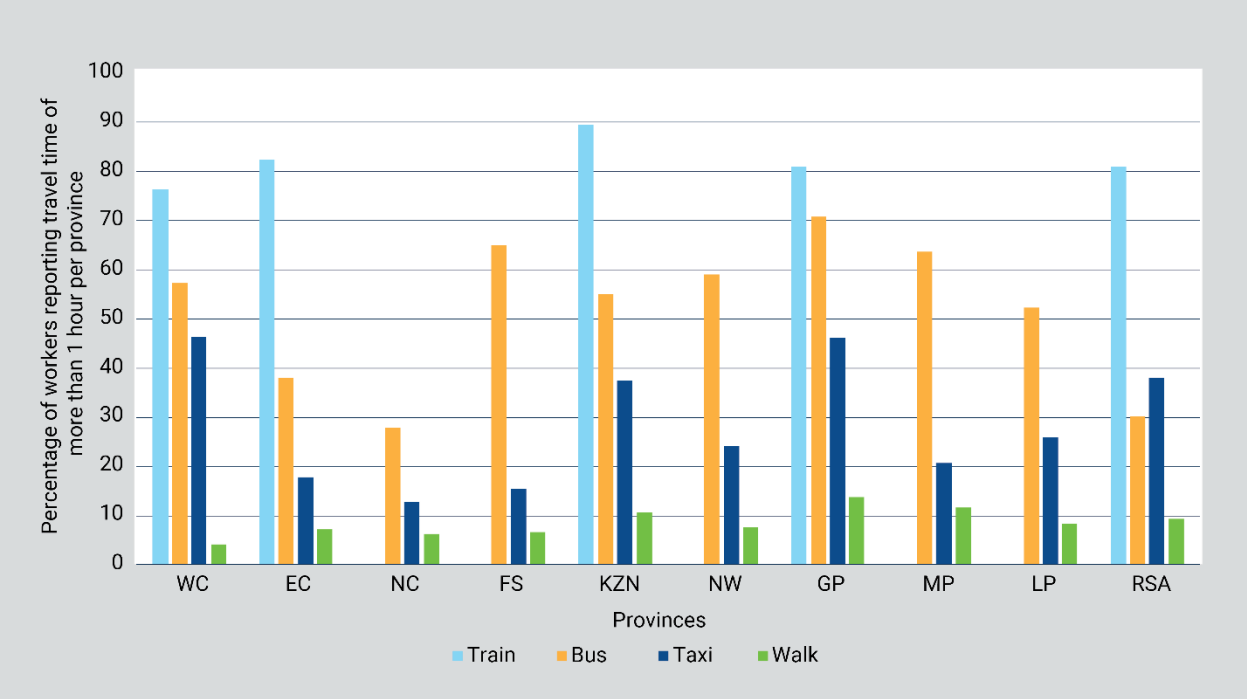
Source: Stats SA, 2018a.

Figure 3.2: City public transport modal split

Affordability of transportation is a major impediment to accessibility and limits job seeking and income generation amongst the lowest income households. The 2020 National Household Travel Survey found that among public transport modes, minibus taxis were the most expensive mode of travel for workers, with average monthly travel costs of R960, followed by buses (R745) and trains (R581) – these costs may have increased in subsequent years as a result of changes in travel demand patterns subsequent to the COVID pandemic lockdowns and the decline of the commuter rail services. 11.4% of urban respondents in the National Household Travel Survey indicated that they walk all the way to work because public transport is too expensive. In 2020, 30.8% of households identified travel cost as the most important element in making transport choices. In metropolitan municipalities, on average 56% of households spend more than 10% of their income on transport (Stats SA 2018a). Across all modes of transport, workers' average travel cost has increased between 2013 and 2020 (Stats SA 2021).

The decline in quality of service has also had important adverse effects for quality of life, impacting the poorest the most. Overall, between 2013 and 2020, the average travel time to work has increased across

all modes of public transport. By 2020, train users travelled for 107 minutes, bus travellers for 84 minutes, and minibus taxi users travelled for 63 minutes each morning to get to work, while those who travelled by car needed on average just over 40 minutes (Stats SA 2022). In comparison, in 2013, the national average time travelled per train and bus was 74 minutes, for minibus taxi users 50 minutes, and 38 minutes for private car users (Stats SA 2013). The percentage of workers who spend more than 60 minutes total travel time to work is reflected in Figure 3.3 below, separated in terms of the mode used.



Source: Stats SA, 2022.

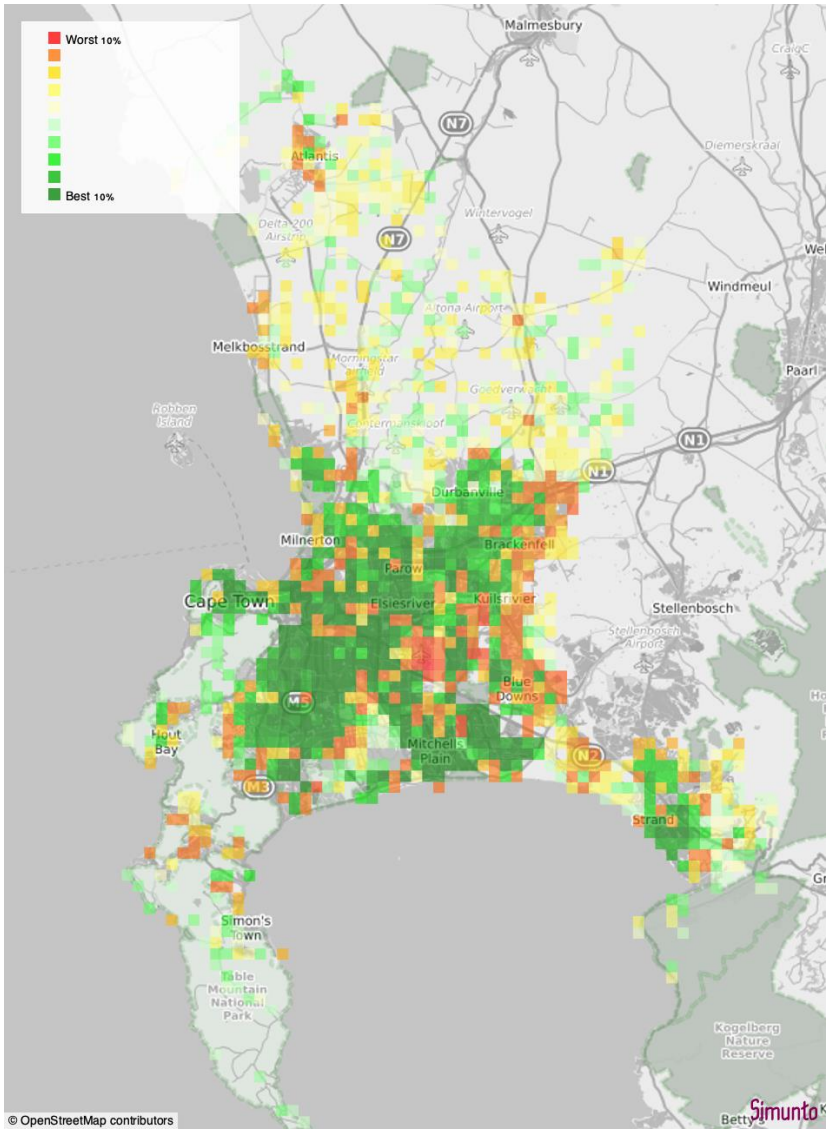
Figure 3.3: Percentage of workers with more than an hour travel time to work

Access to opportunities and amenities is largely dictated by where people live and the transport services that they can access. Many workers who are dependent on public transport live more than one kilometre from a minibus taxi rank, bus stop or train station. At a national level, 11% of workers live 1 km or more from the first available public transport access point (which is usually the minibus). Only 40.9% of workers using train services have access within 1 km (approximately equivalent to a 15-minute walk). The spatial mismatch between opportunities and housing is particularly important in South Africa, where the mismatch that has been inherited from apartheid has been exacerbated by housing programs and market forces (Baffi et al. 2018) that have kept the poorest urban residents on the urban periphery. New suburban areas promoted the displacement of retail activity, entertainment, and other household services, while

these areas tend to be poorly linked to the main public transport networks, increasing both the cost and time required to access opportunities and amenities.

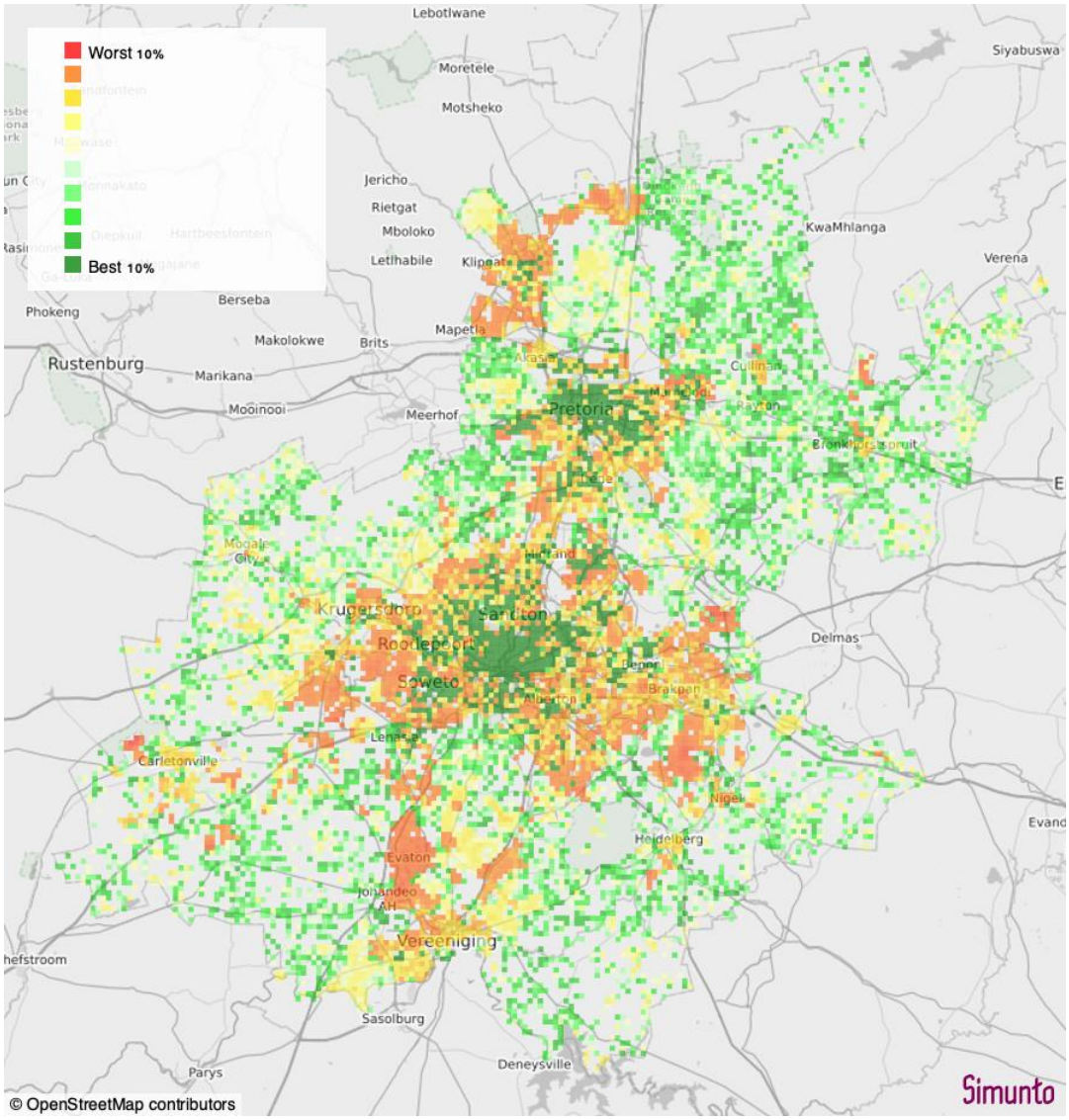
To estimate the impacts of accessibility, this study employed the accessibility measure developed by Ziemke et al. (2018) that captures the features of the South African urban context (Annex A). The accessibility to a variety of activity types was calculated using a generalized cost model that includes both the time and monetary (fare) cost of getting to an opportunity, these both being functions of distance. Activity types included education, shopping, leisure, hospital, other medical facilities, police, other activities such as social services, post office, banking, and work. The accessibility measures for Cape Town and Gauteng, shown in Map 3.1 and 3.2, show the extent of spatial inequality in these areas at the 1 kilometre by 1 kilometre level. The colour scheme shows the deciles of accessibility. So, the red(est) cells are the cells that represent the 10% of all populated cells with the worst accessibility in each metropolitan area. Likewise, the green(est) cells represent the highest 10% of all cells with the best accessibility.

(a) Cape Town



Map 3.1: Current accessibility in Cape Town

(b) Gauteng



Map 3.2: Current accessibility in Gauteng

3.2.2 Rural Access

The Rural Access Index (RAI) is among the most important global indicators for measuring people's transport accessibility in rural areas where the majority of the poor live, and it is the indicator 9.1.1 for the SDG target 9.1. The World Bank is the custodian agency for this indicator and revised the methodology based on the same concept formulated in 2006 but using emerging advanced technologies and datasets in 2016. The metric is conceptually simple – it measures the share of the population who live within 2 km of an all-season road. The latest methodology relies on high-resolution population distribution data along with digitized road network data including road condition information.

South Africa ranks in position 80 out of 183 countries in the world in terms of rural access. This is because its RAI based on the latest globally comparable data from 2016 is 74%. South Africa has a rural access gap of 32.5%, reflecting South Africa's distance from to the best performing countries for this indicator, which are Czech Republic, Singapore, Barbados and Luxembourg. When comparing South Africa to the best UMIC (that is Lebanon), the gap is reduced to 25.8%.

Using the most up to date data on the South African rural roads network, which was collected for this study from the national Department of Transport and provincial Roads Departments, which allows to classify roads as all-weather or not all-weather roads[21], and the latest population data, the RAI for South Africa is even lower, with a score of 57.5% in 2020-21. This means there are approximately 6,059,765 people living in rural areas within 2 km of an all-weather road.

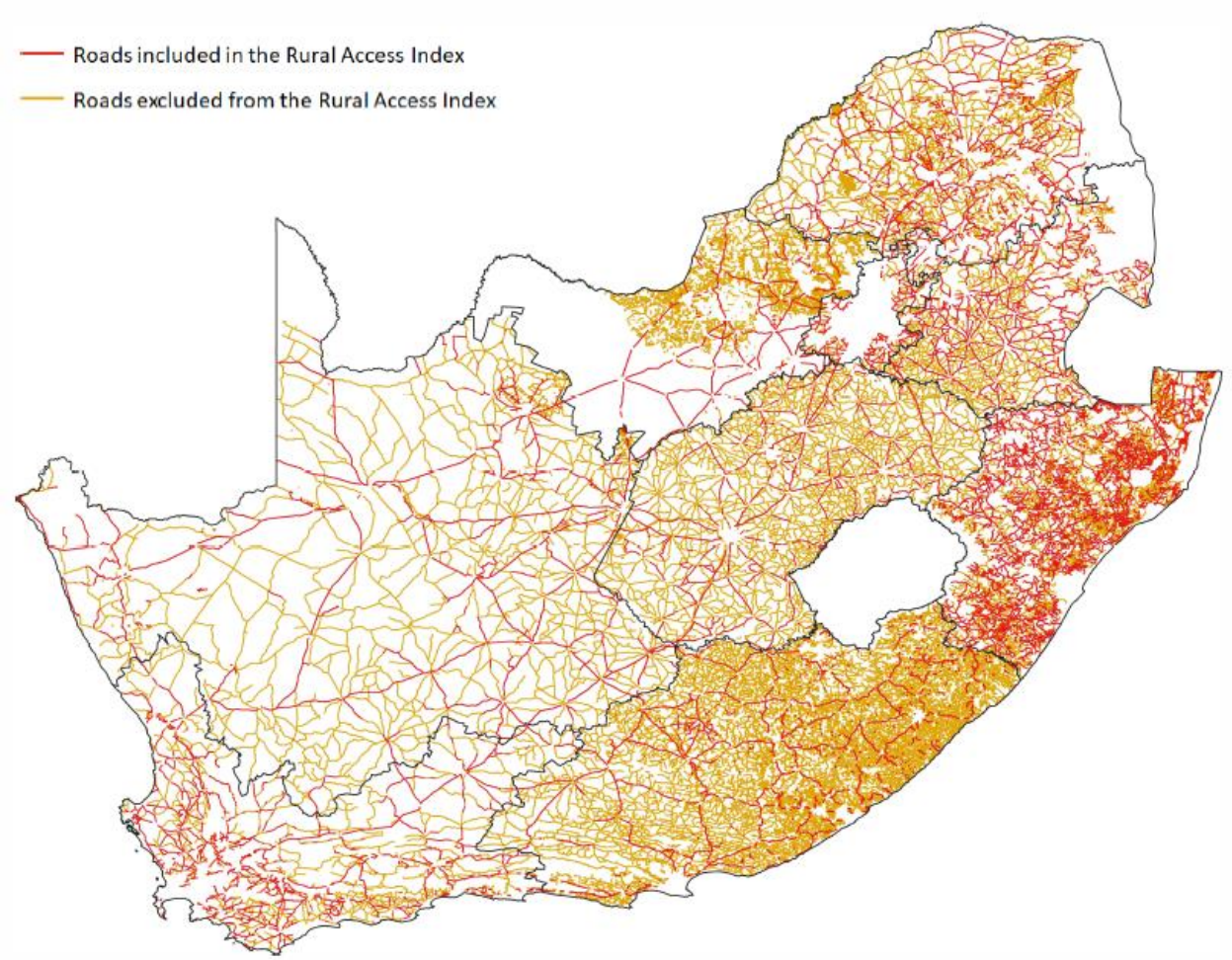
The provincial and local road network in South Africa is overall in poor condition, with the majority of maintenance concerns pertaining to the unpaved rural road network. By 2020 the proclaimed road network was approximately 328,550km[22], including interurban highways. This equates to 43.8% of the total road network (urban and rural). The ownership and management of roads is shared by SANRAL who have jurisdiction over national roads (highways), the 9 provincial road departments, and the 44 district municipal road departments. Provincial road departments currently manage the largest share, 75.4%, of the rural road network, followed by district municipality road departments with 19.1%, while SANRAL's national roads comprise 5.5% of the network.

Paved roads comprise only 18.8% of the total rural road network, while the remaining 81.2% is unpaved, consisting of a combination of gravel and earth roads. About 84.2% of the paved road network was in a fair, good, or very good condition. However, as of 2020 only 9.7% of the unpaved road network was in good or very good condition. This outcome falls far short of the DoT's chosen performance indicator, that no more than 10% of the road network should be in a poor and very poor condition (DoT 2017b).

[21] An all-weather road is a road of sufficient construction and firmness for vehicles and equipment to traverse during normal inclement weather, including expected rain, snow, and freezing temperatures, irrespective of the season. Typically, this refers to paved or constructed unpaved roads. This is a more stringent requirement than an all-season road, which is generally defined as a classified or un-classified road that will not be closed for more than two consecutive days and not more than two weeks per year in total. All-weather roads are by default also all-season roads, but all-season roads are not necessarily also all-weather roads.

[22] Excludes some rural roads managed by the North West province and those in the 12 district municipalities not captured in the national DoT's Road Asset Management System.

One implication of the poor road conditions, especially that of the unpaved network, is that the majority of roads do not qualify as all-weather roads. Map 3.3 shows the roads that do qualify, which represent 24% of the rural road network, and those that do not qualify. So, despite the extent of South Africa's road network on paper, many citizens do not actually enjoy adequate access because roads are not safely and effectively usable in all-weather conditions.



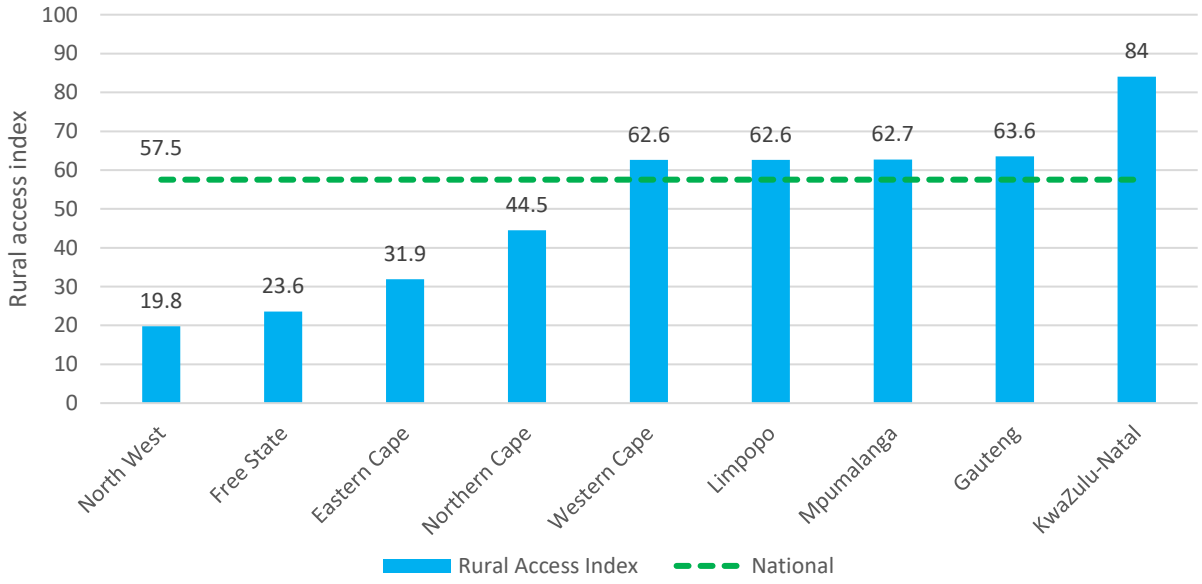
Source: Authors elaboration based on data received from the National Department of Transport and Provincial Road Departments.

Map 3.3: All-weather roads within the rural road network, 2020

According to the land use definitions of the Council for Scientific and Industrial Research (CSIR), the total rural population in 2021 was 10,533,011 people. While some densely populated rural areas are relatively well serviced by all-weather roads, there are also many densely populated rural areas with fewer all-weather roads. As a result, there are 4,473,245 people in rural areas who live beyond 2 km of an effective all-weather road. A significant share, 85% of these isolated rural citizens, or 3,814,922 people, do live

within 2 km of a road, but the road falls short of the all-weather standard—or a proclaimed road in a deteriorated condition. 658,323 people, or 6.3% of the rural population, are completely isolated from the road network. This underlines that inadequacies in asset management are exacerbating the relatively low RAI score, as opposed to limitations in network coverage.

There is also significant variation across the different provinces, as the provincial RAIs shown in Figure 3.4 illustrate. The RAI scores are particularly low in the Free State (23.6), Eastern Cape (31.9), and Northern Cape (44.5) provinces. The Western Cape (62.6), Limpopo (62.6), Mpumalanga (62.7), and Gauteng (63.6) provinces are in line with the national average RAI. Whilst KwaZulu-Natal province exceeds the average with an RAI of 84.



Note: The North West Province was included in the analysis using limited data (the only available data for their Key Performance Indicator network), and hence the results for this province are subject to revision

Figure 3.4: Provincial rural access indices, 2020

3.3 Efficiency

The efficiency policy goal captures the ambition for transport systems to be predictable, reliable, timely and cost-effective. Specifically, the efficiency policy goal embodies the movement of transport vehicles of all types, through terminals and transport infrastructure worldwide, along various routes, either under one mode of transport or a combination of modes, in a timely and least-cost manner to transport goods and passengers, and without undue constraints arising from unreliable and unpredictable operating,

administrative, documentary, legal, regulatory, and institutional frameworks. In the GTF, efficiency is measured with indicators in four thematic categories: energy, technology, institutions/regulations, and finance, with the principal indicators focusing on connectivity. South Africa has an overall efficiency gap of 36.6% (normalized score is 63.4%) relative to the best performing country in the world[23]. The quality of South Africa's domestic land-based transport infrastructure is better than that of other countries in the SSA region and those with similar incomes. On a scale of 1 to 7, in which 7 is the best in the world, South Africa's quality of railroad infrastructure is 3.55, exceeding that of SSA at 2.40 and the UMICs at 3.00. On a similar scale, the quality of roads in South Africa is 4.42, compared to the average rating of roads in SSA at 3.38 and the UMICs at 3.73. A mode-specific breakdown of network efficiency performances follows.

Road network: Freight transport in South Africa, with the exception of the bulk movements, is predominantly road based. In the Southern African Development Community (SADC) region, 80% of freight and 90% of passenger traffic movements respectively are made by road (CBRTA 2020). South Africa scores relatively well in terms of its road connectivity index[24], ranking seventh in the world and higher than the average in SSA and the UMICs by a factor of 1.5.

However, the quality of that network varies significantly and is declining overall. The national road network, although overall in good or very good condition, is ageing and shows a downward trend in condition. There is considerable variability in the management and condition of the low-category roads across provinces, which comprise the majority of the road network.

Rail network: South Africa's rail network ranks eleventh in the world at 22,387 route-kilometres and 30,400 track-kilometres. The country transports more goods by rail than any other country in SSA. The railroad density (kilometres of railroad per square kilometre) is higher than the average in SSA by a scale factor of 3.5 and marginally higher than the average in the UMICs by a scale factor of 1.2. The specialized coal and iron ore lines realize large economies of density, although in the former case, there is a significant risk of stranded assets in the medium to longer term.

However, despite the country's extensive rail network, the rail system, with the singular exception of the heavy bulk lines, fails to provide an efficient and cost-effective service. In addition to the cost, the rail

[23] The best performing country in the world is Germany with an LPI of 4.2 out of 5 in 2018.
[24] The road connectivity index is defined as average speed and straightness of a driving itinerary connecting the 10 or more largest cities that together account for at least 15% of the economy's total population (World Economic Forum, 2019).

system is a major concern, with frequent operational breakdowns owing to theft, vandalism, and power outages, increasing numbers of signal failures, and inadequate maintenance resulting in temporary speed restrictions, all of which consume capacity. This has been exacerbated by inadequate investment in recent years to firstly ensure the network stays at its design capacity, and secondly, extends the capacity to meet current and projected demand.

Sea Ports: South Africa is better connected through its ports than most countries in SSA and the UMICs. South Africa's 2020 third quarter liner shipping connectivity index (LSCI), which indicates a country's integration level into global liner shipping networks, is 40.1. This is greater than the average in SSA at 14.7 and the group of UMICs at 28. South Africa's LSCI places the country among the top three leading countries in Africa over the past decade based on this indicator. The LSCI ranks Cape Town, Coega and Durban as the best connected out of the six major South African ports (UNCTAD 2020). At the other end of the scale, East London and Richards Bay are the least connected, a measure that has remained broadly static throughout 2011–2019.

About 90% of South African exports and imports are handled through the ports. South Africa is not a major player globally, but it is a regional giant. The country's merchandise exports and imports make up 0.48% and 0.57% respectively of global trade via shipping. South Africa's total carrying capacity is higher than most African countries but lower than global comparator countries like Thailand. Bulk carriers and oil tankers form more than 80% of the vessel fleet calling at South African ports (UNCTAD, 2022).

Yet despite this, South Africa's ports are comparatively expensive, inefficient, and unreliable. The spatial and operating efficiency is poor, the inter-modal connectivity and service with rail, except for the bulk movements, is also poor, and there have been limitations in management, maintenance, and investment in recent years. Port operational delays are worse than regional or income comparators. The 2021 World Bank Container Port Performance Index ranks the Durban Port 349th out of 351 global ports. The annual number of ports calls in South Africa is close to 9,000. The median time spent in ports (expressed as number of days) is 1.87, which is higher than the average in SSA of 1.85 days and UMICs of 1.25 days (SuM4All 2020a).

Air transport: The quality of air transport infrastructure in South Africa is 5.6 (SuM4All 2020a) on a scale from 1 to 7, with 7 being the best in the world. This value exceeds the average rating of air transport infrastructure in both SSA and the group of UMICs, rated 3.62 and 4.37, respectively. Up to 2016 South

Africa was the leading country in Africa in terms of air transport connectivity score[25], and was ranked in the top 20 globally[26]. South Africa's air connectivity index is 63.5, on a scale of 0 to 100, well above the average for SSA at 22.95 and the UMICs at 52.83. Box 4 describes the South African aviation market.

Box 4: The South African Aviation Market

In South Africa, three state-owned carriers existed within a competitive air transport market, accounting in 2019 for 50% of the market share, which fell to 10% in 2021. These include: SAA, an integrated full-service network carrier (FSNC) that operated on long-haul routes, domestic routes, and African regional routes with wide-body and narrow-body aircraft until it temporarily ceased operations in September 2020 and recommenced a year later; SA Express, which operated smaller turboprop aircraft and regional jets under a franchise agreement with SAA until April 28, 2020, when it ceased operations and was subsequently placed under Provisional Liquidation that is still ongoing; Mango Airlines, a low cost carrier (LCC) fully owned by SAA which operated primarily on domestic routes within South Africa (and previously, a single regional route) until it was grounded on April 28, 2021, due to nonpayment of outstanding debt and placed in business rescue by court order on August 10, 2021, with an effective date of July 28, 2021.

There are also six privately owned, scheduled, airlines: Kulula.com (an LCC with a market share of 19% in 2019 and 18% in 2020, currently not operating after its parent company, Comair was placed in liquidation); FlySafair (an LCC with a market share of 22% in 2019 and 35% in 2020); Lift Airline (a new start-up LCC brand, operated by Global Aviation—a charter and aircraft leasing company that became a scheduled carrier in December 2020); British Airways Comair (a regional FSNC with a market share of 16% in 2019 and 10% 2020, currently in liquidation), operating narrow-body aircraft as well as two regional airlines; Airlink, which operates turboprop aircraft, regional jets, and crossover aircraft on domestic and African regional routes; and CemAir, which operates turboprop aircraft, regional jets, and crossover aircraft. Privately owned CemAir, established in 2005, served some secondary, regional routes, and leased aircraft to other African airlines. In December 2018, the South African Civil Aviation Authority banned CemAir and grounded its fleet. In April 2019, South Africa's high court ruled that decision illegal and flights progressively resumed in November 2019 (Charlier & Dobruszkes 2020).

By deregulating its domestic market in 1990 and progressively liberalizing its international market in subsequent years, South Africa has created a conducive regulatory platform for a competitive air transport market. SAA operated as a monopoly on the main trunk routes within the domestic market from 1934 until 1990. The market was then deregulated by abolishing statutory protection through a new aviation policy and legislation that allowed private sector airlines to enter the market. Deregulation introduced market competition which had two distinct features (Charlier & Dobruszkes 2020). First, Comair increased its positioning through a franchise agreement with British Airways, providing alternatives to SAA's full-service offerings. The presence of a foreign airline in a domestic market was a novelty. Second, it allowed several low-cost airlines to emerge and flourish to the point of amassing more than 60% of the domestic market by 2019. The market dynamics spurred by

[25] The International Air Transport Association (IATA) airport connectivity indicator (IATA 2020) measures the degree of integration of a country within the global air transport network. It is based on the number of available seats offered in flights originating from a country. For each airport, the number of available seats to each destination is weighted by the size of the destination airport (in terms of number of passengers handled). The weighted totals are then summed for all destinations and then for all airports in the country to produce a score. This score is then divided by the highest score (United States) and multiplied by 100. The scale of this indicator ranges from 0 to 100 [best].

[26] The decline in South Africa's connectivity performance in comparison to other countries on the continent can be attributed to improvements in connectivity in other countries such as Egypt and Ethiopia, coupled with local challenges such as route closures and the eventual bankruptcies of SAA and SA Express.

deregulation pushed SAA to transfer part of its operations to regional affiliates (SA Express and Airlink) and to a launch a low-cost subsidiary (Mango Airlines) with which SAA competed on main domestic trunk routes.

In 1993, South Africa's international air transport market was liberalized. Certain restrictive elements (barriers) of Bilateral Air Service Agreements (BASAs) were removed, which enabled foreign airlines to increase capacity. National interest became a fundamental principle of the Airlift Strategy of 2006 to determine the negotiating mandates for BASAs to ensure greater alignment with government policies and strategies, particularly with the tourism growth strategy (Accelerated and Shared Growth Initiative for South Africa). Foreign designated airlines obtained much more capacity (flight frequency) frameworks, which stimulated inbound tourism substantially from 2005 to 2014, after which the growth leveled off because of internal regulatory and administrative policy issues, especially related to visas. SAA claimed that it incurred losses on its intercontinental operations over a very long period, which reduced the market attractiveness of such intercontinental air services. By the end of 2019, only 12% of inbound tourists were carried by SAA. Major international airlines largely ensured the country's continued connectivity to important source markets.

Since SAA ceased operations on May 2, 2020, all intercontinental flights have been conducted by foreign airlines. Most passenger journeys (60% to 70%) on intercontinental traffic originates in the foreign source markets, where foreign-based airlines operating to South Africa generate support through their networks, alliances, and loyalty schemes. One-stop flights through intermediate Gulf airports have become an essential element of traffic generation. Although not subsidized before the pandemic, many of these airlines have obtained state financial aid to continue operations. BASAs are relatively liberal based on high-capacity (frequency) frameworks, which make provisions for multi-designation of airlines.

South Africa has not yet accepted the European horizontal agreement to replace BASAs with individual European states. Although it has been legally possible for private sector airlines from South Africa to enter intercontinental routes since 2006, no airline has applied for such rights due to the higher risk perceptions of start-up losses and the prospect of competing with SAA and large foreign airlines. However, most South African domestic airlines have concluded codeshare agreements with foreign airlines operating in South Africa.

As a Single African Air Transport Market (SAATM) signatory state, South Africa has fairly liberalized its BASAs in Africa. In recent years, its domiciled airlines, including private airlines, have increased their presence on regional routes depending on the flexibility of the BASA partner state. However, South Africa's reciprocity requirements for fifth freedom rights and the nationality requirements of foreign eligible airlines effectively prevent full implementation of the Yamoussoukro Decision (YD) - a treaty adopted by most members of the African Union which establishes a framework for the liberalization of air transport services between African countries, as well as fair competition between airlines. The country needs to ensure all existing (and future) BASAs comply fully with the provisions of the YD (especially Articles 2, 3, 4, 5, and 6) and fully implement the SAATM's concrete measures to reap the full benefits of a liberalized and competitive market.

South Africa limits FDI in its domestic airlines to 25% (75% of voting rights are held by residents of South Africa) for domestic services, but 49% for international air services (substantial voting rights are held by residents of South Africa) together with some other assurances. Furthermore, the aircraft to be used must be a South African registered aircraft, unless the International Air Service Licensing Council exempts the applicant from this requirement and must be operated by South African licensed personnel. The government can also exempt the applicant from the 75% ownership requirement, but this has not been done so far in South Africa. The YD allows all "eligible airlines" established and licensed in any YD state to be designated by any YD state on any route. South Africa usually requires airlines designated by other states to be substantially owned and controlled by citizens of that state. South Africa also requires that majority ownership and effective control of SAA must be vested in South African nationals.

The pace and shape of market recovery will determine South Africa's state-owned airlines' restructuring options and success. The recovery is expected to last another two years. As of now, there is more capacity available than required in the country. British Airways and Kulula.com (Comair) recommenced operations in September 2021.

The new SAA has also announced the launch of domestic and regional operations with its five-aircraft fleet. Its low-cost subsidiary, Mango Airlines, is aiming to restart with an eight-aircraft operation, being in direct competition with Lift Airline, an LCC owned by the private equity partners of the new SAA company. This is contrary to the new SAA business plan, where Mango Airlines' division would disappear and remain as a sub-brand fare category. The business plan supports the continuation of the intercontinental flights, as of 2022, although it recognizes that these were the routes that generated the greatest losses and registered pre-pandemic load factors of only 70%.

The new SAA would relaunch flights from Johannesburg to Cape Town, Accra, Kinshasa, Harare, and Lusaka, competing with regional carriers on some previously less competed routes, including Airlink, CemAir, Proflight Zambia, and RwandAir. The non-competed destinations of Kinshasa and Accra, while profitable due to the lower breakeven load factor, were suboptimal pre-pandemic with load factors of 57% and 69%, respectively. However, there is reliance on the high percentage of business class passengers (20%) that were traveling pre-pandemic but will take a longer time to return fully to those levels. On the nearby routes, with competition and currently low demand, Airlink, with smaller Embraer regional jets, will have a competitive advantage as it will be able to adapt capacity based on load factors to reduce costs.

The main concern of potentially excessive capacity is that it could trigger the need for state financial aid to keep SAA operating, although post disposal of 51% shareholding, this risk is significantly mitigated. SAA's network scope has been challenged due to its poor financial position. The airline currently lacks network scope in comparison to Airlink's growing network of 13 countries and 45 destinations from Tambo International Airport. While Airlink has expedited the development of partnerships with all major international airlines, SAA remains the airline with the most expansive partnership network in the country. Furthermore, there are public concerns that SAA will not be able to raise the start-up capital required, and that the relaunching of routes will require a minimum of six months of capital investment before they could yield results, maintaining the airline at a loss. It is, therefore, imperative that the due diligence process between the Takatso Consortium-preferred strategic equity partner (SEP) and the government of South Africa determines the approach and content of the capital-raising efforts of the future investor without recourse to state aid for avoidable operational inefficiencies.

Additional factors play against the new SAA business plan, such as its image that has been seriously damaged, especially among high-paying corporate travelers, and the larger aircraft size that will limit its capability to match Airlink's high-frequency/business travel-friendly schedule. Relying on the regional airline's network should be evaluated as a way to feed passengers into the new hub system. Without such a partnership, there is a high probability that the relaunch of SAA will result in a high level of losses and low load factors.

Overcapacity can do more damage than good. Under the current constrained markets, airlines that have reported profits in the past (FlySafair, Comair, and Airlink) can easily become unprofitable and insolvent, resulting in value destruction in the sector and overreliance on SOEs that have proven incapable of offering a sustainable solution in the past. Economic regulators and shareholders, therefore, should ensure that the state-owned airlines are not initiating operation on routes where there is overcapacity, which would result in an unnecessary spending of public resources.

SAA has prepared an ambitious but risky business plan to reenter the market, considering the reestablishment of loss-making long-haul flights as of the second and third years of operation. SAA has R 2 billion (US$136 million) at its disposal and launched a new service before conclusion of an SEP agreement that would provide R3 billion (US$204 million) of funding for the joint venture.

The initiation of long-haul flights under any economic environment should happen only with the support of a profitable domestic and regional network. As such, the viability of the new SAA should be assessed prior to further expansion or recapitalization. The business plan fails to present a segregated approach (maintain an intra-African network until conditions are met) and a mitigation plan in the event of a prolonged COVID-19 crisis.

Energy: South Africa's transport system is energy- and carbon-intensive. The country's energy consumption for transport relative to GDP is 26 gigawatt hours of energy (GOE) per dollar. Road freight and private passenger transport account for the bulk of South Africa's Road sector energy consumption and represents 91.6% of land transport fuel consumption. This represents around 28% of total final consumption in the national energy balances. The bulk of this energy demand (97%) is in the form of liquid fuels, which itself is the bulk of the national liquid fuel demand at 84% (Coelho 2016). This is larger than the average in SSA, which is 21 GOE per dollar, and in UMICs at 24 GOE per dollar. The freight sector is the largest user of fuel in the transport sector and consumes electricity, diesel, and petrol. Electricity is only consumed in the pipeline and rail subsectors. Petrol and diesel account for 30.3% and 66.8% respectively of total energy use in the total freight sector, while electricity accounts for less than 3% (Merven et al. 2019). The price of energy used to fuel 97% of South Africa's road transport sector is disproportionately higher than in other UMICs.

Technology: South Africa has an edge over its peers in embracing technology. South Africa's digital adoption index at 0.64 is above the average in both SSA, 0.32, and UMICs, 0.52, representing a strong enabler to realize more efficient mobility (World Bank, n.d.).[27]

Governance and Institutions: The undue influence governance index is 3.5, above the average for SSA and UMICs (World Economic Forum, 2017)[28]. A key challenge for the whole transport sector is that authority over each mode is split amongst an array of institutions and across different spheres of government (Van Ryneveld 2018). South Africa has made some fundamental strides since 1994 in creating the constitutional and legislative framework for appropriate transport governance. However, policy implementation since the 1996 White Paper on National Transport Policy has been consistently lagging across all industries of the transport sector. There are serious capacity and managerial constraints at all levels of government that hinder the purposeful delivery of policy prescripts.

Policy Implementation and Regulation: In general, South Africa has strong transport legislative and policy frameworks (see section 2.1). Freight and passenger transport are supported by key policies and legislative frameworks, and many strategies. However, the implementation of these frameworks has been

[27] The index measures countries' digital adoption across three dimensions of the economy: people, government, and business.

[28] The undue influence component of the good governance ranges from 1 = worst to 7 = best. It captures security, property rights, social capital, checks and balances, transparency and ethics, public-sector performance, and corporate governance.

marked by inertia that strains institutional arrangements, private sector participation, investment, and innovation.

Finance: Infrastructure investment by the government declined by 0.8% on average in real terms between 2014 and 2019. SOE investment declined by 4.9% on average. Freight infrastructure and transport services are funded from user charges whereas road infrastructure and maintenance, and public transport, are funded from user charges, toll revenue, and tax revenues. Financing of transport infrastructure is, with few exceptions, largely provided by the government from the general fiscus. While the country certainly has experience with PPPs in the transport sector – with nine large PPP contracts having been concluded since 2003 (World Bank 2022) – there remains good opportunity for government to leverage private sector finance and know-how to improve the performance in the sector. To date, PPPs have been limited to large toll road concessions, fleet management programs and the Gautrain Rapid Rail Link between Johannesburg and Pretoria, however, the government has expressed interest in PPPs in maritime, aviation, rural roads and public transport, although progress towards finalizing these deals has remained limited.

South Africa spends more on road infrastructure – both for construction as well as maintenance – than other UMICs, but less than several countries in SSA. South Africa's spending on roads at 1.7% of GDP compares poorly with the 5% of GDP spent in Ethiopia and Mozambique and the just over 2% of GDP spent in Lesotho and Namibia (Foster et al. 2022). Although expenditure on roads is comparatively high, maintenance expenditure is low, representing just a third of capital expenditure (a global benchmark for expenditure on roads is a one-to-one ratio between capital and maintenance expenditure (Rozenberg & Fay 2019). This leads to the deterioration of roads and the need for larger spending to rehabilitate roads than if proper maintenance were in place. This is an indication that efficiency of expenditure can be improved in the transport sector.

South Africa's revenue generated from aviation services, international and domestic, is lower in per capita terms than its comparator countries. South Africa's total international and domestic services revenue in million passenger-kilometres is 34,652. This reflects a value of 67.7 revenue passenger kilometre per capita, which is lower than the average in SSA of 97.3 revenue passenger-kilometre per capita, and in the UMICs at 149.1 revenue passenger-kilometre per capita. South Africa's total services of international and domestic revenue in million ton-kilometres are 3,964. This reflects a per capita value of 34.6 revenue ton-kilometre per capita, which again is lower than in SSA at 92.2 and the UMICs at 125.1 (ICAO 2018).

3.4 Safety

The safety policy goal seeks to drastically reduce fatalities, injuries, and crashes (SDG target 3.6). South Africa has a safety gap of 71.4% relative to the best performing country in the world. South Africa has a mortality caused by road traffic injuries of 25.9 per 100,000 people in 2016. This ranks South Africa in position 143 out of 183 countries in the world. The best performing country in the world is Maldives with a mortality caused by road traffic injuries of 0.9 per 100,000 people in 2016. This position is lower than the gap of the median country in SSA (75.9%) but higher than that in the UMICs (45.9%).

Safety is central to sustainable mobility, but South Africa has a mixed record on transportation safety. While its maritime and aviation safety record is exemplary, the same cannot be said for rail and in particular road safety. Some 14,000 vessels transit around South Africa each month, yet South Africa recorded zero ship losses for the third consecutive year in 2021 with the maritime incidents rate also declining significantly due in large part to continuous work by SAMSA[29], to ensure that all stakeholders observe applicable maritime safety, security and pollution legislation and regulations. During 2021, SAMSA responded to 275 alerts and saved 411 lives through its Maritime Rescue Coordination Centre which monitors the coast from a safety and security perspective and tracks the implementation of international standards for navigation aids. Similarly, South Africa's record on aviation safety is well regarded globally. The International Civil Aviation Organization (ICAO) has ranked South Africa first on the continent in terms of aviation safety and 33rd globally. South Africa had no fatal accidents on scheduled commercial flights with aircraft over 5.7 tons in the last five years. Operators from South Africa had no fatal accidents outside of the country during that same period (ICAO 2022).

Unfortunately, road and rail safety performances are not as impressive. In the last decade, there has been a marginal reduction in the annual number of road crash fatalities from 13,967 in 2010 to 12,503 in 2019 (ITF 2019) bringing the fatality rate to 21.3 deaths/100,000 population, which was still above the global average. Road crash rates remain high, costing an estimated 3.5% of GDP in 2017 (ITF 2019).

Most fatalities caused by road crashes involve motorized vehicles and pedestrians. The latest available data indicates that 85% of the road network has a star rating below 3 (iRAP 2020). A diagnostic carried out for Southern Africa countries (World Bank 2021) highlights that in South Africa, speed and drunk driving are major contributors to road traffic crashes (speed limits in the country are higher than the

[29] Ship losses refers to vessel sinkings and covers all vessels that navigate through South Africa's territorial waters.

globally recommended safe system speeds; 58% of fatalities involve a driver over the legal blood alcohol content (BAC) limit). Men suffer disproportionately (77% of total fatalities are men, 83% of which are in their most productive years 15-64 years old) and pedestrians represent 39% of total fatalities.

Non-Motorized Transport (NMT) infrastructure is critical to reduce the large share of pedestrian and cyclist fatalities especially in provinces with large urban populations that record the higher number of pedestrian fatalities (Arrive Alive 2022). International Road Assessment Programme (iRAP) found that 93% of carriageways surveyed have no adjacent footpaths or bicycle lanes, 92% have no pedestrian crossings, and 100% of undivided rural roads have vehicle speeds greater than 80 kilometres per hour, which leads to unacceptably high risks for pedestrians (World Bank 2021).

A holistic approach and measures aligned with the pillars of the UN Decade of Action 2020-2030, including safer roads and mobility, safer speeds, safer vehicles, safer road users, and effective Post-Crash response, along with effective leadership, funding, governance, and improved data and knowledge management, are critical if the country is to reach the SDG target 3.6 of reducing fatalities by 50% by 2030.

With respect to rail, the quality of South Africa's rail infrastructure, including stations, is threatened by theft, vandalism, maintenance issues and the rail environment is not safe for commuters as well as the general public in South Africa. The 2019/20 State of Safety Report highlights increasing long-term trends in both safety and security-related incidents. The occurrences of security-related incidents per million train km increased dramatically by 194% (compared to 106% since 2010/11). This has impacted rail infrastructure and the efficiency of freight and passenger rail.

3.5 Green Mobility

South Africa has an air quality gap of 35.5% relative to the best performing country in the world, however, this gap is 20% compared to other countries in SSA or in the UMIC group. South Africa has a PM2.5 air pollution annual exposure of 25.1 micrograms per cubic meter[30]. This ranks South Africa in position 109 out of 183 countries in the world. The best performing country in the world is Ethiopia with a PM2.5 exposure of 5.86 micrograms per cubic meter. On overall emissions, South Africa is the 14th largest emitter of GHGs in the world, contributing 1% to global emissions. In terms of road transport CO_2 emissions

[30] The guideline set by the World Health Organization (WHO) for PM2. 5 is that annual mean concentrations should not exceed 10 micrograms per cubic meter, representing the lower range over which adverse health effects have been observed.

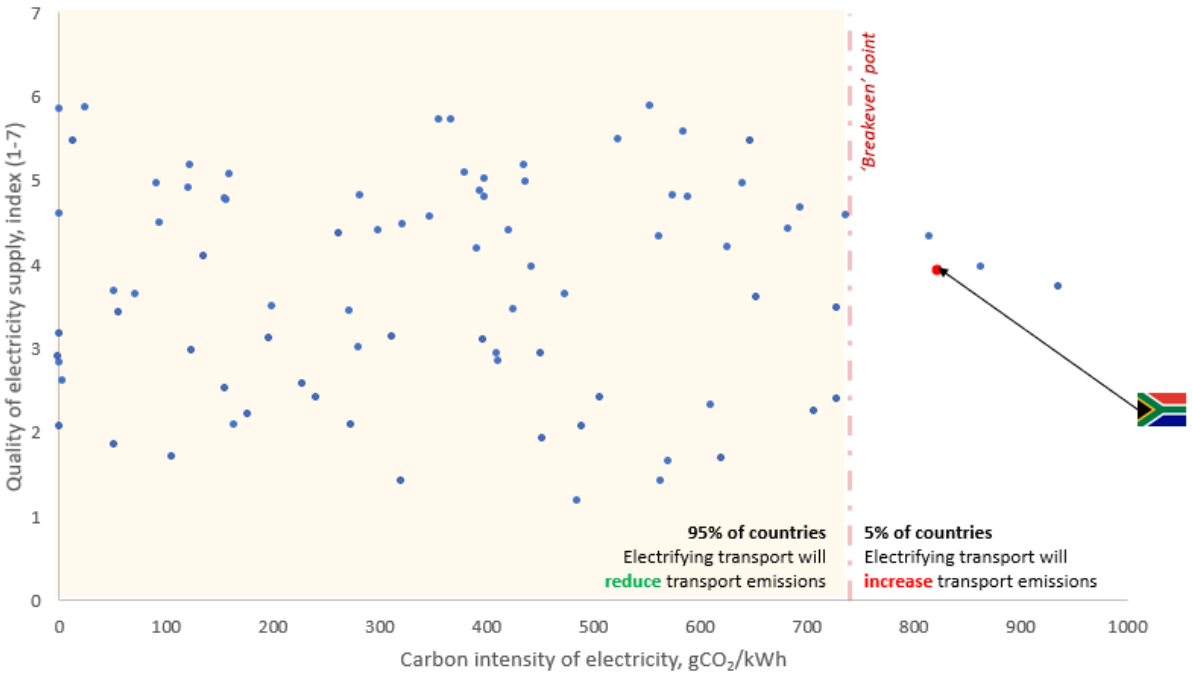
relative to GDP, South Africa has a value 0.063 kg per dollar which is higher than in SSA (0.053) and UMICs (0.0569) (IRF 2017).

South Africa's transport system is energy and carbon-intensive in comparison with SSA countries and UMICs. According to the Department of Mineral Resources and Energy (DMRE 2019), the transport sector constituted 19% of energy demand in South Africa, second only to the industrial sector (52%). Transport contributes 13% of GHG emissions in South Africa (Climate Transparency 2019), ranking it in the 70th percentile against the best performing country in the world on transport related GHG emissions per capita. Carbon emissions are driven by a reliance on road-based transport and spatial inefficiency. Spatial inefficiency - caused by racial segregation policies and the impact of mining on economic development - increases transport emissions. Additionally, the transport sector depends heavily on liquid fuel. 86% of total transport emissions come from road transport (equivalent to 8% of GHG emissions). The road sector consumes about 79% of all liquid fuel, followed by international civil aviation at 13%. Additionally, 0.27 million tonnes of carbon dioxide were produced by South Africa's rail sector. In per capita terms, the rail sector is more polluting than the average country in the SSA region. It is however lower than the average UMIC, on a per capita basis. The Maritime Transport Sector CO_2 emissions are 4.57 million tons or 0.08 tons per capita. This is 8 times above the average in SSA (0.01) and marginally smaller than the average in UMIC that is 0.09. South Africa's inland waterways are virtually pollution free.

South Africa is a leader on electrification in transport relative to other African countries[31], but its source of energy still depends heavily on fossil fuels for electricity generation via coal. Owing to a highly carbon intensive electricity grid (823 grams of CO_2 per kilowatt hour), South Africa is positioned among the top 5% of countries for which electrifying mobility will increase transport sector emissions (Figure 3.5)[32]. However, the government's Integrated Resource Plan for the electricity sector estimates that renewables will make up about 40% of South Africa's electricity production share by 2050 (DMRE 2019), which will help greening transport through electric mobility.

[31] Around 1,000 electric vehicles had been sold in South Africa by early 2022 (African Business 2021, Statista 2022). In July 2021, the first two electric busses were introduced in Cape Town for services (Business insider South Africa 2021).

[32] Countries that rely on high carbon systems to produce electricity are less likely to make a significant dent in emissions through electromobility alone. In contrast, countries with low carbon systems are well equipped to reduce emissions through electromobility.



Source: SuM4All, 2021.

Figure 3.5: Low carbon generation and carbon intensity of electricity in low- and middle-income countries

4 Scenario Analysis

This section examines the transport infrastructure funding needs to reduce the universal (urban and rural) access and (rail and road) safety gaps between 2022 and 2030 in line with SDG 9.1 and SDG 11.2[33] and assesses the impact of several policy options through scenario analyses. The analysis is limited to the question of improving access and safety because these are the two areas where South Africa's transportation system performance is the weakest and infrastructure can help to strengthen the system (see Figure 3.1).

The analysis considers the impact of population and GDP growth in the 2021-2030 period through the following three socioeconomic pathways that were developed for this study (World Bank, 2021b):

- *Baseline.* This pathway assumes population follows the long-term population growth projections for 2021–50, as recently released by Statistics South Africa. It assumes that fiscal policy through 2030 follows current National Treasury projections. The average annual GDP growth projected for the 2021–30 period is 2.21% and the GDP growth in 2030 is projected at 2.61% (Figure 4.1).

- *Urban.* This pathway assumes that total population growth is the same as in the baseline pathway, but that there will be a different distribution of the population across the country due to a trend of urban-centric development and population migration towards cities. The more rapid urbanization increases the tax base, and hence fiscal revenues, but increases the stress on public services and infrastructure provision requirements, resulting in a net deterioration of the fiscal position and a lower GDP growth than in the baseline pathway. The average annual GDP growth projected for the 2021–30 period is 1.98% and the GDP growth in 2030 is projected at 1.98%.

- *Rural.* This pathway assumes total population growth is the same as in the baseline pathway, but that there will be a different distribution of the population across the country due to government intervention in rural areas that makes them more attractive to people. The slower urban-to-rural migration reduces fiscal revenues and increases social transfer payment obligations, causing a

[33] SDG 9.1: Develop quality, reliable, sustainable, and resilient infrastructure, including regional and trans-border infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all.
SDG 11.2: By 2030, provide access to safe, affordable, accessible, and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable, situations, women, children, persons with disabilities and older persons. This is at the heart of the Habitat III New Urban Agenda.

slowing of GDP growth. The average annual GDP growth projected for the 2021–30 period is 1.78% and the GDP growth in 2030 is projected at 1.26%.

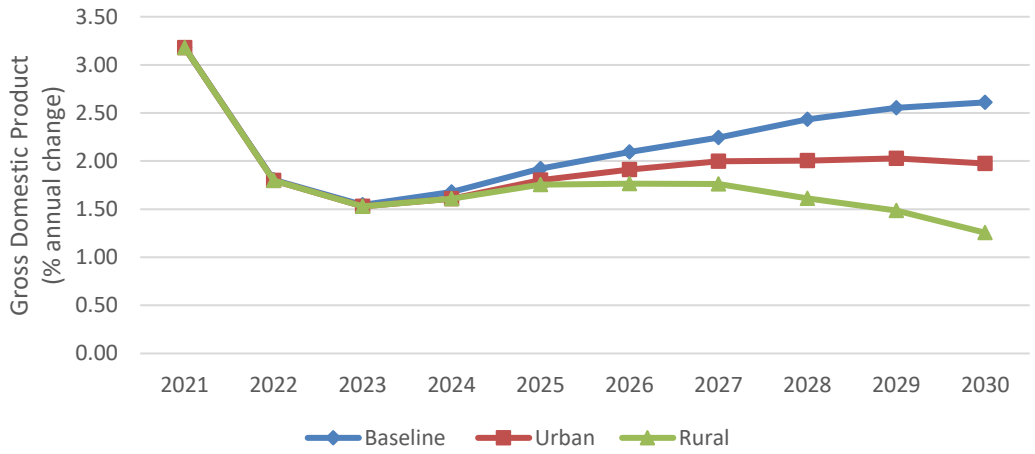


Figure 4.1: GDP growth projections under three pathways, 2021-2030

4.1 Urban Access and Safety

4.1.1 Policy Scenarios

Four policy scenarios are developed to look at transport investment (including infrastructure, and buses and rolling stock for public transport) costs, operations and maintenance costs, and accessibility in urban areas in South Africa. The policy scenarios are the following:

a. The *business-as-usual (BAU)* scenario assumes metropolitan and secondary cities road networks are strengthened, maintenance backlogs are addressed, and ongoing maintenance is provided to support road-based transport and minibus taxis. The extent of the strengthening is based on Kannemeyer (2016). The scenario assumes the ongoing maintenance and operation of urban rail and operational BRTs in Johannesburg (42.2 kilometres), Tshwane (7 kilometres), and Cape Town (31.5 kilometres), and the maintenance of the infrastructure in place for not yet operational BRTs in Tshwane (11 kilometres), eThekwini (31 kilometres), and Nelson Mandela Bay (17.7 kilometres).

b. The *improved rapid transit (IRT)* scenario assumes: (i) the improvement of the quality of urban rail bringing it to full capacity with 20 minutes headways and 75 kilometres per hour of effective speed, including improvement in signalling and conditions of stations, which will improve safety

conditions in the urban rail network, (ii) the start of BRT operations in Tshwane, eThekwini and Nelson Mandela Bay, and (iii) the interventions in the metropolitan and secondary cities road networks considered in the BAU scenario.

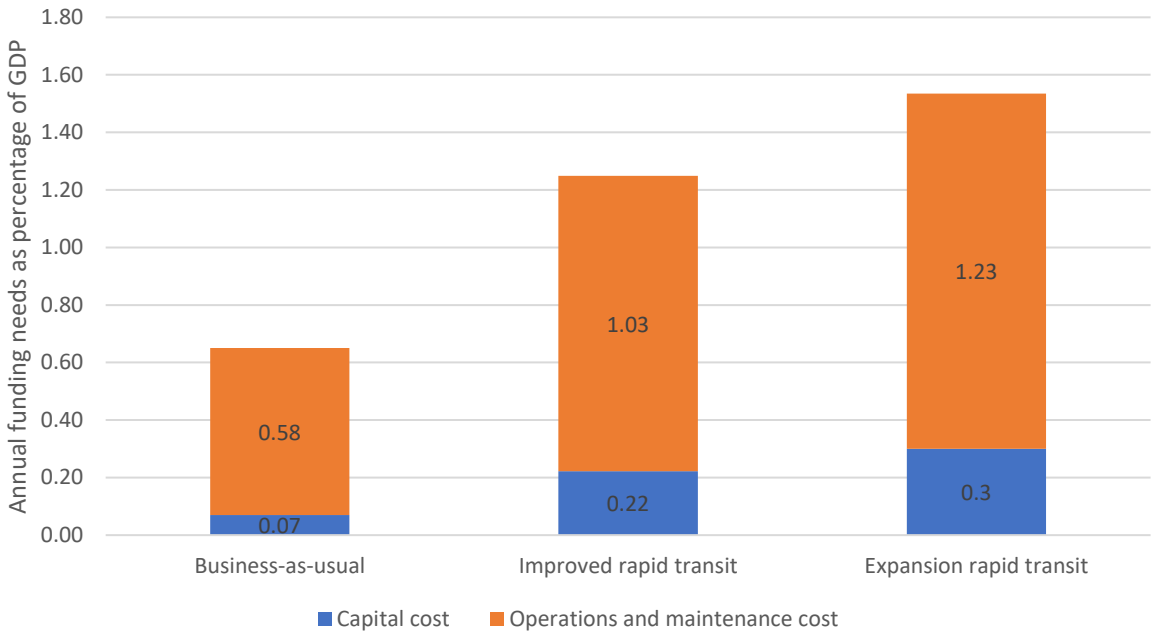
c. The *expanded rapid transit (ERT)* scenario assumes a 28 kilometres expansion of the urban rail network in Cape Town, and Nelson Mandela Bay, and a 120-kilometre expansion of the BRT network in Gauteng, eThekwini, Cape Town, and Nelson Mandela Bay, all of which are investments planned by cities and municipalities (PRASA 2020, DoT 2021), in addition to the interventions assumed in the IRT scenario.

d. The *integrated land-use and transport planning (LUT)* scenario assumes that on top of the interventions assumed in the *IRT* scenario, a joint land-use and transport policy is implemented. Such a land use intervention aims to capture the effect that “take the opportunities to the people" may have, as opposed to “transport the people to the opportunities." Modelling policies that mix land-use and transport instruments are challenging, partly because transit-oriented development policies typically are designed at the local level. The shortcut is to assume that 2% of the populated (1 km by 1 km) cells in an urban area receive a mixed-use facility with all opportunity types except for a hospital, with the cells with lower accessibility having a higher probability of being selected.

4.1.2 Funding Needs

The total transport infrastructure costs increase with the improvement and expansion of the rapid transit system, with the O&M costs representing the lion’s share over the analysis period. The total costs under the BAU, IRT, and ERT scenarios over the 2022-2030 period are R366 billion, R703 billion, and R864 billion, respectively[34]. The annual average costs over the period represent 0.65%, 1.25% and 1.53% of GDP, respectively, under the baseline socioeconomic pathway (Figure 4.2)**.** The transport infrastructure investments under the IRT and LUT scenarios are the same, therefore the investment costs are the same. The restoration and improvement of the urban rail system demands the largest resources, representing 0.7% of GDP per year on average. The differences between the three socioeconomic pathways are small because of the relatively short period of time and the small differences in GDP growth.

[34] See Annex A for the modal disaggregation.



Note: The forecasted GDP in the baseline socioeconomic pathway is used.

Figure 4.2: Average annual total cost under different scenarios, percentage of GDP

Even though the capital costs increase from the BAU to the IRT and the ERT scenarios, the O&M costs range from 80% to 89% of the total costs in the three scenarios. In urban areas total operations and maintenance costs over the 2022-2030 period range from R36 billion per year on average in the BAU scenario, to R77 billion per year in the ERT scenario (Figure 4.3). The total maintenance costs over the period range from R29 billion to R36 billion per year on average. The operation of public transport requires between R7 billion and R41 billion per year, on average, depending on the policy scenario. The operations and maintenance costs amount to 0.6-1.2% of GDP per year, on average, which represents more than 4 times the capital costs. The bottom line is that cities should be prepared to spend significantly more resources on the operation of their public transport systems rather than on the construction of new infrastructure.

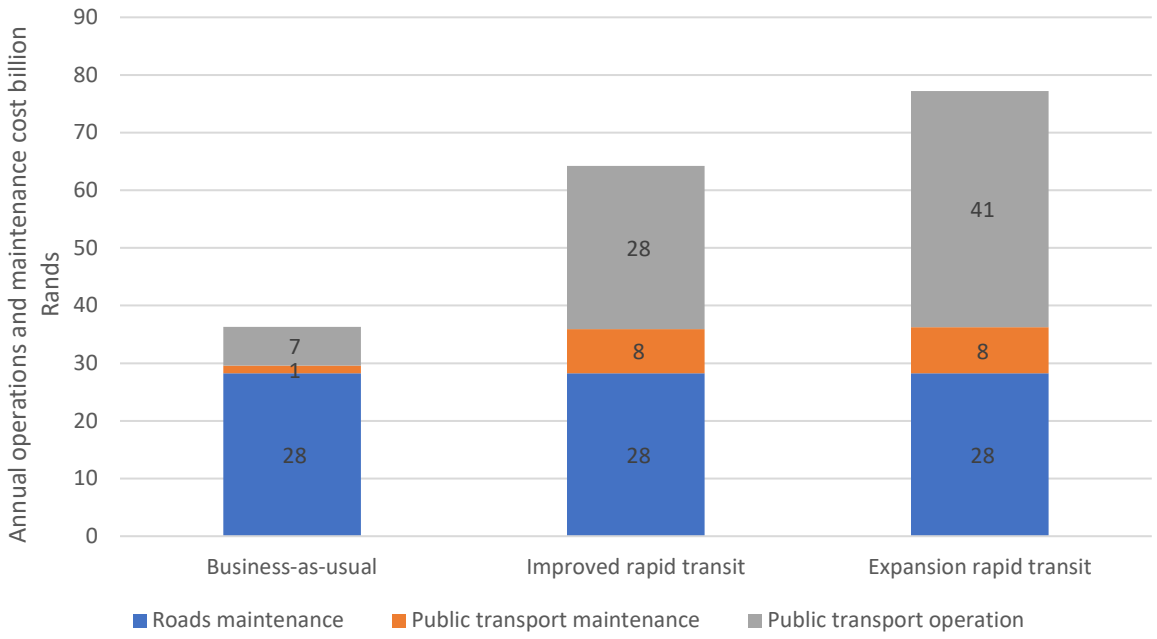


Figure 4.3: Average annual operations and maintenance cost

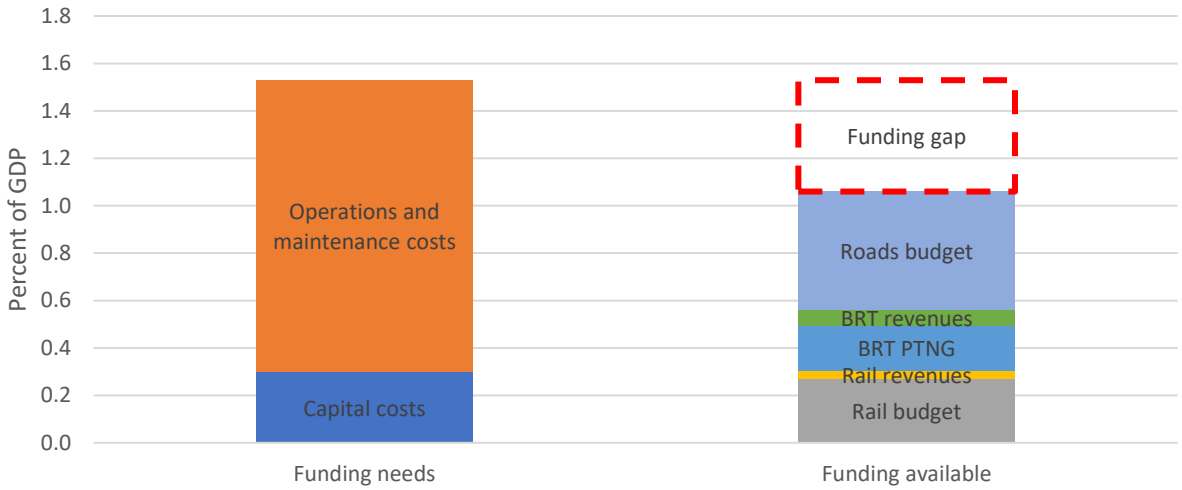
4.1.3 Funding Gap

The funding gap is the difference between the total costs of implementing a policy scenario and the funding potentially available. Estimating the funding available in 2022-2030, or in any future period, is a challenging exercise because the funds available depend on government decisions that cannot be predicted and revenue forecasts. Therefore, significant assumptions need to be made and so the estimated funding gap should be seen only as an indication of a potential need for additional funds.

The estimated average annual funding gap in urban transport is 0.4% and 0.5% of GDP in the IRT and ERT policy scenarios (Figure 4.4), respectively, and there is no funding gap in the BAU scenario. The total funding gap in the 2022–30 period is about R235 billion in the IRT and R280 billion in the ERT. Based on the 2021/22 budget allocations approved by Municipal Councils for road transport in metros and secondary cities, the funding available for metropolitan and secondary cities roads as percentage of GDP is assumed to remain constant over the 2022-2030 period.[35] As a result, the estimated funds available are enough to cover the proposed road works in all scenarios. In the case of BRTs, National Treasury has granted Public Transport Network Grants (PTNGs) to all current and proposed BRTs in the policy scenarios.

[35] See Annex A for the assumptions made to estimate available funding for urban transport and the available funding under the different scenarios.

The PTNG covers capital and indirect operating and maintenance costs, while the direct operating and maintenance costs are to be covered with revenues from fares, parking, and cities' rates. As a result, the funding gap depends on the predicted revenue collection, which in the BAU and IRT scenarios is enough to cover the direct operating and maintenance costs, and in the ERT scenario leads to an average annual funding gap of about 0.05% of GDP. If local governments were unable to collect any revenue to fund BRT operations, then the average annual funding gap would be 0.01%, 0.5% and 0.6% of GDP in the BAU, IRT, and ERT, respectively. This is an unrealistic assumption, but it provides an upper bound for the funding gap in the event that actual revenues are lower than predicted.



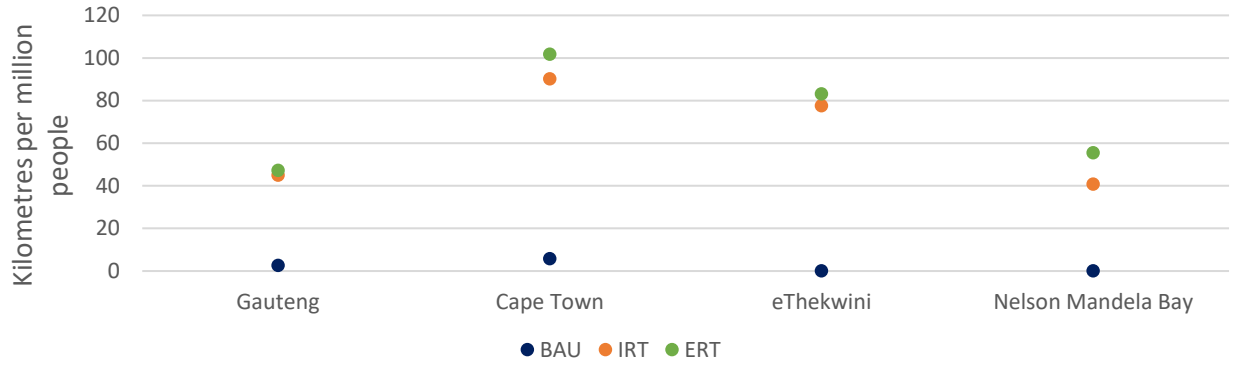
Note: The forecasted GDP in the baseline socioeconomic pathway is used.

Figure 4.4: Funding gap in the extended rapid transit policy scenario

In the case of urban rail, the available government funding for the IRT and ERT scenarios is estimated based on the 2021/22 budget allocations approved by Parliament for Metrorail operations and capital, which are assumed to remain constant as percentage of GDP during the 2022-2030 period. The ridership of urban rail in the IRT and ERT scenarios is assumed to increase over the period and reach its design capacity by 2030. As a result, the average annual funding gap for urban rail is estimated at about 0.4% of GDP in the IRT scenario and 0.45% of GDP in the ERT scenario. In the BAU scenario, where the capital and operating costs are lower, it is assumed that the rail budget would be reprioritized to cover the capital costs and the part of operating costs not covered by fare revenue, which is assumed to remain constant. Therefore, the estimated funds available are enough to cover the rail costs under the BAU.

4.1.4 Accessibility

The RTR in all four metropolitan areas increases with the improvement in urban rail and with the expansion of the urban rail and BRT networks. In the BAU scenario with baseline population, the RTR is 2.6 and 5.7 kilometres per million people in Gauteng and Cape Town, respectively (Figure 4.5). In the IRT scenario with baseline population, the RTR reaches 45, 90.3, 77.6 and 40.8 kilometres per million people in Gauteng, Cape Town, eThekwini, and Nelson Mandela Bay, respectively. If the urban rail and BRT networks are expanded as modelled in the ERT scenario, the RTR (assuming baseline population) will be 47.2, 101.7, 83.1, and 55.6 kilometres per million people in Gauteng, Cape Town, eThekwini, and Nelson Mandela Bay, respectively[36].



Note: The transport investments under the IRT and LUT scenarios are the same, therefore the RTR is the same in both scenarios.

Figure 4.5: Rapid Transit to Resident Ratio in 2030 under baseline population, by metropolitan area

Both the improvement and the expansion of rail have a negligible effect on the accessibility in any of the four metropolitan areas by 2030. The median accessibility (defined in Annex A) increases between 2021 and 2030 in three metropolitan areas and decreases in one, but the changes are driven by the changes in population and opportunities, the latter driven by GDP growth. As Figure 4.6 shows, the change in the median accessibility in the BAU, IRT and ERT scenarios in 2030 is the same, for a given socioeconomic pathway, which indicates that the improvement and expansion in urban rail will have no effect on median

[36] The population in the studied metropolitan areas is lower under the baseline socioeconomic pathway than under the urban and rural socioeconomic pathways, therefore the RTRs are lower in the latter, but the ranking across scenarios remains unchanged.

accessibility[37]. The improvement and expansion in urban rail will have a positive impact in some parts of Gauteng and eThekwini, when the population and opportunities are kept constant, but only in very few of the 1-kilometer by 1-kilometer populated cells in each metropolitan area (Figure 4.7).

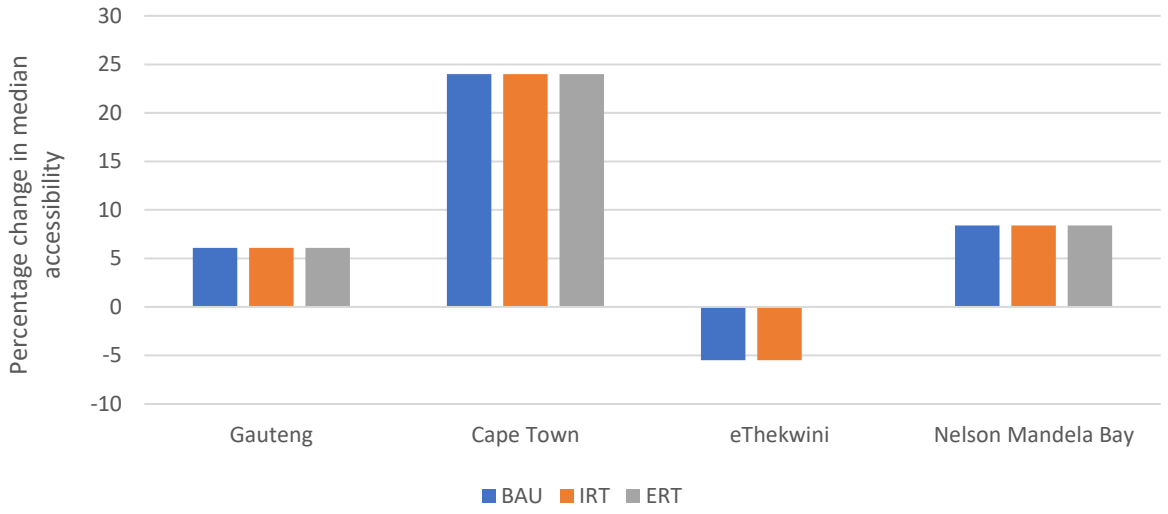
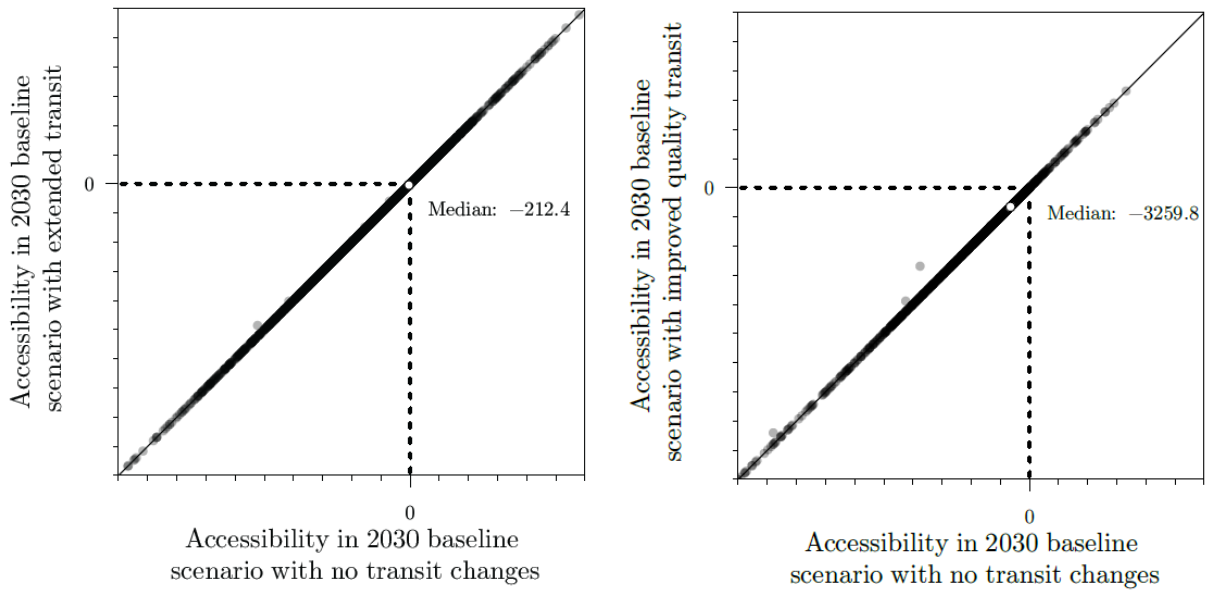


Figure 4.6: Change in median accessibility between 2021 and 2030 under BAU, IRT, and ERT scenarios and baseline population

[37] The accessibility analysis does not consider the expansion on BRT as the data required for the analysis is not available. That said, adding 120 kilometers of BRT across the four metropolitan areas would not have a significant impact on accessibility.



(a) Gauteng (b) eThekwini

Note: The accessibility measures are calculated using the baseline population assumptions. Each dot represents a 1-kilometer by 1-kilometer populated cell in the metropolitan area.

Figure 4.7: Urban accessibility in 2030 with and without rail improvement and extension

The results indicate the limitations of large infrastructure investments in formal urban transport in South Africa and the importance of considering accessibility to a broad range of activities when planning transport investments. The reasons for the limited impact of the infrastructure investments in formal urban transport are the spatial structure of the metropolitan areas, the location of the rail corridors, and minibus taxis dominating urban rail over short to medium distances. The South African rail service was designed and planned to move large groups of (displaced) workers from peripheral townships far from the economic centres. The improvements could reduce travel time and costs along those rail corridors, but they are not large enough to lead to higher accessibility than minibus taxis, which allow people to reach a broader range of activities at a lower generalized transport cost with a door-to-door service, while rail will only get the transport user from station to station. In Gauteng only 0.7% of areas show rail as providing the greatest accessibility, in eThekwini the percentage is 0.4%, in Nelson Mandela Bay 0.6% and in Cape Town, with its more extensive rail network, only 1.1%. Therefore, improving minibus taxi services, which does not require large infrastructure investments, has the potential to improve urban access and the experience of urban commuting over the short to medium term.

Integrated land-use and transport planning yield higher accessibility per rand spent on transport. The results of the LUT scenario show that policies that support the development of opportunities closer to where people live, with an emphasis on the least accessible areas, have a large impact on accessibility. Under the baseline socioeconomic pathway, the median accessibility in 2030 increases in all four metropolitan areas considered (Figure 4.8). With the increase in Gauteng being 3 times the increase without land use planning. Integrated land-use and transport planning consistently outperforms rail improvement and extensions in all socioeconomic pathways.

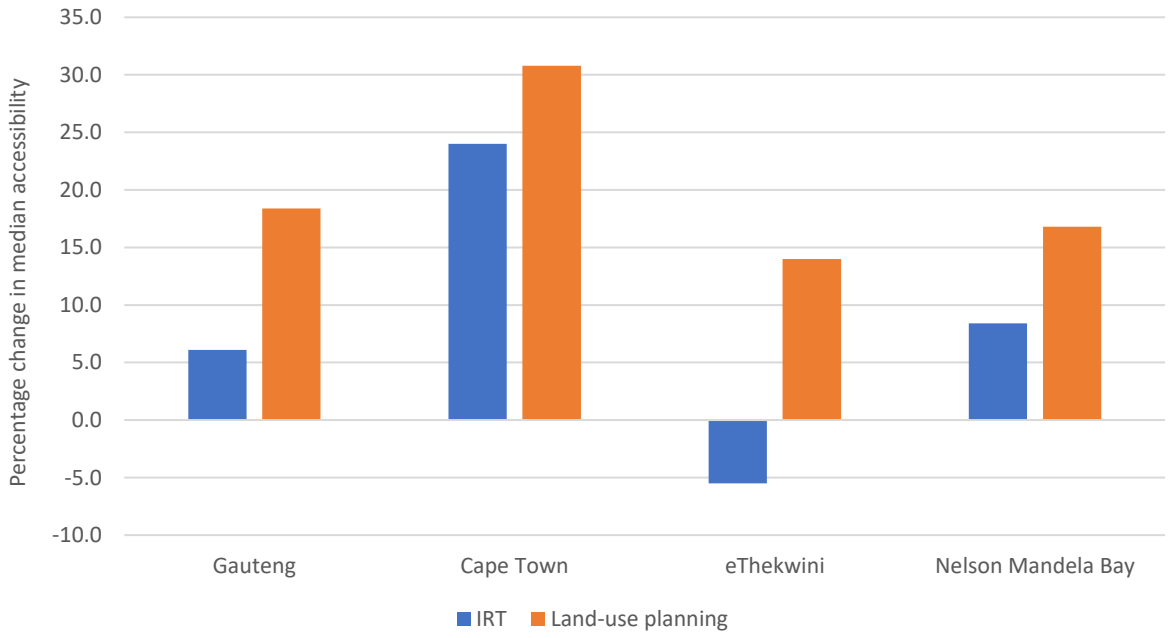


Figure 4.8: Change in median accessibility between 2021 and 2030 under IRT, and land-use planning scenarios and baseline population

Integrated land-use and transport planning is the only policy intervention considered that decreases or limits the increase in the accessibility gap, which is the difference between the highest and the lowest accessibility in a city. Especially in the current state in South Africa where economic inequality is already high and deteriorating, it is important to also consider the impact that an intervention will have on the accessibility gap. Under the baseline socioeconomic pathway, land-use planning reduces the accessibility gap in all four cities. In the urban and rural pathways, the inequality gap with land-use planning decreases in eThekwini, and increases in Cape Town, Gauteng and Nelson Mandela Bay, but less than without land-use planning (Figure 4.9). The former indicates that in these two socioeconomic pathways the areas with

good accessibility in Cape Town, Gauteng and Nelson Mandela Bay improve more, pulling ahead further than the inaccessible areas in those cities.

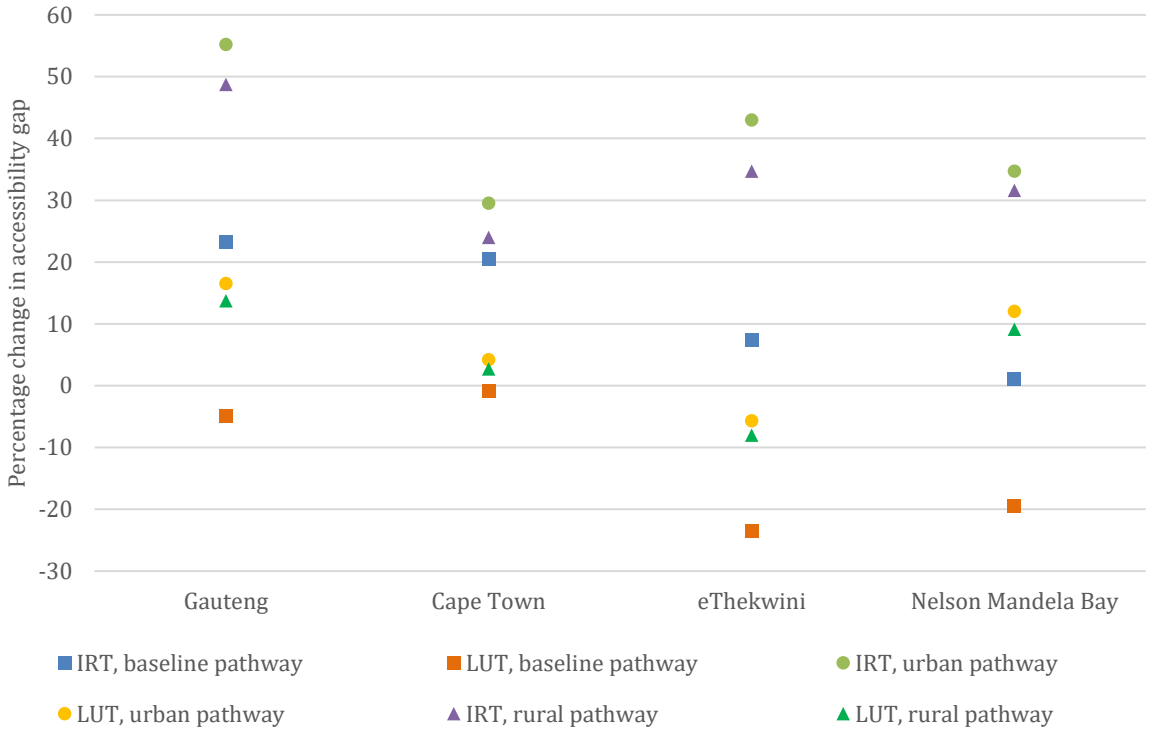


Figure 4.9: Change in accessibility gap between 2021 and 2030, with and without land-use planning

Transport infrastructure interventions alone are inadequate to bridge the historic and current access gap and should be complemented with land-use planning. South African cities are not fully benefiting from or taking full advantage of urbanization, and so are not reaping the urban dividend (CoGTA 2016). The popular phrase that we need to move people closer should clearly not be interpreted as requiring only transport infrastructure. A fundamental requirement is to relook, rethink and adopt a multi-pronged approach to addressing land-use transport interactions to maximize urban development.

4.2 Rural Access and Safety

4.2.1 Maximizing Access by 2030

A policy option for the government in terms of rural access can be to focus on reaching the highest possible RAI score by 2030 at the lowest cost. Such option requires rehabilitating the existing roads without changing the current type of road surfaces and the length of the rural roads network. The highest possible RAI without changing the length of the rural roads network is 94% as explained in section 3.2.2.

The difference between the status quo and this option is that the latter assumes a major push to rehabilitate roads that have been allowed to deteriorate, along with subsequent adherence to maintenance schedules as recommended in the Highway Development and Management Model (HDM-4) rehabilitation and maintenance guidelines (HDMGlobal n.d.).

The strategy to increase the RAI to the highest possible level by 2030 without changing the length of the rural roads network and the current type of road surfaces would cost between R385 billion and R402 billion. This is equivalent to about 0.7% of GDP per year, on average, between 2022 and 2030. The average annual cost to rehabilitate deteriorated roads in densely populated rural areas during this period is about 0.15% of GDP (Figure 4.10). The average annual cost to rehabilitate the more extensive network of deteriorated roads in sparsely populated rural areas over the same period is about 0.3% of GDP. The remaining is the cost to maintain the current all-weather roads, which varies between 0.22% and 0.25% of GDP, depending on the scenario.

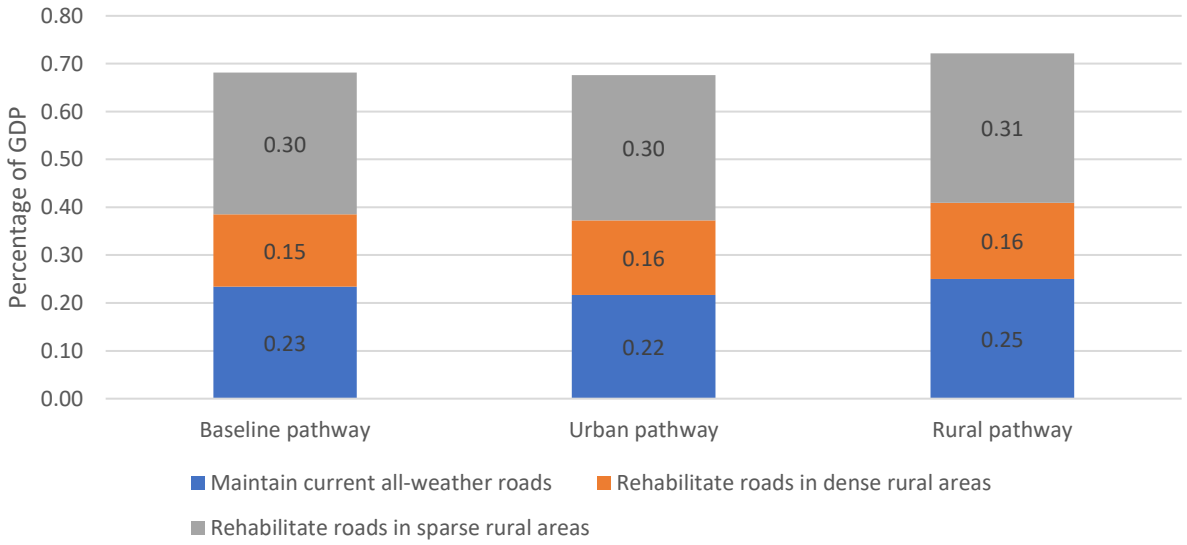


Figure 4.10: Average annual cost of increasing the RAI as quickly as possible in 2022-2030, as a percentage of GDP

The projected funds available for rural road works are not enough to fund the maximization of the RAI by 2030. The annual capital and maintenance expenditures are constrained by the funding available to the provincial and municipal governments in the period 2022-2030, which are estimated as discussed in Annex A. The projected funds amount to about 0.43%, 0.39% and 0.45% of GDP per year in the 2022-2030 period,

under the baseline, urban, and rural socioeconomic pathways, respectively. This indicates a funding gap of around 0.27% of GDP per year.

4.2.2 Efficient Access Policies

Prioritizing the use of scarce fiscal resources and focusing on a long-term horizon will allow the government to spend efficiently. To do that the analysis in the report uses the rural road project prioritization model developed by Ross and Townshend (2018) and refined by Townshend (2020). Its estimates of inputs have been verified by South Africa's National Treasury, and applications are currently being piloted by SANRAL. The prioritization is based on a 30-year horizon to capture the maximum effective lifespan of an unmaintained gravel road and to align the analysis with NATMAP 2050.

The model classifies rural roads as either: (i) Basic access, meaning that they are essential to connecting at least one densely populated area to essential services (schools and clinics); (ii) Strategic, meaning that they support the highest contribution to economic growth independently of fluctuations in business and commodity price cycles; (iii) Tactical, meaning that they make positive contributions to economic growth under some (but not all) market conditions; or (iv) Surplus, meaning that if they were unproclaimed, this would generate a net saving to the economy and would not deprive any rural communities of access to essential services. The model identifies prospects for relocating small rural schools and clinics so as to shift roads from category (i) to category (iv). This would allow the network to be rationalized so as to optimize its value for any given level of maintenance expenditure, given a maintained commitment to the principle that no rural community should be deprived of essential services access.

4.2.2.1 Policy Scenarios

The prioritization analysis assesses different policy alternatives in terms of infrastructure investment and maintenance costs, and all-weather access in rural areas to determine preferred alternatives. The following four policy scenarios are analysed:

a. The constrained, *unrationalised, gravel surfaces (CUG) scenario* assumes the extension of the current rural road network will remain unchanged and roads will be rehabilitated maintaining their current surfaces.

b. The constrained, *unrationalised, sealed surfaces (CUS) scenario assumes* the extension of the current rural road network will remain unchanged, and roads will be rehabilitated by sealing them.

c. The constrained, *rationalised, gravel surfaces (CRG) scenario* assumes the rural road network is rationalised following essential services relocations and roads will be rehabilitated maintaining their current surfaces.

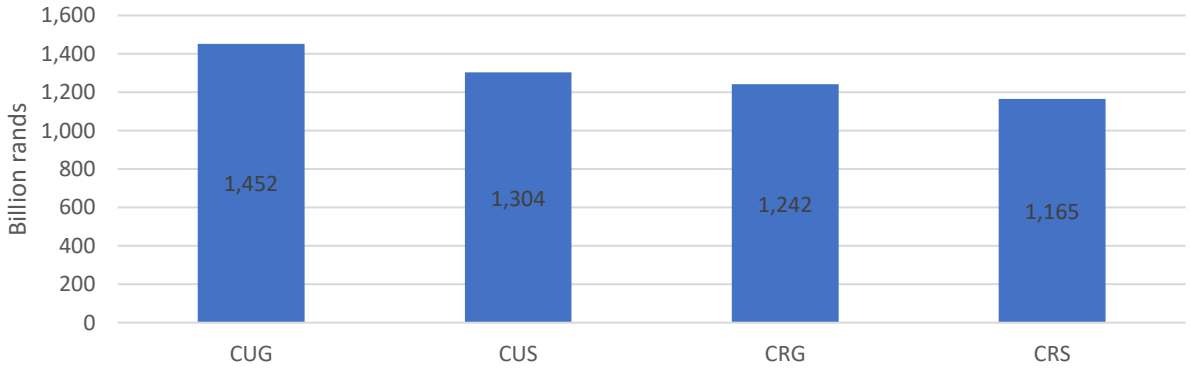
d. The constrained, *rationalised, sealed surfaces (CRS) scenario* assumes the rural road network is rationalised following essential services relocations and roads will be rehabilitated by sealing them.

One dominant policy action in any prioritization, in the sense that no economically sound strategy could fail to incorporate it, is to rehabilitate paved strategic roads that are currently deteriorated. Failure to do this would exponentially increase future maintenance costs, while simultaneously undermining the value of improving other roads because their integration with the overall network would be further attenuated. Indeed, such failure would imply setting the financing of the network into a 'doom loop' as rising maintenance costs interact with fiscal constraints to force progressive shrinkage of the network and surrender of some existing access rather than an extension of access. Therefore, all four policy scenarios assume that deteriorated paved strategic roads are rehabilitated as quickly as possible (a capital investment) and that operational resources for their subsequent on-time maintenance are committed. The prioritization then continues with basic access roads, followed by tactical roads, which are prioritized based on their expected gross value added.

4.2.2.2 Funding Needs

The dominant long-term policy to reach the highest possible RAI is to seal all roads in the rationalized network. The CRS scenario yields the lowest long-run total cost to reach an RAI of 94% at R1,165 billion in the baseline socioeconomic pathway (Figure 4.11). The reasons are that the rationalized network is smaller than the unrationalized one and that when considering the life cycle of roads, gravel roads become more expensive to maintain than sealed roads. The cost of sealing all rural roads in a rationalized network (CRS) is 6%, 11%, and 20% lower than the costs under the CRG, CUS, and CUG policy scenarios, respectively. The CUG policy scenario, which assumes the same policies as in section 4.2.1—that is rehabilitating the existing roads without changing the current type of road surfaces and not building new

rural roads—yields the largest cost in the 2022-2051 period. This result shows that a focus on maximizing the RAI by 2030 will lead to a waste of public resources. Hence, a horizon that captures the life cycle of the assets should be used when planning to select sustainable policies.



Note: The cost is calculated assuming the baseline socioeconomic pathway.

Figure 4.11: Total cost to convert entire rural roads network into all-weather roads by 2051

Like in the case of urban access, it is important to allocate resources to the maintenance of assets, which includes routine maintenance and rehabilitation. Figure 4.12 shows that routine maintenance and rehabilitation costs represent 9% and 17% of costs, respectively, under the policy of sealing rural roads. This contrasts with the policy to continue with gravel roads, where rehabilitation costs and maintenance costs represent 91% and 9% of costs, respectively. The result highlights the importance of allocating adequate resources to both rehabilitation and maintenance of assets, even under the policy of sealing roads, which requires significant capital investments.

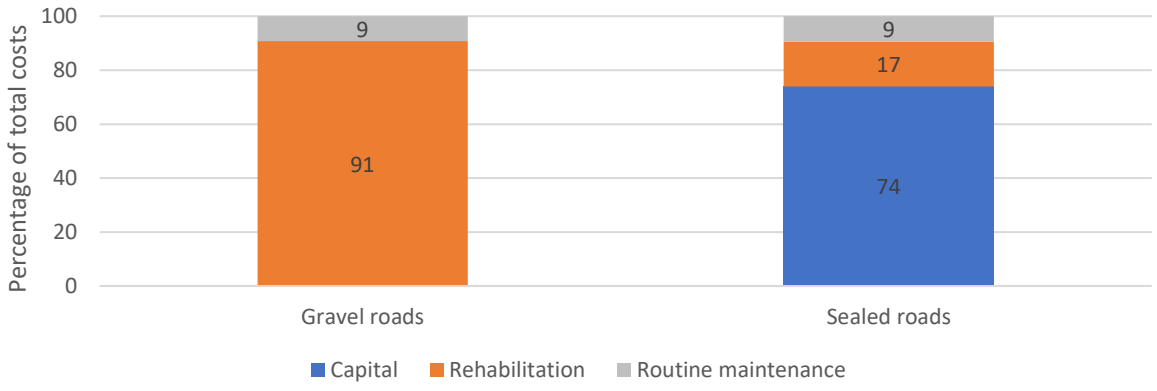
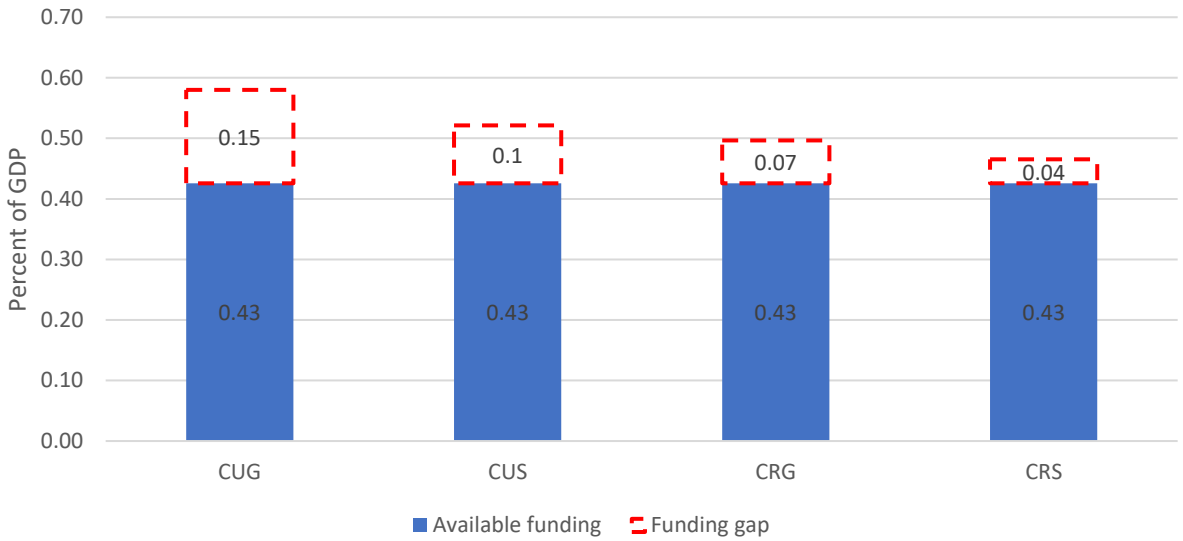


Figure 4.12: Cost decomposition under different rural road surface policies

4.2.2.3 Funding Gap

The projected fiscal resources available for rural roads for the 2022–51 period are not enough to cover the cost of achieving an RAI score of 94%. The policy to rationalize the network and seal all rural roads (CRS) by 2051 would cost only 0.47% of GDP per year, on average, between 2022 and 2051. This policy is not fiscally feasible based on the projected budget for rural road works, which assumes the available budget remains constant as percentage of GDP (see Annex A for a discussion on the estimation of available budget). However, the gap in the 30-year period is only 0.04% of GDP per year on average, or R100 billion in 2022–51, while the gap for the unrationalized, gravel surfaces (CUG) scenario is 0.1% of GDP per year on average (Figure 4.13), or R240 billion in 2022–51. Even if the government is not able to mobilize additional resources, the unmaintained kilometres of gravel road at the end of 2051 would be the lowest in the rationalized sealed surface scenario.



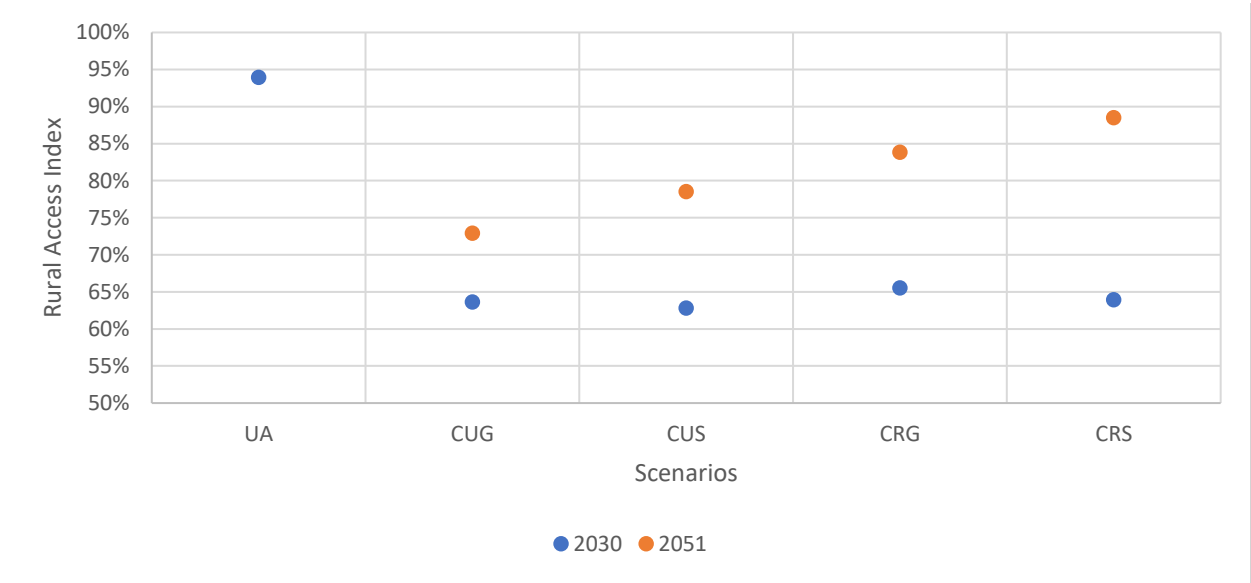
Note: The height of each bar represents the annual average funding needs to achieve a 94% RAI under each scenario, assuming the baseline socioeconomic pathway.

Figure 4.13: Annual average funding needs and funding gap for the 2022-2051 period by policy scenario, as percentage of GDP

4.2.2.4 Access and Safety

With the available funding for rural road works the 2030 and 2051 RAI will be below the highest possible RAI by at least 28.5 and 5.5 percentage points, respectively. By 2030, the highest RAI that can be achieved is 65.5% under the rationalized, gravel surface scenario, given the fiscal resources available for the 2022-

2030 period and the population under the baseline socioeconomic pathway[38] (Figure 4.14). By 2051, the highest RAI that can be achieved is 88.5% under the rationalized, sealed surface scenario, given the available fiscal resources for the 2031-2051 period.



Note: UA refers to unconstrained access, that is the short-term policy approach of maximizing RAI by 2030 presented in the previous section.

Figure 4.14: Rural Access Index in 2030 and 2051 under different policy scenarios, and baseline socioeconomic pathway

Rationalizing the rural road network would allow the government to provide all-weather access to a larger share of the rural population at the same cost. Relocating some small rural schools and clinics would turn roads that currently connect households to essential services (schools and clinics) but do not make a net positive contribution to South Africa's GDP into roads that if they were unproclaimed would not deprive any rural communities of access to essential services. As a result, the RAI under both rationalized scenarios (CRG and CRS) will be higher than under both unrationalised scenarios (CUG and CUS) in 2030 and 2051 (Figure 4.14), with the difference increasing over time.

Rationalization of the rural roads network would require considerable coordinated planning and implementation among multiple official agencies and departments, at both provincial and municipal levels. It will also require oversight by the national government. South Africa's track record with respect

[38] The RAI that could be achieved by 2030 under the urban and rural socioeconomic pathways would be about 1 percentage point lower.

to such coordination cannot be regarded as encouraging. Local populations would rightly be suspicious of plans to relocate schools and could be anticipated to resist such change unless grassroots consultation and involvement were managed with care, genuine empathy, and official humbleness. Such local involvement could not be recruited and carried toward consensus overnight. It could fail altogether, leaving the road network stuck in its current condition.

Sealing rural roads not only is less costly than gravel roads, but they are also safer leading to lower accident costs. Unsurfaced roads are associated with higher accident rates than surfaced roads as they are susceptible to slipperiness in both wet and dry weather and generate dust that reduces visibility for following and approaching vehicles. Table 4.1 presents the average road accident rates applicable to earth, gravel, and the lowest class of surfaced roads based on the road surface specific accident rates applied in SANRAL's national HDM-4 configuration. Applying the average road accident costs published by the Road Traffic Management Corporation for 2015, for every 100 million vehicle-km travelled the accident costs on gravel roads are R73.7 million higher than for single carriage roads with a paved shoulder. The relatively low safety afforded by gravel roads therefore represents a significant avoidable cost to property and life.

Table 4.1: South Africa's Safety gap HDM-4 accident classes and the associated costs, 2015

Road description	Accident rates per 100 million vehicle-km			Total accident costs per 100 million vehicle-km (rands)
	Fatal	Injury	Damage only	
Unpaved dirt road	13.9	141.7	988.2	188,591,089
Engineered gravel road	12.1	122.9	857.4	163,623,374
Single carriage with unpaved shoulder	6.9	70.7	492.8	94,053,140
Single carriage with paved shoulder < 1 m	6.6	67.6	471.2	89,932,255

4.3 Road Safety

An important safety gap that is not covered in the rural and urban analysis is with regards to safety in high traffic roads, that is urban and interurban roads. Both the improved and expanded rapid transit scenarios include interventions in signalling and station improvements that will contribute to closing the safety gap in urban rail, but no intervention in road safety. A key priority should be investments to improve the safety standard of high traffic roads to a 3-star rating standard. Infrastructure and speed management investments to achieve such an objective include improvements in the road design, particularly improving

design standards for pedestrian and cyclist infrastructure, and creating safe environments to make walking and cycling safer. Bringing 75% of the high traffic roads to a 3-star rating will require South Africa to invest 0.57% of GDP per year, on average (iRAP 2020), or R322 billion between 2022 and 2030[39]. The funding gap regarding road safety in high traffic roads cannot be estimated because of a lack of information on the available funding for road safety interventions.

4.4 Total Funding Needs to Improve Access and Safety

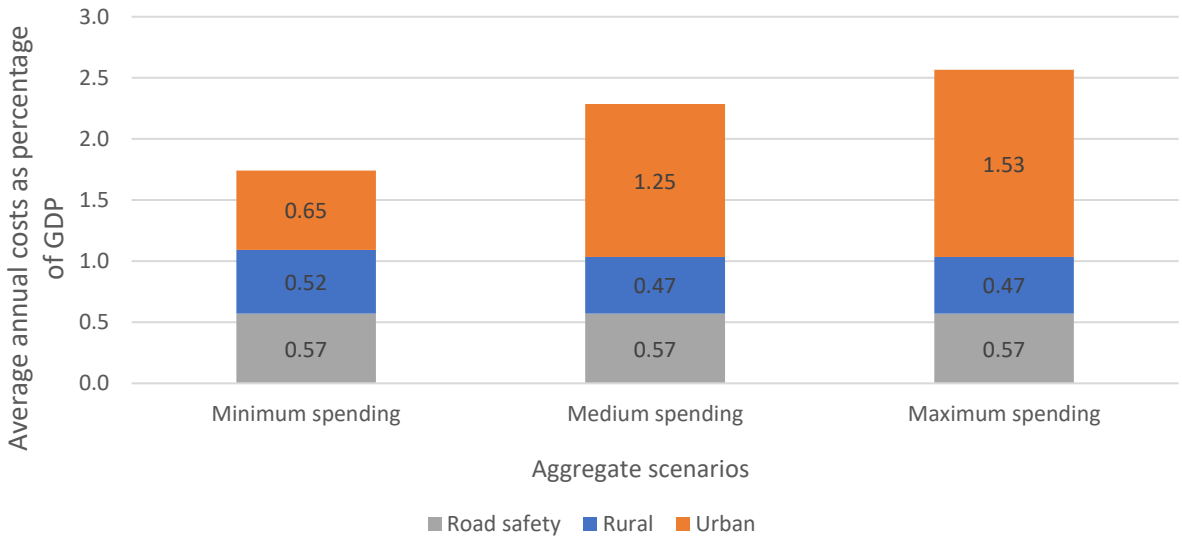
The analysis in section 4.2 shows that the policy of sealing rural roads dominates the policy of rehabilitating rural roads keeping the current surface. The analysis also shows the policy of rationalizing the rural roads network dominates that of keeping the current extension of the road network. However, relocating small schools and clinics is challenging and therefore an ambitious policy action. The urban policy scenarios—BAU, IRT/LUT, and ERT—also present different levels of ambition. Therefore, the two rural policy scenarios—CUS and CRS—the three urban policy scenarios and the policy action on road safety can be combined into the following three aggregate policy scenarios, with different levels of ambition and spending needs:

a. *Minimum spending*. This scenario combines the less ambitious rural policy scenario where rural roads are sealed but the road network is not rationalized, the urban business-as-usual policy scenario, and the policy to bring 75% of the high traffic roads to a 3-star rating.
b. *Medium spending-preferred scenario*. This is the preferred scenario because it combines the more ambitious and more efficient rural policy scenario where rural roads are sealed and the road network is rationalized, the improved rapid transit with integrated land-use and transport planning policy scenario, which is the most efficient of the urban scenarios, and the policy to bring 75% of the high traffic roads to a 3-star rating.
c. *Maximum spending*. This scenario, which is the most ambitious one, combines the rural policy scenario where rural roads are sealed and the road network is rationalized, the expanded rapid transit policy scenarios, and the policy to bring 75% of the high traffic roads to a 3-star rating.

In sum, to improve transport access and safety in line with the three above scenarios, South Africa needs to spend R1 trillion, R1.3 trillion, and R1.5 trillion, respectively, in the 2022–2030 period, which amounts to 1.7%, 2.3%, and 2.6% of GDP per year, on average, under the baseline socioeconomic pathway (Figure

[39] The Rand values are based on the GDP projections developed for this study.

4.15)[40]. The total funding gap cannot be estimated because of a lack of data on available funding for road safety interventions, as explained above.



Note: The calculations are based on the forecasted GDP in the baseline socioeconomic pathway.

Figure 4.15: Total funding needs to close the universal access and safety gaps, percentage of GDP

[40] The differences between the three socioeconomic pathways are small because of the relatively short period of time and the small differences in GDP growth.

5 South Africa's Action Plan toward Sustainable Mobility

The diagnostic of South Africa's transport system and scenario analysis highlight key priority actions that are critical to closing the gap towards sustainable mobility around the four goals, some of which would contribute to closing the gap in more than one goal (maximizing co-benefits).

5.1 Policy Action Plan

The South Africa action plan towards sustainable mobility considers three priority policy directions. South Africa has an extensive, well developed, although deteriorating transport infrastructure base, and significant effort should be extended to support the effective utilization of these assets towards achieving the country's developmental objectives. Therefore, in short, it is recommended that South Africa focuses firstly on optimizing the utility of its existing transport assets, and secondly, only once the utility of these has been exhausted, consider expanding its transport infrastructure. Thirdly, it is important to ensure the long-term sustainability of the transport network and so it is important that policies and investments are climate resilient and Paris-aligned (consistent with development trajectories considered compatible with the Paris Climate Agreement temperature and climate resilience targets).

Priority 1. Optimize the utility of existing transport infrastructure assets.

Priority should be given to the optimized use and better management of existing assets, before investing in new or expanding existing ones. To accomplish this, there are important existing policy knots that relate to institutional misalignment and that present obstacles that prevent the execution of existing policy commitments. Critical policy issues requiring attention include, inter alia, concluding on issues of authority with respect to transport modes and relevant facilities, resolving imbalances in costing between road and rail that, along with operational issues, impedes the shift from road to rail, encouraging greater private participation in the freight rail and maritime sectors, establishing a functioning transport economic regulator, and delivering certainty on the question of road maintenance funding (in both urban and rural contexts).

South Africa, by and large, has sound policies, plans and a vision that illustrates its commitment to tackle vulnerabilities in the transport and mobility system. However, South Africa's transportation system is falling behind in many areas and, while policies exist that could help in addressing challenges, they are either poorly implemented or not implemented at all. Institutional barriers, challenges with

intergovernmental coordination, and a lack of capacity within implementing departments, prevents the translation of such policies into action.

Considering the extensive investment required to both restore and maintain existing transport infrastructure, public-private partnerships that capitalizes on potential efficiencies in the private sector should be exploited whenever possible. There are several areas where the private sector can play a greater role:

- Port terminal capital investments and operations
- Rail infrastructure refurbishments and operations
- Road upgrading and maintenance (through for instance performance-based contracting (PBC's))
- Commuter rail services operations
- Public transport facilities development and management
- Bus operations contracts

A focus on integrated land use and transport planning as a central function of local government and strengthening intergovernmental systems to ensure planning alignment across departments to maximize the impacts of investments and coordinate asset and operational management is identified as the first step to ensuring that social services are developed and situated in those areas that increase access to progressively realize constitutional rights.

Priority 2. Invest to expand transport infrastructure assets once the utility of existing infrastructure has been maximized.

When the reach of existing infrastructure is no longer adequate, and on a case-by-case basis, consider new investments. Through robust frameworks for project prioritization, supported by feasibility assessments, consider new investments that integrate insofar as possible with existing transport services for both passengers and goods.

Priority 3. Support a Paris-aligned and resilient transport system.

All policies and investments in the action plan should be geared towards improving the quality of South Africa's transport system to ensure it is resilient and Paris-aligned (e.g., accede to and implement international conventions, set and implement climate change adaptation standards).

5.2 Recommendations

Building on the action plan above, this section presents specific recommendations for each of the four goals in the SuM4All framework, namely, access, efficiency, safety, and green. Annex C links the findings with the recommendations and the institutions with primary and secondary responsibility.

5.2.1 Access

5.2.1.1 Urban Access

The analysis conducted for this study highlights that both land use change and public transport improvements are needed to ensure that the government's transformative agenda is realized. The spatial transformation and focused investment agenda need to be supported by a reorganization of the institutional framework of public transport, and a capacitation of local governments mandated to deliver on these goals. The following sections detail specific actions by subject:

5.2.1.1.1 Institutions and organization

1. ***Implement long-standing policies for devolution of authority over public transport to metropolitan governments.***
2. ***Support smaller metros to capacitate themselves adequately with systems and qualified personnel to assume responsibility for devolved modes of transport.***

Public transport functions are performed more effectively at local level. This ensures more relevant plans, greater alignment between land use management and transport planning, improved accountability to citizens, and greater economic sensitivity and nuance in planning. Currently, authority over public transport in South Africa is split between the spheres of government and across different entities, despite policy and legislative intentions around devolution. Better resource allocation and accountability will be achieved by implementing longstanding policies to integrate and consolidate public transport responsibilities at city level. This implies furthering discussions on devolution of authority over various modes of transport to metropolitan and large urban local governments, and in the case of Gauteng, where multiple metropolitan governments neighbour each other, finding a resolution for the need for coordination across these adjacent metros. While some local governments are likely already in a position to assume responsibility for all modes of transport (Cape Town, eThekwini, and the Gauteng municipalities), others will need to be supported to adequately capacitate themselves before devolution can take place (Nelson Mandela Bay, Mangaung, and Buffalo City).

The devolution of authority for commuter bus and minibus taxi services comes with specific complexities. A process for re-tendering commuter bus services by cities that will ensure continuity of service needs to be developed and initiated. Provincial Regulatory Entities need to be absorbed into municipal structures. Cape Town and eThekwini have already made good progress preparing for these steps, while other cities still have to start.

Devolution of rail has a range of more complex challenges that need resolution. A detailed strategy needs to be developed that considers each metropolitan area's unique context and provides appropriate plans accordingly. The strategy also needs a response to the question of what the role of PRASA will be, how to deal with transfer of facilities and staff, how to manage ongoing long-term contracts, how to repair vandalized infrastructure, how to devolve subsidies, and how to involve the private sector.

5.2.1.1.2 Bus Rapid Transit

1. ***Review and update the integrated public transport network (IPTN) plans with the view to ensure fiscal sustainability of proposals.***
2. ***Carefully consider BRT service offerings in terms of the competitive landscape, customer needs, market positioning and return on investment during the design phase.***

IPTN plans are the central metropolitan planning instrument informing the development and roll-out of BRT services. At the outset of the national IRPTN program, all cities eligible for PTNG funding were to develop IPTN plans that demonstrated compliance with the ideals of the DoT's Public Transport Strategy and Action Plan, which was quite specific in terms of expected norms and standards:

- 85% of all residents within 1km of rapid public transport network by 2020
- Upgraded modal fleet, facilities, stops and stations
- Extended hours of operation (16-24hrs)
- Peak frequencies (5-10min) - Off peak frequencies (10-30min)
- Full special needs and wheelchair access
- Safe and secure operations monitored by control centre
- Electronic fare integration when making transfers
- Integrated feeder services including walking/cycling and taxi networks
- Integration with metered taxi services and long-distance intercity services
- Car competitive public transport option - enables strict peak period car use management

Capital funding through PTNG was tied to city plans demonstrating compliance with these specifications. While capital for BRT was provided through the conditional grant, cities were expected to fund operations meeting these standards from fare revenue and any funds received through secondary revenue streams (advertising primarily). Cities soon determined that it would not be possible to achieve these standards without substantial counter-funding from their own revenues – leading most cities to agree with their councils for a predetermined level of support from municipal budgets. This varied substantially across cities but was generally between 4% and 8% of the municipal budget.

For example, in 2012 Cape Town's Council agreed that it would be prepared, and could at most afford, to contribute up to the equivalent of 4% of property rates income to Cape Town's MyCiTi operating costs (City of Cape Town 2015). However, the city's Multi-year Financial Planning framework indicated that this would leave approximately R50 million annually as unfunded expenditure, just for the current Phase 1 and the N2 Express Services. The city instituted a program of service quality "moderation" to bring costs back under control, but then was not able to meet the ambitious expectations set out by the DoT. Even then, it was unclear how the city would be able to afford the increased operating costs of expanding the service beyond Phase 1. Currently, the city has requested additional income support from its council through an increase in the rates contribution cap from 4% to 5% when the currently under construction Phase 2A operations start (City of Cape Town 2021). The situation in other cities is even more dire: Tshwane's A Re Yeng services are recorded as generating R19,904,714 in 2019, while operating expenses were R239,135,349 (City of Tshwane 2020). Rea Vaya, Johannesburg's BRT service was delivering a farebox recovery rate of 27% (the fraction of operating expenses which are met by the fares paid by passengers) (City of Johannesburg 2017). While these results vary both globally and within regions, on average well-functioning systems should expect at least a 60% recovery ratio – Latin American systems often exceed 80% (Fan et al. 2021).

Any public transport solution introduced in South African cities needs to be context sensitive. Implementing context-sensitive transport solutions is germane for project success, especially when the urban form and resulting travel patterns are so different to those of the Latin American cities where BRT was pioneered. Unfortunately, the customization needed when implementing South Africa's BRT program did not fully take into account the differences in travel demand patterns of South African cities. A combination of over-reliance on optimistic travel demand models to predict revenue, and an underestimation of costs, has resulted in several systems running operating deficits. Structural differences in travel markets must be considered in the planning and technical and financial design of future BRT

corridors. Axiomatic assumptions, such as BRT being able to fully cover direct operational costs through fare revenue, should not be taken at face value because they do not always hold true.

South African cities, like many around the world, will need a variety of public transport modes to meet their growing needs. While BRT should play a role in the modal mix, there should be more careful consideration of the necessity for standards that increase capital costs without necessarily delivering operational and cost benefits. Weak ridership on current BRT systems also points to problems with network planning and market positioning. Overall, given the weak financial performances versus the large investment made to date (in excess of US$3 billion - approximately R54 billion and climbing), as currently conceived, BRTs are not cost-effective for South African cities.

5.2.1.1.3 Minibus Taxis

1. ***Recognise minibus-taxis as a key part of solutions to South Africa's public transport challenges alongside other modes and work with minibus taxi industry role-players to enhance its efficiency.***
2. ***Focus resources on capital expenditure to improve roads and facilities used by minibus-taxis.***
3. ***Recognise the importance of good regulation and enforcement and develop new, more effective means to do so.***

Minibus taxis should be integrated into formal public transport networks and planning exercises. The Public Transport Strategy and Action Plan identified the mode as performing a feeder function for BRT, but IPTN project implementations to date have largely been based on full replacement of existing services with BRT trunk and feeder buses. Taxi operators are compensated for their loss of livelihood through a combination of cash and schemes to incorporate them into contracted operators of BRT services.

There is significant potential to improve the quality of service offered by the industry directly through programs focused on introducing scheduled operations and electronic fare collection. Efforts should be directed towards investigating and implementing measures to support the taxi industry, to modernize its service offering and to enhance the efficiency of their businesses. A key impediment to this change is the cost of capital available to the industry. Arguably, one of the most successful interventions in improving the service offering of the taxi industry has been the Taxi Recapitalisation Program. Initiated in 1999, the program aimed to formalise the industry by giving operators a scrapping allowance to incentivize the scrapping of old fleets. The allowance could be used to exit the industry or as capital for a new taxi. By

2018, the program had scrapped 72,653 taxis and has recently been revised to incentivize the removal of even more old vehicles from the roads (TRSA n.d.). At a cost of R4.4 billion (R1 billion less than the annual amount allocated through the PTNG), the initiative has had a visible impact on the quality of vehicles used by the sector. Efforts such as these demonstrate that with long-term, meaningful support, significant transformations in the industry can be brought about.

Improving the service quality in the minibus taxi sector will render much more substantial returns to passengers (and operators) than will be possible and affordable through a direct redistributive type of subsidy. Investments should be directed towards improving ranking facilities, many of which are entirely informal, unpaved and not serviced, developing bus stops and embayment at busy boarding locations on route, and investing in roads used by taxis to improve travel times and conditions.

Among the very few initiatives around the country aimed at improving travel speeds for minibus taxis, the dedicated public transport lane built on the N2 in Cape Town demonstrates the potential impact of a comparatively small investment on service quality for taxi commuters. The lane operates during peak hours only and is monitored by cameras to manage offences. During the peak periods it carries up to 26,000 passengers per hour in the peak direction, providing up to 30-minute travel time advantage over adjacent general traffic lanes, which typically serve only 2,700 people per hour per lane in passenger cars.

While it is important to support the industry through investment, it is equally important to support the authorities established to regulate the industry. Currently, provincial government – through a body called the Provincial Regulatory Entity (PRE) – is in charge of the formal processes for accepting applications from minibus taxi operators for operating licences, ensuring they are supported by the relevant associations, hearing any objections from the public to their being granted, and issuing them if approved. However, the key decision relating to whether market conditions are suitable for the issuing of the licence is made by the municipality. The municipality, which in terms of the National Land Transport Act (NLTA) is the local Planning Authority for transport, is supposed to make the decision based on empirical evidence and with reference to its Integrated Transport Plan. If the Planning Authority rules that, based on market conditions, an operating licence may not be granted, the PRE may not contradict this.

In Gauteng and Johannesburg, where the demand is greatest, the system is overwhelmed, to the extent that there is now an estimated 7-year backlog in processing operating licence applications – amounting to 26,000 licences. This is attributable to poor systems and low staffing capacity as well as that the PRE is also required to deal with applications for routes crossing provincial boundaries on behalf of the National

Public Transport Regulator. The backlog has been driven partly by the fact that, prior to the dispensation introduced by the National Land Transport Transition Act (NLTTA) in 2000, permits to operate were issued to minibus taxis on an indefinite basis. These are now restricted to a maximum of seven years, requiring a very significant number of operating licence renewals.

Moreover, in most cases the Johannesburg Planning Authority has insufficient empirical information on which to make a ruling based on market conditions and therefore makes no ruling, sending applications back to the Gauteng PRE with neither approval nor disapproval, leaving the PRE to make a ruling without considering market conditions. The management of the process in Gauteng and Johannesburg has been exacerbated by the fact that the NLTA, which replaced the NLTTA in 2009, does not provide for the registering of taxi associations and association members. Thus, the mechanism for managing the associations and ensuring applicants are supported by the relevant association when applying for licences does not function as well as it should. In particular, new associations cannot currently be registered. The NLTTA passed in 2000 provided for a Provincial Taxi Registrar to perform this function, but this role is absent in the 2009 legislation.

Systems can only be effective to the extent they are enforced, and enforcement tends to be quite weak. Moreover, the culture of the industry tends to be volatile and strongly resistant to enforcement authorities. The Gauteng PRE used to have a fully capacitated inspectorate of law enforcement officers. However, in 2009 these were transferred to a newly created Department of Community and Safety which has a much wider enforcement remit. The loss of control over these resources to a different department with different management reporting structures and priorities has led to significant enforcement challenges.

To the extent that there is enforcement of operating licences and in the context of such severe processing backlogs, proof of application for a licence is usually regarded as sufficient. In effect, authority is largely imposed by taxi associations protecting their area of operations and only allowing their member to operate. Levels of conflict remain high, with continual outbreaks of violence, especially between members of competing associations.

5.2.1.1.4 Commuter Rail

1. ***Support PRASA to refine its recovery plan with clear and costed capital investment and operational action plans.***

2. ***Support PRASA to expedite programs to restore rail services, including the reconstruction of damaged / vandalized track and catenary infrastructure, signal systems and stations.***
3. ***At the same time, expedite the development and implementation of a comprehensive strategy for the devolution of passenger rail services to municipalities.***
4. ***In the interim, strengthen coordination between cities and PRASA to ensure alignment on investments and planning.***

South Africa's commuter rail networks were developed to transport workers across long distances at very low fares. There are extensive commuter rail networks in Gauteng, eThekwini and Cape Town, and smaller networks in Nelson Mandela Bay and Buffalo City municipalities. The collapse of railway services has impacted commuters severely, both in terms of travel costs and accessibility. The functioning of urban transport systems has also been negatively impacted by rapidly growing congestion and pollution due to the consequent shift to road-based modes. Urgent measures are needed to restore the rail networks to full functionality.

Restoring rail services to full functionality will require significant investment in the repair and restoration of stations, signalling systems, track and per way infrastructure. Of immediate importance is the production of a recovery plan with clear and costed capital investment and operational action plans to guide the recovery program. PRASA should continue with the focused roll-out of Metrorail services, in parallel with focused investment to attain the full resumption of the services. Over the longer term, actions to devolve authority over rail will need to be informed by a review of the role of PRASA in South Africa's integrated multi-modal public transport system and the prioritization of actions needed to support improved integration.

It should be noted that while restoring the passenger rail will improve the RTR ratio, these investments by themselves are not sufficient to impact substantially on accessibility. Improving accessibility will require supporting the rail mode through integration with complementary improved minibus taxi services and the supplementary BRT networks. Cities can support PRASA though transport planning alignment, safety and communication support initiatives and urban and precinct planning support. Investments in public transport need to be supported by initiatives to promote the spatial transformation required to overcome the legacy of apartheid spatial planning either through a focus on transit-oriented development or other public transit centric land use development initiatives. Since land use planning and management and development control are within the jurisdiction of cities, it is important that PRASA's recovery plans and

the consequent investments into the infrastructure at stations are carefully coordinated with city governments to maximize value through complementary investments by the cities and to minimize the disruption caused by construction at these key interchange points.

5.2.1.2 Rural Access

1. ***Rehabilitate deteriorated paved strategic roads and pave all unpaved strategic roads.***
2. ***Develop a rationalized basic road network and seal all roads in this network.***
3. ***Ensure close coordination with relevant departments in the provision (and potential relocation) of social infrastructure to align with the rationalized basic road network.***
4. ***Ensure that sufficient resources are allocated to the maintenance of assets, which includes routine maintenance and rehabilitation.***
5. ***Ensure that roads departments are adequately capacitated with qualified staff and equipment to manage the road assets under their control.***

The fundamental and structural problem of the South African rural road network is that it is too large to be adequately maintained given realistic fiscal resources. This problem is compounded by the fact that the majority of the rural network consists of gravel roads, and the cost of maintaining them, relative to the cost of maintaining sealed roads, has been rising over the last two decades. Consequently, maintenance of the network has been both inadequate and unsystematic, with the result that most of the network, and almost all of the sub-network that provides access for isolated communities, have severely deteriorated.

A rapid improvement of the RAI score could be achieved simply by implementing the status quo policy framework, that is, following the HDM-4 rehabilitation and maintenance guidelines (HDMGlobal n.d.). Rehabilitating all deteriorated roads in densely populated rural areas would increase the RAI score by nearly 30%, while extending this program to include low density areas as well, would only increase the RAI by a further 6.5%.

However, even though a short-term focus on maximizing the RAI would correct for the years of neglect that has left most of the network in a deteriorated condition, it would entirely fail to address the structural problems of the network: that it is too large to be sustainably maintained under realistic fiscal constraints; that too much of it is unpaved, and consequently facing indefinitely rising real costs for maintenance; that

it is increasingly environmentally harmful; and that it is not resilient against the higher frequency of extreme weather events and conditions expected due to climate change.

The structural problems could be addressed by (i) rationalizing the network while also embarking on a carefully coordinated intergovernmental process to relocate or build additional basic services such as small rural schools and clinics in closer proximity to far flung rural communities, which will over time be much less expensive than rehabilitating and subsequently maintaining the entire over-extended network; and (ii) rehabilitating roads only with low-cost seals rather than gravel.

There is a significant shortfall in provincial road funding except for Gauteng, KwaZulu-Natal and Western Cape allocating sufficient funds to address their maintenance backlogs. While additional funding will be required to arrest the decline of the network, investment in better asset management systems and in the capacity of provincial road departments could help ensure that available resources are invested wisely. Achieving maximum efficiencies from roads budgets will require good data and knowledge regarding the condition of the network, and experienced and skilled staff to make decisions and oversee work at every stage of the project cycle.

Given the lack of available funding, the funding gap required to address the current backlogs and the capacity gaps in provincial road departments, government should consider opportunities to bring the efficiencies of private sector to rural roads management by employing more efficient contracting mechanisms. Performance-based maintenance contracts can help governments improve road asset management and induce cost-efficiencies. PBC is a type of contract in which payment for the deliverable is explicitly linked to the contractor successfully meeting or exceeding certain clearly defined performance indicators. PBC involves a significant shift away from more traditional approaches to the delivery and maintenance of road infrastructure and associated services by departing from the clients having responsibility for the design and supervision of construction and maintenance activities, to focusing on the key outcomes that the client wishes to achieve. Most PBCs consist of a subset of the following six components: design, build, finance, operate, maintain, and transfer. Typically, contractors are paid a fixed periodic annuity or “availability payment” subject to meeting the predetermined performance criteria.

5.2.1.3 Gender

1. ***Actively engage and consult women as stakeholders.***
2. ***Collect gender specific and disaggregated data.***

3. ***Institutionalize gender in transport policy and planning.***
4. ***Develop gender-responsive infrastructure and operations.***

Transport policy, planning, and practice must address the gender sensitive aspects of transport. Making transport policy more responsive to the needs of women requires a structured approach to understanding their needs, identifying instruments to address them, analysing the costs and benefits of those instruments, and establishing an appropriate policy framework. Although frameworks exist in South Africa to consult stakeholders, a stronger effort needs to be made to ensure that women and other vulnerable groups are able to participate, and that their voices are heard (SuM4All Forthcoming b).

Few public participation or stakeholder engagement practitioners are specifically trained in gender-sensitive engagement processes, although guidance encourages the seeking out of diverse voices. Participatory processes need to have a gender-informed approach and follow ethical considerations, including safe spaces for women, stakeholder consultation at times that are suitable for women, provision of transportation, and trained facilitators. In that sense, the government can work with an appropriate gender and mobility champion to develop inclusive, gender responsive stakeholder engagement guidance and protocols (SuM4All Forthcoming b).

The lack of monitoring mechanisms and regular gender specific and gender disaggregated data collection do not allow for a robust evidence-based planning process and evaluation of the status of gender and transport in South Africa. In that sense, the government should develop the framework and requirements for gender specific gender disaggregated data requirements, collection methods, and application opportunities. This will include developing practical guidance on what gender specific data are needed to deliver gender responsive transport and ensuring that this guidance is based on stakeholder engagement and knowledge sharing from relevant regional and international best practices (SuM4All Forthcoming b).

Consultations with women as stakeholders and the collection and analysis of gender specific and gender disaggregated data should inform transport planning. Therefore, gender should be mainstreamed into national transport policies and plans to establish and improve the decision-making process on gender-sensitive transport. An important step in that direction would be to develop an appropriate gender and mobility framework or strategy for South Africa. This will require establishing a timeframe and budget for development and approval of the gender and mobility framework or strategy and ensuring that the framework or strategy includes associated budgets, resources, targets, and monitoring or evaluation protocols. Comprehensive indicators and targets covering the three key pillars of women and transport—

i.e., women as transport users, women as transport workers, and women as transport decision makers—should be developed (SuM4All Forthcoming b).

Women's transport infrastructure and service needs are often narrowly interpreted as being a need for lighting and security, facilities for prams, and wheelchair access. Consultation with all users, including women, will improve the understanding of what constitutes considerations for women. This should be followed with a review and update, when needed, of design standards to ensure women needs are provided. The exercise should consider best practices for each mode and vehicle type—walking, cycling, minibus-taxi, rail, bus, public transport interchange, bus shelter, and street furniture (SuM4All Forthcoming b).

5.2.2 Efficiency

5.2.2.1 Ports

1. ***Develop a port sector strategy that clearly defines the role and function of each port in the network.***
2. ***Encourage greater private sector involvement in terminal operations.***
3. ***Improve the integration between ports and rail.***

Transnet is vertically integrated along the entire freight logistics value chain and dominates the value chain from the landing of cargo or liquids in ports to their final destinations. To ensure equity of access to ports facilities and services given Transnet's dominance, the National Ports Regulator was established in terms of the National Ports Act of 2005. While the Regulator's primarily oversees pricing and issues of access to ports facilities and services, it also monitors compliance with the regulatory framework and also hearing any complaints and appeals lodged with it from the industry and the public.

Transnet has six operational divisions including the TNPA, which acts as the landlord services to the eight South African commercial seaports. Transnet Port Terminals (TPT) has a monopoly on automotive roll-on/roll-off terminals and dominates container-handling terminals. Transnet Freight Rail (TFR) is the heavy haul freight rail company maintaining an extensive rail network that connects with rail networks in SSA.

Transnet's unique and unusual institutional structure contributed to a lack of competition among the ports. Whilst the private sector is involved on the bulk side, there are no specialist independent container terminal operators, operating solely or jointly, at any of the South African ports. Industry has voiced

concerns about the current institutional structure and TNPA's ability to maintain independence from TPT given that they both fall under Transnet. That said, an independent regulator – the Ports Regulator of South Africa (PRSA) – exists and has the role of monitoring and overseeing the activities of TNPA only, as well as approving of its tariffs each year. TNPA is now being established as an autonomous body within the corporate structure.

The situation is similar for the freight rail network given that TFR owns and operates the country's only long-distance rail network, and all freight locomotives and wagons. While no legal constraints exclude private operators from the freight rail market, entry barriers are high making third part access challenging for private operators. Operating environment and contractual conditions for access to the network have previously made it challenging for private sector operators to maintain commercial viability. Despite recent changes in policy, private operators are still in practice limited to branch line operation only. While Transnet has recently begun investigating opportunities to allow third party access onto its core network, currently all mainline operations are conducted by Transnet and required to use Transnet's operating staff (drivers) at their expense. Where the branch line joins the mainline, Transnet would hook wagons using one of their locomotives for the onward journey at the private operator's expense, and slots for mainline access were dictated by Transnet's priority traffics, and not guaranteed. Given the challenges with locomotive availability and slot reliability, as well as the expense of renting Transnet locomotives and drivers, over and above the cost of maintaining infrastructure to Transnet's satisfaction, it remains challenging for private sector branch line operators to launch and stay in operation.

For freight containers, long term (post pandemic) growth potential exists if capacity constraints at the ports are addressed, and efficiency and scheduling reliability improve. Similarly, rail has a lot of growth opportunities, but capacity is limited to the condition of rail infrastructure, reliability issues, and a shortage of locomotives.

The Port of Durban is strategically located to access international shipping routes between the global east and west and provides a gateway to the main economic hub of South Africa (Gauteng). It is the busiest container port in South Africa and SADC. Durban has hinterland linkages to major trade corridors via rail and road infrastructure. The port has the capacity to handle containers, vehicles, liquid bulk, dry bulk and break-bulk cargo across its five main terminal facilities. From a size and capacity perspective, it ranks as one of the largest African ports, after Port Tangier-Med (Morocco) and Port Said (Egypt), which have a capacity of 9.0 million Twenty Foot Equivalent Units (TEU) (throughput of 4.8 TEU) and 5.4 million TEU

(throughput of 3.8 million TEU), respectively. Transnet has identified potential port expansion initiatives for Durban, to establish it as the premier container hub port in the region, aiming to increase capacity from 4.5m TEUs per annum to between 10-11 million more TEUs within by 2050.

Transnet has proposed a number of initiatives including: (i) port expansion by building additional terminals (Maydon Wharf and Point Container Terminal) to increase capacity; increase competition (by virtue of (ii) below), and modernize the port; (ii) leveraging private operators' operational and commercial expertise to improve commercial performance and operational efficiency of the Durban Container Terminal (DCT) (through a 'bring your own cargo' approach for bidder eligibility); and (iii) delivering on the DCT Pier 1 Phase 2 (Salisbury Island) expansion and deepening of the berths at DCT Pier 2, to modernize the port and ensure quay wall stability.

The key in all these initiatives is: to ensure that the role of the individual port is clear, and they are well placed to compete locally, regionally and internationally; ensure sufficient capacity to meet current and projected demand; bring in private expertise to improve spatial and operational efficiency, and private capital; and improved integration between ports and rail to maximize the modal shift from road to rail. This will bring about decongestion at the ports and improve on the environmental benefits through such a modal shift.

5.2.2.2 Freight Rail

1. ***Pursue initiatives to leverage additional private sector participation in rail to capture additional market share from road.***

The Natal Container Corridor (NATCOR) is the backbone of South Africa's freight transportation network. linking the coastal areas with Gauteng through rail containers with terminal points at City Deep (Johannesburg) and the Port of Durban. The current rail container supply chains compete very poorly with road container supply chains. Transnet's objective is to fundamentally reposition the intermodal service offering and capture market share from the road. This should help reduce inland transport prices, reduce port congestion and reduce the carbon footprint of the container supply chain. Two reform phases are envisaged: (i) Sale or lease of inland rail-based container terminals, with Transnet keeping a minority stake. One or more private sector operators will take over operations at the terminals as part of an integrated service offering; and (ii) Sale of current NATCOR container wagon fleet to wholesale customers who would own or lease wagon rakes, utilizing haulage services provided by Transnet. These initiatives

have broader applicability across the entire TFR network but would need to be developed with these key considerations in mind:

- How best to create a rail service on the NATCOR that supports the desired logistics model in the market and compete effectively with road transport and attract traffic from road transport,
- Policy, pricing and costing requirements on both modes to achieve the objective,
- The level of private investment (indicative estimates) that could be leveraged for the proposed (optimal) developments, and what benefits those investors would expect to realize,
- The degree of competition both between modes and operators that should (the optimal) and will be introduced with current proposals, and
- The links to the proposals for private sector participation in container port and terminal operations, with the overall objective of improving (i) the rail-port interface; (ii) short-haul services to a possible inland container depot in the vicinity of the port (extended gate) and long-haul services delivering a high-quality service to the Gauteng region (to public or private terminals), and beyond.

5.2.3 Safety

1. ***Systematize the use of road safety audits for all high traffic roads and ensure adequate funding for required investments.***
2. ***Reduce blood alcohol limit for young and novice drivers from 0.05 to less than 0.02 and expand the deployment of random breath testing and the application of appropriate penalties.***
3. ***Strengthen enforcement to increase seatbelt wearing.***
4. ***Introduce legislation to reduce speed limits and develop an integrated speed management plan***
5. ***Adopt United Nations Economic Commission for Europe (UNECE) vehicle safety standards.***

Recommendations for improved road safety over the coming decade, follow the principles of the safe system approach to road safety and include promoting shifts to more sustainable and safer transport modes (shifts from road to rail, private mobility to safer public transport and non-motorized transport) while addressing key gaps under the pillars of the UN Decade of Action:

i. *Safer Roads*: The investment in safer infrastructure, particularly retrofitting of existing infrastructure to improve its inherent safety, is a major challenge. Key priority calls for the generalized use of road safety audits for all high traffic roads and supporting investments to bring

75% of the hight traffic roads to a 3-star rating standard (iRAP 2020)[41]. With a high proportion of pedestrian deaths annually, having appropriate design standards in place for pedestrian and cyclist infrastructure and improving safety around schools is critical (South Africa is listed by the WHO as applying only 'partial' road safety audit requirements or star rating assessments for new roads and allocating investment for treatment of high-risk infrastructure safety locations).

ii. *Safer Road Users:* Introduce policies and strengthen enforcement to address drunk driving by reducing BAC limit for young or novice drivers from 0.05 to <0.02, and introducing legislative and enforcement deterrence measures, including deployment of random breath testing (RBT) and the application of appropriate penalties. Revise seat belt laws to require both front and rear seat occupants to be belted and enforcement to increase seat belt wearing (only 33% of drivers and 31% of front seat passengers use seat belts) and implement improved enforcement of helmet wearing standards for cyclists.

iii. *Speed Management:* Introduce legislation to reduce speed limits to 30-50 km/hr in urban areas, 80 km/hr in rural areas, and 100 km/hr on motorways. Develop an integrated speed management plan that includes infrastructure changes on urban streets and rural roads starting with the highest risk locations (e.g., schools, markets and villages) through traffic calming measures (speed bumps, speed cameras, etc.), and include dedicated police enforcement combined with public promotional campaigns.

iv. *Safe vehicles:* Implement regulatory requirements for mandatory fitment of seat belts and anchorages, ensuring this includes public transport vehicles and adopt UNECE vehicle safety standards related to frontal impact and antilock braking systems (ABS) (UNECE 1998), with improved regulations relating to public transport, including vehicle safety requirements.

A general observation is that the road safety situation in South Africa, as in many parts of the world, is due less to technical deficits in the knowledge of what interventions would be effective, but rather a need for increased commitment and prioritization for effective implementation. More effective decision-making needs to be underpinned by:

- establishing sound road safety strategies and plans with measurable targets,

[41] iRAP star ratings are used for road safety inspection, road safety impact assessments, and in designs. Star ratings are an objective measure of the level of safety which is 'built-in' to the road through more than 50 road attributes that influence risk for vehicle occupants, motorcyclists, bicyclists, and pedestrians. Star ratings reflect the risk as it relates to an individual road user. 1-star roads have the highest risk, and 5-Star roads have the lowest risk.

- having a high level of commitment to improved performance,
- improving awareness of what is readily achievable,
- restructuring of road safety management arrangements to increase accountability and focus on outcomes, and
- enhancing program funding to facilitate the necessary development and implementation of actions.

Road safety management practices must evolve in parallel to investment in infrastructure to facilitate the implementation of initiatives listed above. With appropriate governmental commitment, increased governance, and funding, many of these could be readily implemented and would be of substantial benefit to road users across the country.

5.2.4 Green Transport

5.2.4.1 Urban Transport

1. ***Ensure that measures are implemented to limit sprawl and promote the densification of existing built environment footprints.***
2. ***Expedite the restoration of commuter rail services.***
3. ***Focus on improving the quality of road-based public transport and support the transition of informal transport operators to formal transit, including, where practical the introduction of higher occupancy vehicles in the taxi industry.***

The South African urban form plays an important role in driving up GHG emissions, while it is also a critical factor in determining what adaptation and mitigation measures would work best in the context. Public transport, given the long trip distances and dispersed urban form, is expensive to develop and operate, far more so than in, for instance, Latin American contexts which have smaller built footprints, higher density development and more mixed land uses. In this context, careful management of urban development is vital to ensure that the status quo is not exacerbated, and city forms are gradually transformed towards a more sustainable future.

Improving the quality of public transport is central to achieving the twin goals of economic transformation and sustainable mobility. Existing public transport systems, most notably commuter rail, are in a state of severe decline in part because of a lack of investment in maintenance and expansion. Reviving these

systems, while ensuring their climate resilience and climate efficiency, will be key to ensuring sustainability.

The decline of formal transport has been met by a rapid growth in informal or paratransit modes. Minibus taxis now provide 70% of all public transport services in South Africa, using almost universally, diesel powered 16-seater buses, irrespective of the route characteristics. Besides the impacts on congestion, the inefficiencies of this system greatly impact on the country's ability to achieve its climate change objectives. Addressing the shift to informality in public transport becomes a critical lever towards improving the overall sustainability of the transport system.

5.2.4.2 Freight and Logistics

1. ***Promote the shift from road to rail.***
    a. ***Support Transnet to restore lost capacity on key corridors through sustainable, climate resilient investment in deteriorated infrastructure and to ensure the reliability of train slot availability.***
    b. ***Ensure efficient asset utilization through the sale of spare capacity on the network to private sector operators.***
2. ***Support Transnet to develop and implement a clear strategy to minimize/mitigate the negative impacts of climate change and the environmental risks in its operations and enhance the climate change and environmental opportunities in its business.***

The rapid expansion of the road freight industry between 1980 and 1990 has resulted in an over-supply of transport, reducing profitability, and decreasing quality standards. The road freight industry successfully negotiated with the government for the need to increase the vehicle-carrying capacity, which is generally dictated by the weight, semi-trailer length, height, width, and overall combination length. This has placed the road freight industry in a favourable position to compete with long-haul railway services for high-value commodities.

Rail's market share subsequently declined dramatically due to operational constraints on the rail service provider, resulting from the transport policy decisions of the government as a major shareholder. Subsequently, a gradual decline in rail service reliability and capacity constraints on key corridors, due in part to deferred maintenance, but also more recently due to vandalism of infrastructure, has further accelerated the loss of market share. Moreover, there is a lack of policy comparability in costing of

infrastructure across road and rail modes: Transnet is required to earn a positive rate of return on investment in railway infrastructure, and prices its services to cover the cost of capital involved. A different regime applies to primary road infrastructure, encouraging the skewed distribution of traffic across the modes, and the generation of significant external costs, in the form of accidents, pollution, congestion, and the costs associated with the premature deterioration of the road network. Promoting a shift from road to rail is a key sectoral priority for the government and an imperative to achieving the climate change goals of the country.

In the maritime sector, Transnet operates 16 sea terminals across the country's 7 main ports. Key seascape and marine pollution issues that Transnet currently faces include dust mitigation and air quality management at dry bulk terminals; the need for rapid decarbonization across operations; improved capacity for climate risk assessment and mitigation; rehabilitation of contaminated coastal areas; and an updated assessment of coastal and offshore environmental risks.

The government has made sustainability and a just transition (including a just social transition) the core values of its Economic Reconstruction and Recovery Plan. As the country works to "rebuild better," there is an opportunity to include climate-impact considerations on COVID-19 recovery efforts to ensure that economic recovery is more sustainable in the long-term. While Transnet has made some attempts at addressing its climate impacts, most notably through developing an energy management plan, there is a need for Transnet, as the key player in the sector, to develop a holistic strategy that will help it to minimize/mitigate the negative impacts of climate change and the environmental risks in its operations and enhance the climate change and environmental opportunities in its future work.

5.2.4.3 Rural Transport

1. ***Ensuring reliable, climate resilient connectivity and accessibility on a rationalized basic paved road network.***
2. ***Allocating sufficient funding for regular maintenance and asset preservation of a rationalized basic paved rural road network.***
3. ***Increasing the use of low-cost local solutions – both labour through micro-enterprises as well as locally produced material – for the maintenance of remaining earth and gravel roads.***
4. ***Building local capacity to help local communities maintain a minimum connectivity year long and under extreme climate events.***
5. ***Ensuring road authorities develop and adopt climate resilient standards.***

Rural accessibility is a key issue for the South African government's transformation agenda and will be vital to mitigate against the expected water stresses due to climate change. Maintaining rural connectivity on a core road network is essential for the sustainability of the agriculture sector and ensuring access to basic services for rural communities. Some of the actions needed for climate change adaptation in rural transport are the same to increase rural access, such as ensuring sufficient funding for regular maintenance and sealing of roads. An important additional action is to ensure road authorities have adequate capacity to adopt climate resilient standards and practices to ensure the longevity of the assets and ensure ongoing accessibility for rural communities.

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Annex A: Methodologies for assessing accessibility and fundings needs

Urban accessibility

Econometric accessibility, in its traditional form, is a place-based measure of how easy one can access different activity types using specific modes. This current work follows a utility-based approach as described by Ziemke et al. (2018) in more detail.

A study area is tessellated into a regular grid of many small square areas of 1 km by 1 km, referred to here as the set of locations or cells. For each cell, the accessibility to a specific activity type, say for example education, is calculated. The metric weighs the utility of all education opportunities in the study area, including the generalized cost of getting there. For this project, the generalized cost includes both the time and monetary (fare) cost of getting to an opportunity, both being functions of distance. The more costly it is to get an opportunity, the less likely a person will pick that opportunity because the trade-off between the intrinsic value of performing the activity and the cost of getting to the activity is not attractive. This has its foundation in random utility theory. But all opportunities are still accounted for and contribute towards the calculation of access to a type of opportunity.

Econometric accessibility therefore does not look at the current choices people exercise, but rather evaluates the access to education, for example, irrespective of where people may choose to attend education. This has value as it allows for people to choose a different education opportunity in the future.

In this project the accessibility to a variety of activity types is calculated. This includes education, shopping, leisure, hospital, other medical facilities, police, other activities such as social services, post office, and banking, and work. The analysis cannot account for the true number of job opportunities at a facility, or the relevance of the level of work. In the absence of additional (unavailable) data, the analysis merely accounts for a potential place of work. For gaining access to each activity type the analysis considers four modes of transport, namely walking, cycling, minibus and formal public transport. For each activity type in a given location the analysis picks the mode with the best accessibility and then for each location the median accessibility since it is more robust than the mean and does not get skewed by extreme values.

When testing an accessibility intervention, it is both helpful and essential to quantify the number of people affected, either positively or negatively. Therefore, the analysis multiplies the econometric accessibility score with the number of people residing in a cell to adjust the measure by population.

Funding needs in urban transport

As discussed in section 4.1.1, the policy scenarios developed to assess the funding needs, including capital and operations and maintenance costs are the following[42]:

a. The *business-as-usual (BAU)* scenario assumes metropolitan and secondary cities road networks are strengthened, maintenance backlogs are addressed, and ongoing maintenance is provided to support road-based transport and minibus taxis. The extent of the strengthening is based on Kannemeyer (2016). The scenario assumes the ongoing maintenance and operation of urban rail and operational BRTs in Johannesburg (42.2 kilometres), Tshwane (7 kilometres), and Cape Town (31.5 kilometres), and the maintenance of the infrastructure in place for not yet operational BRTs in Tshwane (11 kilometres), eThekwini (31 kilometres), and Nelson Mandela Bay (17.7 kilometres).

b. The *improved rapid transit (IRT)* scenario assumes: (i) the improvement of the quality of urban rail bringing it to full capacity with 20 minutes headways and 75 kilometres per hour of effective speed. Achieving this level of service will require tracks rehabilitation, improvements in signalling, improvement of stations, and purchase of rolling stock, (ii) the start of BRT operations in Tshwane, eThekwini and Nelson Mandela Bay, and (iii) the interventions in the metropolitan and secondary cities road networks considered in the BAU scenario.

c. The *expanded rapid transit (ERT)* scenario assumes a 28 kilometres expansion of the urban rail network in Cape Town, and Nelson Mandela Bay, and a 120-kilometre expansion of the BRT network in Gauteng, eThekwini, Cape Town, and Nelson Mandela Bay, all of which are investments planned by cities and municipalities (PRASA 2020, DoT 2021), in addition to the interventions assumed in the IRT scenario.

The quantification of the funding needs follows a hybrid approach for metropolitan and municipal urban roads, urban rail, and BRTs, which combines a bottom-up and a top-down approach. For urban rail it uses the expansion plans developed by PRASA for tracks, signalling, stations, and rolling stock and adjusts the investments to achieve the level of service according to the aspirational targets set for the analysis by

[42] Section 4.1.1 presents a fourth scenario, the integrated land-use and transport planning scenario. The transport investments under this scenario are the same as under the improved rapid transit scenario, hence, the funding needs are the same.

2030 based on optimal service practices. It uses optimal engineering practices for maintenance and best available estimates on the conditions of the infrastructure assets to determine optimal rehabilitation and maintenance works and their frequency over the period of analysis.

In the case of BRT, the methodology uses the cities' plans to determine investment and operations and maintenance needs for the period of analysis. In the case of metro and municipal roads, the methodology uses the latest available estimates on the conditions of roads and maintenance backlog from SANRAL, and optimal engineering practices to determine the needs for capital and maintenance work on the road network to achieve the targets set for the period of analysis.

The methodology uses a unit-cost approach to determine the infrastructure funding needs. It uses estimates of unit investment costs, rehabilitation costs for existing infrastructure, and operation and maintenance costs for existing and new infrastructure and rolling stock. The estimates come from PRASA plans, National Treasury information, multi-year financial operational plans from cities, and SANRAL.

The funding needs for urban rail, BRT, and urban roads under the three scenarios are shown in Table A.1.

Table A.1: Total funding needs under different scenarios for 2022–30, billion rands

		BAU	IRT	ERT
Urban rail	Capital	24.8	109.9	116.7
	O&M	51.2	300.7	311.7
BRT	Capital	0	0.8	38.0
	O&M	21.4	22.8	129.1
Urban roads	Capital	14.2	14.2	14.2
	O&M	254.3	254.3	254.3

Estimated funding available for urban transport

Urban roads: The funding available for metropolitan and secondary cities roads is assumed to remain constant as percentage of GDP over the 2022-2030 period. The 2021/22 budget allocations approved by Municipal Councils for road transport in metros and secondary cities (National Treasury 2021a, 2021b) are used as baseline and the GDP growth under the three different socioeconomic pathways is used to estimate available funding.

Bus rapid transit (BRT): BRT capital and indirect operating and maintenance expenditure is funded by the Public Transport Operating Grant (PTNG). National Treasury has granted PTNGs to all current and proposed BRTs in the policy scenarios. As a result, the government available funding for BRTs is estimated as the capital costs plus 53.7% of the operating and maintenance costs. The percentage of indirect operating and maintenance costs used is the average for Johannesburg, Cape Town, and Tshwane as submitted by cities to the national Department of Transport (DoT 2020). The direct operating and maintenance costs are assumed to be covered with revenues from fares, parking, and cities' rates. The total revenue of the metropolitan municipalities as reported to the national Department of Transport (DoT 2020) in 2019/20 is used for every year with no price escalation in the BAU, escalated yearly by revenue per passenger trip with an additional 116,000 passenger trips a year to the projected 59.4 million passenger trips in 2029/30 (DoT 2020) in the IRT, and escalated yearly by revenue per passenger trip with an additional 17.6 million passenger trips a year to the projected 215.1 million passenger trips in 2029/30 (DoT 2020) in the ERT.

Urban rail: The available government funding for the IRT and ERT scenarios is assumed to remain constant as percentage of GDP over the 2022-2030 period. The 2021/22 budget allocations approved by Parliament for Metrorail operations and capital (National Treasury 2021c) are used as baseline and the GDP growth under the three different socioeconomic pathways is used to estimate available funding. Revenue for rail is projected based on the 2019/20 audited Metrorail fare revenue and performance data as provided to National Treasury over the medium term (National Treasury 2021c). For the IRT and ERT policy scenarios, the passenger numbers increase from the projected ridership for 2023/24 to reach the projected 780 million passenger trips in 2030 which represents the design capacity of the service. In the BAU scenario, where the capital and operating costs are lower, it is assumed that the rail budget would be reprioritized to cover the capital costs and the part of operating costs not covered by fare revenue. The latter is estimated assuming the current annual ridership will remain constant between 2022 and 2030.

The projected annual average funding available for urban transport as percentage of GDP under each scenario is shown in Figure A.1.

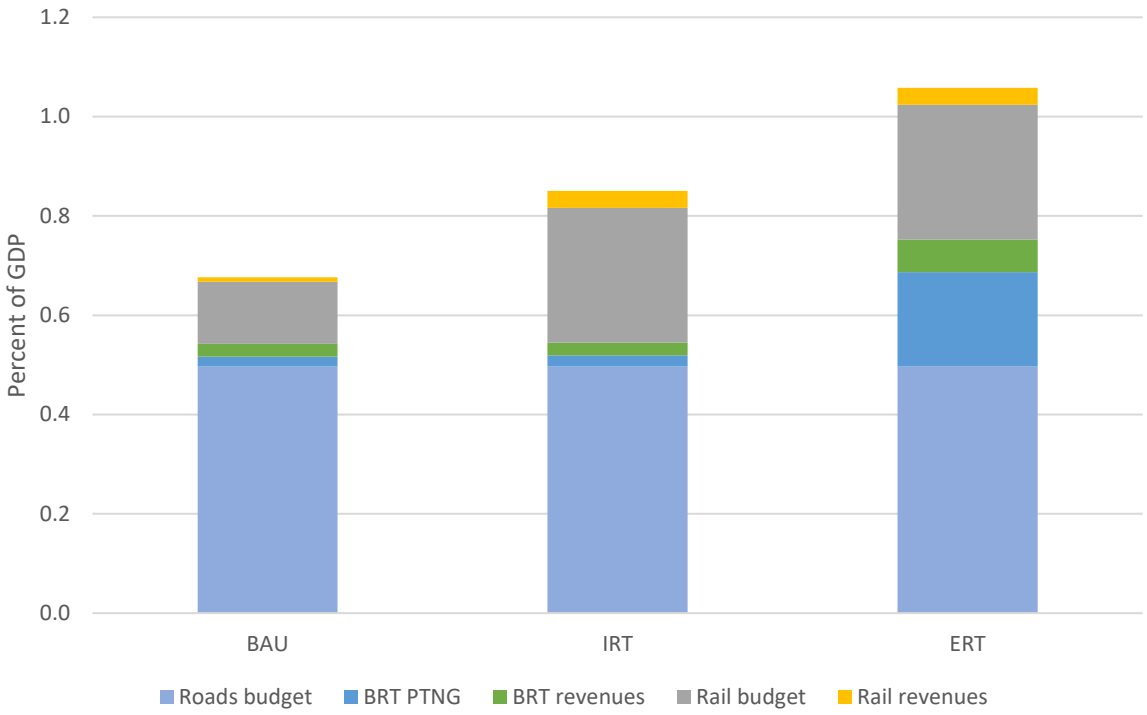

Figure A.1: Projected annual average available funding for urban transport

Rural accessibility

Rural accessibility is measured using the Rural Access Index (RAI), which was developed by Roberts, Shyam, and Rastogi (2006). The RAI is among the most important global indicators for measuring people's transport accessibility in rural areas. The metric is conceptually simple – it measures the share of the population who live within 2 km of an all-season road. The original work relied on available household surveys and modelling techniques, which had several shortcomings in terms of spatial representativeness, comparability, and sustainability. For those reasons and given the renewed interest in the RAI in the context of the Sustainable Development Goals, a more sustainable and consistent method for measuring rural access has been proposed using new spatial data and techniques.

The new RAI method, which is the one used in this study, is conceptually the same as the previous work—that is, it measures the share of the population who live within 2 km of an all-weather road in rural areas—but it uses high-resolution population distribution data along with digitized road network data including road condition information for its computation (World Bank 2016). The analysis uses the current and

projected geographic distribution of population developed for this study and the modelled road network in 2030 and 2051 to estimate the corresponding RAI scores.

Funding needs in rural transport

The analysis uses the prioritisation model developed by Ross & Townshend (2018) and refined by Townshend (2020). Its estimates of inputs have been verified by South Africa's National Treasury, and applications are currently being piloted by the South African National Roads Agency (SANRAL).

The model classifies rural roads as either:

(i) *Basic Access*, meaning that they are essential to connecting at least one densely populated area to essential services (schools and clinics), but are not Strategic as defined below;

(ii) *Strategic*, meaning that they support the highest contribution to economic growth independently of fluctuations in business and commodity price cycles

(iii) *Tactical*, meaning that they make positive contributions to economic growth under some (but not all) market conditions, but are not Basic Access roads during periods when this contribution is negative or zero; or

(iv) *Surplus*, meaning that if they were unproclaimed, this would generate a net saving to the economy and would not deprive any rural communities of access to essential services.

A standard calibrated dynamic stochastic general equilibrium model of the South African economy is used to identify roads in classes (ii) – (iv). The classification is reflected in a prioritisation model that includes parameters for maintenance costs that vary with surface types, calculated over a 30-year horizon. The prioritisation rule is that maintenance of basic access roads is the first lexical priority to ensure that all South Africans enjoy at least the minimum constitutionally prescribed level of access to constitutionally protected primary and secondary school facilities. The second priority is strategic roads. The third priority are tactical roads. The lowest priority is surplus roads.

The model then minimises the extent of the basic access road network by hypothetically relocating basic services (schools and clinics) subject to the constraint that every existing household must be within 5 km of such services. This converts some basic access roads into surplus roads.

Cost parameters are empirically specified, given current relative costs and costs forecasts based on the expected road deterioration. The model includes rehabilitation costs, periodic maintenance costs, and annual routine maintenance costs. The model considers the impact of heavy rainfall, periodic flooding, or steep road gradients that increase the rate of gravel loss and shorten the period between re-gravelling events based on the CSIR's Green Book (Le Roux et al. 2019). The roadwork unit cost data are from the National Treasury's Road Network Cost Model, which was cross-checked and updated where relevant using a study to calibrate HDM-4 gravel road performance models in the Western Cape province (Government Technical Advisory Centre 2018). The Road Network Cost Model disaggregates these roadwork costs according to input factors, which allows to vary the cost of capital over time across scenarios based on the socioeconomic pathways.

As presented in section 4.2.2.1, the following four policy scenarios are analysed:

a. The constrained, *unrationalised, gravel surfaces (CUG) scenario* assumes the extension of the current rural road network will remain unchanged and roads will be rehabilitated maintaining their current surfaces.

b. The constrained, *unrationalised, sealed surfaces (CUS) scenario assumes* the extension of the current rural road network will remain unchanged, and roads will be rehabilitated by sealing them.

c. The constrained, *rationalised, gravel surfaces (CRG) scenario* assumes the rural road network is rationalised following essential services relocations and roads will be rehabilitated maintaining their current surfaces.

d. The constrained, *rationalised, sealed surfaces (CRS) scenario* assumes the rural road network is rationalised following essential services relocations and roads will be rehabilitated by sealing them.

The funding needs for rural roads under the four scenarios are shown in Table A.2.

Table A.2: Total funding needs under different scenarios, billion rands

		CUG	CUS	CRG	CRS
2022-30	Capital	0	133	0	102
	O&M	356	179	294	168
2031-51	Capital	0	399	0	326
	O&M	1,095	593	949	568
2022-51	Capital	0	532	0	429
	O&M	1,452	772	1,242	736

Note: The funding needs are calculated assuming the baseline socioeconomic pathway.

Estimated funding available for rural roads

To develop the scenarios for rural road access improvements in South Africa to 2030, it is necessary to estimate the available budget envelopes for rural road works over this period. The revenue and expenditure data for the provincial and municipal road departments were reviewed, as they manage all unpaved rural roads and the overwhelming majority of deteriorated paved rural roads that constitute the network in need of improvement. The 2021 budget for provincial roads captures the Provincial Road Maintenance Grant allocation, which according to historical outcomes was assumed to be approximately matched in aggregate by allocations from provincial own revenues (Minister of Finance 2021). Given the diversity of funding sources for municipal road departments, the 2021 budget for municipal roads reflects the Road Transport expenditures by municipalities (excluding metropolitan municipalities) in 2020/21 published in the Section 71 Statement of Expenditure (National Treasury 2021a).

The combined 2021 provincial and municipal road budgets were grown over the period 2022 to 2030 and 2022-2051 by GDP growth in the baseline socioeconomic pathway, and GDP growth adjusted for the investment-to-GDP ratios relative to the baseline scenario in the urban and rural scenarios. In line with the 2013/14 to 2016/17 expenditure data from the National Treasury's Basic Accounting System, 55% of the total budget was ring-fenced for routine and periodic road maintenance activities. This portion of the budget was earmarked for the continued upkeep of rural roads already in an all-weather condition. The remaining budget was further revised downwards by 30% in the Baseline scenario, 35% in the Urban scenario, and 25% in the Rural scenario to account for the share of the budget earmarked for urban roads. The projected annual budget envelopes for rural road access as percentage of GDP under each scenario are shown in Figure A.2.

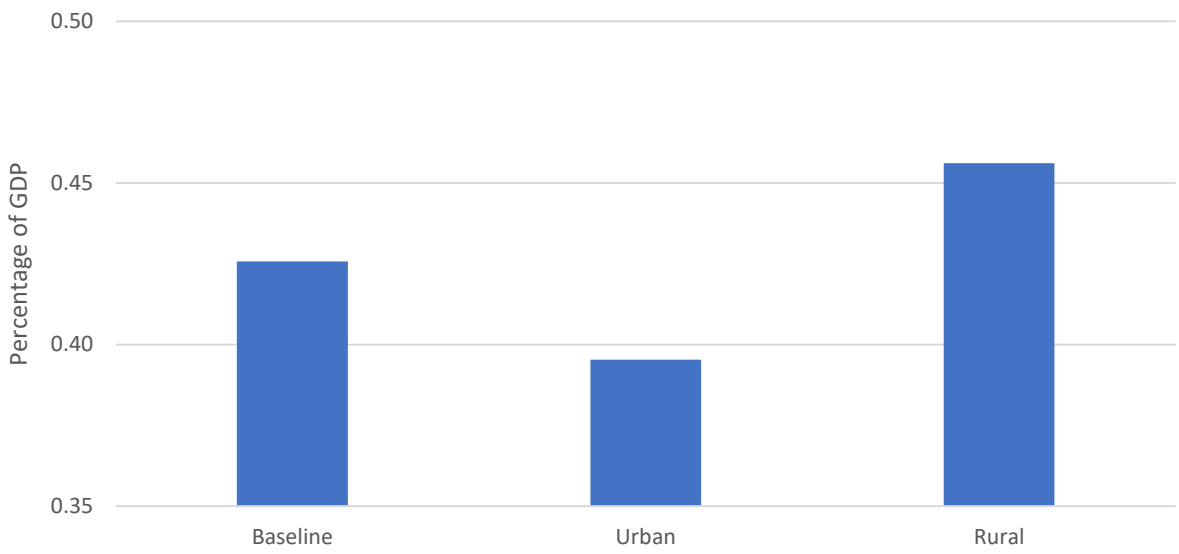

Figure A.2: Projected annual budget envelopes for rural road access

Annex B: Data sources

Road network data:

Eastern Cape Department of Roads and Public Works

Free State Department of Police, Roads and Transport

Gauteng Department of Roads and Transport

Kannemeyer, L. 2016. South African Road Network Condition, Needs and Funding. SANRAL

KwaZulu-Natal Department of Transport

Mpumalanga Provincial Government

National Department of Transport

Northern Cape Department of Roads and Public Works

Roads Agency Limpopo

Western Cape Government. 2022. Road Network Information System. [Online] Available at: https://rnis.westerncape.gov.za/rnis/rnis_web_reports.main.

World Bank

Current transport services data:

Annual Division of Revenue Acts (various): Public Transport Network Grant Framework

Automotive Association of South Africa, congestion data

City Multi-year Financial Operations Plans (BRT)

City of Cape Town IPTN, 2014

City of Cape Town Transport and Urban Development Authority, Transport Development Index, 2018

CSIR, Gauteng Province Household Travel Survey Report, 2019/20

Current Public Transport Records for Gauteng

National Treasury: Estimates of National Expenditure, 2021, Vote 40

PRASA Annual Report, 2018/19

PRASA Corporate Plans

Access data:

National Treasury, City Support Programme, Urban Transport Analysis for the Urbanization Review, January 2018

StatsSA, Census 2011

StatsSA, General Household Survey, Selected development indicators, Metros, 2017

StatsSA, National Household Travel Survey, 2021

StatsSA, 2020 Land Transport Statistics

Environmental data:

Centre for Scientific and Industrial Research. 2022. GreenBook. [Online] Available at:

https://greenbook.co.za/

Macroeconomic and population data:

World Bank, Going beyond the Infrastructure Funding Gap: A South African Perspective Population and Gross Domestic Product Projections as Inputs to the Infrastructure Demand Scenarios August 25, 2021

Budget and finance data:

National Treasury. 2021. Division of Revenue Bill. [Online] Available at:

http://www.treasury.gov.za/legislation/bills/2021/%5BB3%20-%202021%5D%20(Division%20of%20Revenue).pdf

National Treasury. 2021. Section 71 Report. [Online] Available at:
http://mfma.treasury.gov.za/Media_Releases/s71/2021/4th_2021/Pages/pdf.aspx

National Treasury, State of Local Government Finances and Financial Management, 2020

National Treasury, various Budget Reviews, Nominal GDP Actuals

South African City's Network, State of City Finances, 2020

Costs:

City Multi-year Financial Operations Plans (BRT)

National Treasury

PRASA Corporate Plans

SANRAL estimates of road maintenance backlogs

Western Cape Department of Transport and Public Works

Benchmarking data:

Network Rail, Rail infrastructure Cost Benchmarking, Hamburg/London, 2008

PRoRail, International Benchmark 2011 – 2015 ProRail / NS, 2017

Infrastructure and performance data:

City Multi-year Financial Operations Plans (BRT)

National Treasury: Estimates of National Expenditure, 2021, Vote 40

Diagnostic data

World Economic Forum (WEF): Global Competitiveness Report (Perception Survey)

World Health Organization (WHO): Global Health Observatory data repository;

World Health Organization (WHO): Brauer, M. et al. 2017, for the Global Burden of Disease Study (PM2.5 air pollution, mean annual exposure)

World Bank (WB): World Development Indicators,

United Nations Conference on Trade and Development (UNCTAD): UNCTADstat

International Road Assessment Programme (iRAP): Star Ratings URL: https://irap.org/rap-tools/infrastructure-ratings/star-ratings/

International Road Federation (IRF): World Road Statistics (WRS) 2020 edition

Institute for Transportation and Development Policy (ITDP): Rapid Transit Database

International Energy Agency (IEA): Data and statistics CO2 Emissions from Fuel Combustion

International Union of Railways (UIC),

International Civil Aviation Organization (ICAO),

International Maritime Organization (IMO),

United Nations Environment Programme (UNEP),

Research for Community Access Partnership (ReCAP), TRL, and Azavea: Rural Access Index (geospatial methodology) URL: https://rai.azavea.com/.

Annex C: Linking Findings and Recommendations

Table C.1: Key findings and recommendations

	Findings	Recommendations	Primary responsibility	Secondary responsibility
Access				
Urban access				
Institutions and organization	Public transport functions are performed more effectively at local level.	Implement long-standing policies for devolution of authority over public transport to metropolitan governments.	DoT	Local governments
	Currently, authority over public transport in South Africa is split between the spheres of government and across different entities, despite policy and legislative intentions around devolution.	Support smaller metros to capacitate themselves adequately with systems and qualified personnel to assume responsibility for devolved modes of transport.	DoT	Provincial / Local governments
Bus rapid transit	Cities have struggled to roll-out financially sustainable BRT services.	Review and update IPTN plans with the view to ensure fiscal sustainability of proposals.	DoT	Local governments
		Carefully consider BRT service offerings in terms of the competitive landscape, customer needs, market positioning and return on investment during the design phase.	DoT	Local governments
Minibus taxis	Minibus taxis should be integrated into formal public transport networks and planning exercises.	Recognise minibus-taxis as a key part of solutions to South Africa's public transport challenges alongside other modes and work with minibus taxi industry role-players to enhance its efficiency.	DoT	Provincial / Local governments
	Dedicated, high quality facilities can offer significant returns in travel time for passengers and operating costs for operators.	Focus resources on capital expenditure to improve roads and facilities used by minibus taxis.	Local governments	Provincial governments
	Regulatory systems have become outdated and are undermining important oversight and planning functions of authorities.	Recognise the importance of good regulation and enforcement and develop new, more effective means to do so.	Provincial governments / DoT	Local governments
Commuter rail	Restoring rail services to full functionality will require significant investment in the repair and restoration of stations, signalling systems, track and per way	Support PRASA to refine its recovery plan with clear and costed capital investment and operational action plans.	DoT / PRASA	National Treasury

	infrastructure, and the production of a Recovery Plan with clear and costed capital investment and operational action plans is needed to guide the recovery program.			
	The collapse of railway services has impacted commuters severely, both in terms of travel costs and accessibility. PRASA should continue with the focused roll-out of Metrorail services, in parallel with focused investment to attain the full resumption of the services.	Support PRASA to expedite programs to restore rail services, including the reconstruction of damaged / vandalized track and catenary infrastructure, signal systems and stations.	DoT / PRASA	National Treasury
	Public transport functions are performed more effectively at local level.	At the same time, expedite the development and implementation of a comprehensive strategy for the devolution of passenger rail services to municipalities.	DoT	PRASA
	Closer coordination between city governments and PRASA is required to ensure alignment for planning.	In the interim, strengthen coordination between cities and PRASA to ensure alignment on investments and planning.	PRASA	Local governments
Rural access				
Rural roads	Maintenance of the road network has been both inadequate and unsystematic, with the result that most of the network, and almost all of the sub-network that provides access for isolated communities, have severely deteriorated.	Rehabilitate deteriorated paved strategic roads and pave all unpaved strategic roads.	Provincial governments	DoT
	South Africa's rural road network is too large to be adequately maintained given realistic fiscal resources. This problem is compounded by the fact that most of the rural network consists of gravel roads with rapidly increasing maintenance costs.	Develop a rationalized basic road network and seal all roads in this network.	Provincial governments	DoT
	A rationalized road network will require careful consideration of the location of social service facilities to ensure minimum access requirements are met.	Ensure close coordination with relevant departments in the provision (and potential relocation) of social infrastructure to align with the rationalized basic road network.	Provincial governments	DoT
	There is a significant shortfall in provincial road funding except for Gauteng, KwaZulu-Natal and Western Cape allocating sufficient funds to address their maintenance backlogs.	Ensure that sufficient resources are allocated to the maintenance of assets, which includes routine maintenance and rehabilitation.	Provincial governments	DoT
	Achieving maximum efficiencies from roads budgets will require good data and knowledge regarding the condition of the network, and experienced and skilled	Ensure that roads departments are adequately capacitated with qualified staff and equipment to manage the road assets under their control.	Provincial governments	DoT

	staff to make decisions and oversee work at every stage of the project cycle.			
Gender				
	Limited consultations including women, and Few public participation or stakeholder engagement practitioners are specifically trained in gender-sensitive engagement processes.	Actively engage and consult women as stakeholders.	DoT	Provincial and local governments
	Lack of regular gender specific and gender disaggregated data collection.	Collect gender specific and disaggregated data.	DoT / Stats SA	Provincial and local governments
	Gender focus is not explicit in transport policies and plans. Also absent is any explicit policy recognition of the gendered nature of travel, or policy direction to redress inequity in this regard.	Institutionalize gender in transport policy and planning.	DoT	Provincial and local governments
	Policies implicitly assume that attention to universal access will meet the needs of women travellers, but this is not sufficient to address all user needs.	Develop gender-responsive infrastructure and operations.	DoT	Provincial and local governments
Efficiency				
Ports	Transnet's unique and unusual institutional structure contributed to a lack of competition among the ports. Whilst the private sector is involved on the bulk side, there are no specialist independent container terminal operators, operating solely or jointly, at any of the South African ports.	Develop a port sector strategy that clearly defines the role and function of each port in the network.	Transnet	DoT / DPE
	Considering the extensive investment required to both restore and maintain existing transport infrastructure, public-private partnerships that capitalize on potential efficiencies in the private sector should be exploited whenever possible.	Encourage greater private sector involvement in terminal operations.	Transnet	DoT / DPE
Freight rail	While the coal and iron ore lines are viable stand-alone business, the general freight business has declined markedly in density, serving only 11% of the share of rail-friendly traffic.	Pursue initiatives to leverage additional private sector participation in rail to capture additional market share from road.	Transnet	DoT / DPE
Road safety				

	South Africa is listed by the WHO as applying only 'partial' road safety audit requirements or star rating assessments for new roads and allocating investment for treatment of high-risk infrastructure safety locations	Systematize the generalized use of road safety audits for all high traffic roads and ensure adequate funding supporting investments to bring 75% of the high traffic roads to a 3-star rating standard (iRAP 2020)	DoT	SANRAL / Provincial governments
	58% of fatalities involve a driver over the legal blood alcohol content (BAC) limit	Reduce BAC limit for young or novice drivers to <0.02 from 0.05 currently.	DoT	RTMC
	Good practice leading to general deterrence in high-income countries has included the conduct of around one RBT per driver per annum.	Expand the deployment of random breath testing (RBT) and the application of appropriate penalties.	DoT	RTMC
	In South Africa where only around one-third of vehicle occupants wear a seat belt	Strengthen enforcement to increase seat belt wearing.	DoT	RTMC
	Speed limits in the country are higher than the globally recommended Safe System speeds	Introduce legislation to reduce speed limits to 30-50 km/hr in urban areas, 80 km/hr in rural, and 100 km/hr on motorways.	DoT	RTMC
	Unsafe road environments coupled with inappropriate speeds, can contribute to high fatality rates, which substantiates the need to determine the maximum speeds allowable for safe travel on roadways that have high levels of pedestrian activity.	Develop an integrated speed management plan that includes infrastructure changes on urban streets and rural roads starting with the highest risk locations (e.g., schools, markets and villages) through traffic calming measures (speed bumps, speed cameras, etc.).	SANRAL / Provincial governments	DoT
	UNECE WP29 vehicle regulations on imported or domestically manufactured vehicles relating to frontal impact, or motorcycle antilock braking systems (ABS) are not applied, and electronic stability controls are not fully implemented in South Africa.	Adopt United Nations Economic Commission for Europe (UNECE) vehicle safety standards related to frontal impact and ABS system (UNECE 1998).	DoT	RTMC
Green transport				
Urban transport	The urban form of South African cities plays an important role in driving up GHG emissions, increasing travel distances and intensity of motorised travel, while it is also a critical factor in determining what adaptation and mitigation measures would work best in the context.	Ensure that measures are implemented to limit sprawl and promote the densification of existing built environment footprints.	Local governments	
	Restoring and improving commuter rail services while enhancing the efficiency of public road transport should be a priority to support initial decarbonization steps. SA's commuter rail services offer the best opportunity to curb	Expedite the restoration of commuter rail services.	PRASA	DoT

	road traffic congestion and emissions in the short to medium term.			
	Minibus taxis now provide 70% of all public transport services in South Africa, using almost universally, diesel powered 16-seater buses, irrespective of the route characteristics. Besides the impacts on congestion, the inefficiencies of this system greatly impact on the country's ability to achieve its climate change objectives.	Focus on improving the quality of road-based public transport and support the transition of informal transport operators to formal transit, including, where practical the introduction of higher occupancy vehicles in the taxi industry.	Local governments	Provincial governments / DoT
Freight and logistics	Rail's market share subsequently declined dramatically due to a gradual decline in rail service reliability and capacity constraints on key corridors, as a result of deferred maintenance, and more recently severe vandalism of infrastructure.	Support Transnet to restore lost capacity on key corridors through sustainable, climate resilient investment in deteriorated infrastructure and to ensure the reliability of train slot availability.	Transnet	DoT / DPE / NT
	While Transnet has made attempts at addressing its climate impacts, most notably through developing an energy management plan, it is yet to develop a holistic strategy for climate change.	Support Transnet to develop and implement a clear strategy to minimize/mitigate the negative impacts of climate change and the environmental risks in its operations and enhance the climate change and environmental opportunities in its business.	Transnet	DoT / DPE / NT
Rural transport	Provincial and rural roads that are in a poor state of repair are vulnerable to climate-related risks and may be impassable after heavy rains, disrupting normal business sometimes for days or weeks.	Invest to ensure reliable, climate resilient connectivity and accessibility on a rationalized basic paved road network.	Provincial governments	DoT
	SA currently allocates well below 20% of its transport expenditure to maintenance, far less than peer countries such as Indonesia and Malaysia.	Allocate sufficient funding for regular maintenance and asset preservation of a rationalized basic paved rural road network	Provincial governments	DoT
	Road authorities have not invested in updating design standards or manuals in light of changing climatic patterns, in particular rainfall patterns.	Road authorities need to develop and adopt climate resilient standards to ensure the longevity of the assets and ensure ongoing accessibility for rural communities and the sustainability of the agriculture sector.	DoT	SANRAL / Provincial governments

Annex D: List of upper middle-income countries

Table D.1: Upper middle-income countries

Country Name	Country Code	Region
Albania	ALB	Europe & Central Asia
Armenia	ARM	Europe & Central Asia
Azerbaijan	AZE	Europe & Central Asia
Bulgaria	BGR	Europe & Central Asia
Bosnia and Herzegovina	BIH	Europe & Central Asia
Belarus	BLR	Europe & Central Asia
Belize	BLZ	Latin America & Caribbean
Brazil	BRA	Latin America & Caribbean
Botswana	BWA	Sub-Saharan Africa
China	CHN	East Asia & Pacific
Colombia	COL	Latin America & Caribbean
Costa Rica	CRI	Latin America & Caribbean
Cuba	CUB	Latin America & Caribbean
Dominica	DMA	Latin America & Caribbean
Dominican Republic	DOM	Latin America & Caribbean
Algeria	DZA	Middle East & North Africa
Ecuador	ECU	Latin America & Caribbean
Fiji	FJI	East Asia & Pacific
Gabon	GAB	Sub-Saharan Africa
Equatorial Guinea	GNQ	Sub-Saharan Africa
Grenada	GRD	Latin America & Caribbean
Guatemala	GTM	Latin America & Caribbean
Guyana	GUY	Latin America & Caribbean
Iran, Islamic Rep.	IRN	Middle East & North Africa
Iraq	IRQ	Middle East & North Africa
Jamaica	JAM	Latin America & Caribbean
Jordan	JOR	Middle East & North Africa
Kazakhstan	KAZ	Europe & Central Asia
Lebanon	LBN	Middle East & North Africa
Libya	LBY	Middle East & North Africa
St. Lucia	LCA	Latin America & Caribbean
Maldives	MDV	South Asia
Mexico	MEX	Latin America & Caribbean
North Macedonia	MKD	Europe & Central Asia
Montenegro	MNE	Europe & Central Asia
Mauritius	MUS	Sub-Saharan Africa
Malaysia	MYS	East Asia & Pacific

Namibia	NAM	Sub-Saharan Africa
Peru	PER	Latin America & Caribbean
Paraguay	PRY	Latin America & Caribbean
Romania	ROU	Europe & Central Asia
Russian Federation	RUS	Europe & Central Asia
Serbia	SRB	Europe & Central Asia
Suriname	SUR	Latin America & Caribbean
Thailand	THA	East Asia & Pacific
Turkmenistan	TKM	Europe & Central Asia
Tonga	TON	East Asia & Pacific
Turkey	TUR	Europe & Central Asia
St. Vincent and the Grenadines	VCT	Latin America & Caribbean
Venezuela, RB	VEN	Latin America & Caribbean
Samoa	WSM	East Asia & Pacific