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Low Carbon Frameworks: Transport

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GREENHOUSE GAS EMISSIONS MITIGATION OPPORTUNITIES AND MEASURES IN PASSENGER TRANSPORT

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WWF's Transport Low Carbon Frameworks transport project explores the possibilities and implications of greenhouse gas emission reduction strategies (mitigation) in the South African transport sector, such that a flourishing economy and human wellbeing are fostered. This report provides an overview of mitigation opportunities, initiatives and measures for the passenger transport sector in South Africa, which can serve as a quick reference.

Emissions from transport

South Africa's National Climate Change Response Policy outlines the country's commitment to moving to a lower carbon economy (Republic of South Africa, 2011). Within the White Paper, the transport sector is identified as a significant greenhouse gas (GHG) emitting sector. The latest South African Greenhouse Gas Inventory (DEA, 2013), an official submission to the UNFCCC, was published in 2013. The most recent data provided in the inventory (for 2010), suggests that energy used in transportation contributed a total of 47.4 Mt CO₂e, or 8.4% of South Africa's greenhouse gas emissions. Passenger transport is thought to make up slightly over half of these emissions. If indirect emissions were included from the upstream extraction, refining and distribution of fuels and generation of electricity, the emissions attributable to the transport sector would be larger. For more detail, see *Briefing Note on Transport Emissions in South Africa* at www.wwf.org.za/transport_emissions.



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A framework for understanding mitigation in the transport sector

Mitigation in the transport sector is considered in terms of the widely adopted Avoid-Shift-Improve framework. Within this framework, illustrated in Figure 1, a distinction is made between the following:



AVOID

Some of us are choosing car-free or car-minimalist lifestyles.

- Mitigation **initiatives** that are implemented to reduce greenhouse gas emissions;
- Mitigation **opportunities**, which are achieved by implementing the initiatives; and
- The **measures** that are used to support the implementation of initiatives.

Figure 1 provides some examples of opportunities and initiatives, with Figure 2 giving some examples of the measures that can be used. It is important to highlight that the same measure may be used to support Avoiding, Shifting and Improvement opportunities, and that a single measure may facilitate multiple initiatives and realise multiple opportunities.

Figure 1 **The avoid-shift-improve framework illustrating the opportunities, initiatives and measures applicable to passenger transport**

	AVOID	SHIFT	IMPROVE
OPPORTUNITY	Avoid or remove the need for passenger transport	Shift to lower carbon modes for passenger	Improve the efficiency of passenger transport
INITIATIVES	Land use densification Telecommuting	Non motorised transport Increase use of two and three wheelers	Improved rail infrastructure Hybrid vehicles
MEASURES*	PREI	PREIT	REIT

Data source: based on Dalkmann and Brannigan (2007)
 Note: * P = planning; R = regulatory; E = economic; I = information; T = technological

Figure 2 **Examples of measures for mitigation of emissions from passenger transport**

Planning instruments	Regulatory instruments	Economic instruments	Information instruments	Technological instruments
Transport infrastructure planning NMT infrastructure	Parking restrictions Toll lanes	Emissions tax Fuel taxes Congestion charging	Public awareness campaigns Vehicle labelling	Traffic signal optimisation Public transport apps

Data source: based on Dalkmann and Brannigan (2007) and Dalkmann and Sakamoto (2011)

Overview of mitigation opportunities, initiatives and measures applicable to passenger transport

The tables below summarise the mitigation opportunities, initiatives and measures available in the passenger transport sector. These lists are by no means exhaustive but serve to provide an indication of the broad range of mitigation measures that are available.

Table 1 Summary of mitigation opportunities and initiatives applicable to passenger transport

Opportunity	Initiatives	Description	Reference
Avoid or reduce the need for transport	Subsidised housing provision	Medium to high density subsidised housing, within urban core areas, in close proximity to public transport should be provided to lower income groups.	(Gauteng DRT, 2013a)
	Land use densification and mixed use land development	These two spatial planning interventions allow people to live closer to work and services, as well as to public transport networks.	(Gauteng DRT, 2013a)
	Telecommuting and videoconferencing	Reduces the need for employee travel either to work or to meetings.	(Gauteng DRT, 2012; Gauteng DRT, 2013a; Tunçer & Narberhaus, 2008)
	Online shopping	Online shopping with enhanced delivery services is a low carbon alternative to consumers making trips to shop.	(Tunçer & Narberhaus, 2008)
Shift to lower carbon modes for passenger	Bus Rapid Transit (BRT)	Cheaper and quicker alternative to expanding the rail system. A BRT system has designated bus lanes, integrated fare systems, well-designed bus stops and quick boarding systems.	(Bohler-Baedeker & Hugging, 2012)
	Construction of new passenger rail routes	Building new rail routes where there are none existing at present.	(Gauteng DRT, 2013a)
	Mainstreaming non-motorised transport	NMT infrastructure to link community facilities, schools and transport nodes.	
	Two and three wheelers	Motorised two and three wheelers have lower fuel usage and emissions than cars.	(DoT, 2007)
Improved efficiency of passenger transport: operational measures	Upgrading and improving rail infrastructure and efficiency	Rail transport provides mass transport services, high average travel speeds and has lower carbon emissions than private vehicle transport.	(Gauteng DRT, 2013a)
	Improved maintenance of transport infrastructure	Ensuring travel infrastructure including roads and rail systems are well maintained improves efficiency of use.	(Gauteng DRT, 2012)
	Flexi work hours	Allowing employees staggered work times reduces congestion during peak hours.	(Gauteng DRT, 2012; Gauteng DRT, 2013a)
	Extended hours of operation and more frequent public transport services	Public transport should be operated 7 days a week, for 16-24 hours a day. During peak periods, public transport frequency should be every 5-10 minutes and every 10-30 minutes off peak.	(DoT, 2007)
	Multi-modal integration systems with public and road transport	Core road and trunk rail corridors with feeder systems increases efficiency.	(DoT, 2007)
	Park and ride facilities	Such facilities promote connectivity with the public transport network.	(DoT, 2007)
	Ease of access to disabled, elderly and scholars	All forms of public transport and changeovers need to be readily accessible to everyone.	(DoT, 2007)



Opportunity	Initiatives	Description	Reference
Improved efficiency of passenger transport: technology measures	Implementation of an Intelligent Transport System (ITS)	Such systems provide for more efficient usage of transport systems including public transport systems.	(Gauteng DRT, 2012)
	Running efficient transport information call centres	Call centres supplying up-to-date travel information allow users to make more informed transport choices.	(Gauteng DRT, 2012)
	Improving combustion engine vehicle efficiency	Making vehicles available which have engines that are more fuel efficient and thus give rise to lower emissions.	(Weber et al., 2011)
	Reduction in vehicle weight and aerodynamic optimisation	Lighter vehicles use less fuel while less drag results in reduced fuel consumption.	(Tunçer & Narberhaus, 2008)
	Introduction of energy saving vehicle components	Introducing fuel-saving measures into vehicles which include low-friction lubricants, systems that allow for automatic engine idling, gear shift indicators, tyres with low rolling resistance and tyre pressure monitoring systems.	(Bohler-Baedeker & Hugging, 2012)
Improve greenhouse gas emissions efficiency of passenger transport: alternative fuels	Use of gas as alternative fuels	Compressed Natural Gas (CNG) and Liquid Natural Gas (LNG) are preferred lower carbon alternative energy options for public transport vehicles. Liquid Petroleum Gas (LPG) can also be used as an alternative fuel.	(Gauteng DRT, 2012; UNEP, 2011)
	Use of hydrogen as an energy carrier	Vehicles running on fuel cell technology use an electrochemical process to convert fuel into electricity with hydrogen as the primary fuel source.	(UNEP, 2011)
	Promoting increased uptake of biofuels (bioethanol and biodiesel)	Alternative fuels produced from certain crops, crop residues, municipal waste or algae.	(Tunçer & Narberhaus, 2008)
	Promoting uptake of electric vehicles	Battery electric vehicles (BEV) depend entirely on on-board rechargeable batteries, others use hydrogen-powered fuel cells and some rely on a grid connection. Plug-in hybrid vehicles (PHEV) combine an internal combustion engine with batteries that can be charged by plugging into the grid. Emission savings depend largely on how a country produces its electricity.	(Bohler-Baedeker & Hugging, 2012)
	Promoting uptake of hybrid vehicles	Hybrid electric-diesel vehicles combine diesel and electric engines. Hybrids often incorporate various efficiency-improving technologies like those that recover energy during braking. Hybrids are especially effective for vehicles driving in traffic that stop frequently, allowing batteries to recharge.	(Bohler-Baedeker & Hugging, 2012)

Table 2 Summary of mitigation measures applicable to passenger transport

Category of measure	Measure	Description and examples of initiatives from Table 1 that would be supported	Reference
Planning measures	Land use planning	Planning for shops, public services, residential areas and places of employment within a close proximity to each other, with effective travel links. This thus supports land use densification and mixed use land development	(Dalkmann & Brannigan, 2007)
	Sustainable transport and related infrastructure planning	Effective planning including development of integrated transport systems and intermodal links is required to support the shift from private vehicles to mass transit public transport and NMT. Also refers to employing the principles of sustainability when designing and rehabilitating transport infrastructure, using low impact designs and materials. For example, lower temperature asphalt designs use less energy, ultra-thin concrete pavement layers use less material and the use of energy efficient luminaries will lower energy consumption for road lighting.	(Bohler-Baedeker & Hugging, 2012; Gauteng DRT, 2014)
	Reversible lanes and road space reallocation to balance private cars and more sustainable modes	Having designated public transport vehicle lanes and reversible lanes designated for public transport vehicles would ease congestion and decrease travel time through encouraging increased use of public transport.	(Gauteng DRT, 2012; Gauteng DRT, 2013a)
	Benchmarking	Benchmarking the performance of a transport system against other systems nationally or globally helps to identify congestion and energy intensive nodes and provides decision makers with the information required to identify gaps, set targets and decide which of the initiatives identified above will help improve the system.	(Bohler-Baedeker & Hugging, 2012)
	Green procurement policies	Municipalities and companies lead the way by implementing measures to preferentially purchase vehicles for the fleets that are fuel-efficient and meet environmental performance standards.	(Bohler-Baedeker & Hugging, 2012)
	Planning for NMT infrastructure	Includes dedicated bicycle lanes, bicycle parking, park and ride facilities and bike share systems, as well changing facilities, showers and bicycle stands at workplaces. NMT needs to be integrated into the public transport network along with pedestrian zones, sidewalks and crossings.	(Bohler-Baedeker & Hugging, 2012)
	Planning for public transport systems with improved comfort of stations and public transport vehicles	Good shelters, boarding islands, improved lighting, information kiosks, signage and multi-modal terminals at public transport stations and stops. Public transport is more attractive to passengers when it is reliable and comfortable as a result of high design standards.	(Bohler-Baedeker & Hugging, 2012; DoT, 2007)
	Incorporating traffic impact assessments in development	Economic developments should carry out traffic impact assessments when selecting locations for business and residential developments to ensure the adoption of appropriate initiatives for the area.	(Bohler-Baedeker & Hugging, 2012)
	Electricity generation from less carbon intensive alternatives	The production of a country's electricity affects the energy efficiency of railway electrification and electric vehicles and hence introducing planning measures to reduce the emissions intensity thereof will reduce emissions associated with these modes of transport.	(Bohler-Baedeker & Hugging, 2012)

Category of measure	Measure	Description and examples of initiatives from Table 1 that would be supported	Reference
Regulatory measures	Provision of high occupancy lanes	Designated high occupancy lanes will encourage carpooling initiatives.	(Gauteng DRT, 2012; Gauteng DRT, 2013a)
	Implementing parking restrictions and increased cost of parking	Limiting the amount of available parking and increasing the cost of parking substantially in commercial centres will discourage the use of private vehicles and promote public transport.	(Gauteng DRT, 2012; Gauteng DRT, 2013a; Bohler-Baedeker & Hugging, 2012)
	Provision of toll lanes	Charging for use of particular roads may discourage private transport use.	(Gauteng DRT, 2012; Gauteng DRT, 2013a)
	Bus priority at intersections	Prioritising buses at intersections will ensure shorter traveling times and may encourage public transport usage.	(Gauteng DRT, 2012; Gauteng DRT, 2013a)
	Road space rationing by restricting travel at specific times of the day to certain vehicles	Restricting the use of certain vehicles (freight) at certain times of the day to ease congestion during peak periods.	(Gauteng DRT, 2012; Gauteng DRT, 2013a)
	Plate restrictions	Restricting the use of vehicles depending on their registration plate numbers on particular days of the week or at certain times during the day.	(Bohler-Baedeker & Hugging, 2012)
	Vehicle quota system	Limit the growth in vehicle ownership through restricting the number of cars that are sold or owned.	(Bohler-Baedeker & Hugging, 2012)
	Setting standards for fuel efficient vehicle purchases	Ensuring that there is a standard for measuring the fuel efficiency of vehicles.	(Bohler-Baedeker & Hugging, 2012)
	Environmental zones/ Low emission zones	Only vehicles meeting a prescribed emissions standard can enter these zones.	(Bohler-Baedeker & Hugging, 2012)
	Traffic diverters	Traffic diverters are structures that block traffic away from certain routes. These instruments ease congestion and decrease travelling time.	(Bohler-Baedeker & Hugging, 2012)
	Speed restrictions	Cars travelling at lower speeds use less fuel.	(Bohler-Baedeker & Hugging, 2012)
	Fuel quality regulations	Ensure fuel quality standards to meet the needs of advanced engine technologies.	(Bohler-Baedeker & Hugging, 2012)
	Vehicle emissions testing	Regulations for old and new vehicles to require regular testing prior to issuing operating licenses.	(Wright, 2007)



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Category of measure	Measure	Description and examples of initiatives from Table 1 that would be supported	Reference
Economic measures	Implementing public transport subsidies	Subsidising public transport will benefit low-income earners and encourage a shift from private to public transport because it is cost effective.	(Gauteng DRT, 2012; Gauteng DRT, 2013a)
	Time, distance and place road pricing	Charging road users based on when, where and how much they drive will help to drive initiatives relating to shifting to public transport, car pooling and off-peak driving.	(Gauteng DRT, 2012; Gauteng DRT, 2013a)
	Congestion charging	Charge a fee based on vehicles in a particular area during certain times of the day when congestion is at its peak.	(Bohler-Baedeker & Hugging, 2012)
	Incentives for fuel efficient vehicle purchases	This would encourage the purchase of fuel-efficient vehicles.	(Bohler-Baedeker & Hugging, 2012)
	Introduction of fuel taxes	Fuel taxes encourage purchases of vehicles with lower fuel consumption. The tax is levied either at the refinery gate or fuel wholesaler.	(Bohler-Baedeker & Hugging, 2012)
	Introduction of emissions taxes	A tax based on the volume of emissions from a vehicle per kilometre driven, to encourage purchases of low emission vehicles. In South Africa this is already charged at the point of sale.	(Bohler-Baedeker & Hugging, 2012)
	Sales taxes on new vehicles	Discourage vehicle ownership by imposing a sales tax or annual registration tax.	(Bohler-Baedeker & Hugging, 2012)
	Public transport travel allowances for employees	Travel allowances could be used as an incentive to encourage employees to use public transport.	(Litman, 2011)
	Vehicle scrapping subsidy	A subsidy is provided to scrap older vehicles in favour of newer, more fuel-efficient, lower emitting vehicles.	(McKinsey & Company, 2009)
Information measures	Public awareness campaigns	Informing the public about the significance of climate change, resource scarcity, carbon emissions to encourage a shift from private to mass transit, public transport, NMT and more fuel efficient vehicles.	(Gauteng DRT, 2013b; Bohler-Baedeker & Hugging, 2012)
	Capacity building in the transport industry	Promote economic development through economic beneficiation and job creation by providing skills training and capacity building in the transport sector. This will contribute to more efficient transport systems.	(Gauteng DRT, 2013a)
	Increased driver training	Fuel efficient/ eco-driving techniques for public transport drivers will help to improve efficiency of transport systems.	(Bohler-Baedeker & Hugging, 2012)
	Vehicle labelling initiatives	This transparency may encourage vehicle manufacturers to produce more fuel efficient vehicles, in addition to promoting consumer awareness.	(Bohler-Baedeker & Hugging, 2012)
Technology measures	Traveller information tools	Improve passenger information at stations and inside vehicles displaying all routes, times and delays in real time. Improved ease of use of public transport will result in increased uptake thereof.	(Gauteng DRT, 2012; Gauteng DRT, 2013a)
	Traffic signal optimisation.	This measure improves traffic flow and thus improves the efficiency of the transport system.	(Gauteng DRT, 2012; Gauteng DRT, 2013a)
	Fare integration options	Common ticketing system for all modes of transport with discounts when changing over from one mode to another. Encourages increased public transport use.	(Bohler-Baedeker & Hugging, 2012)
	Electronic road pricing	Charging commuters to travel on roads may encourage a shift to public transport.	(Wright, 2007)
	Public transport mobile apps	Ease of access to public transport routes and times, updated in real time. Encourages users to use these facilities, particularly if the apps integrate across public transport providers.	(Weber, et al., 2011)
	Ride-sharing apps	Such systems connect commuters willing to carpool.	

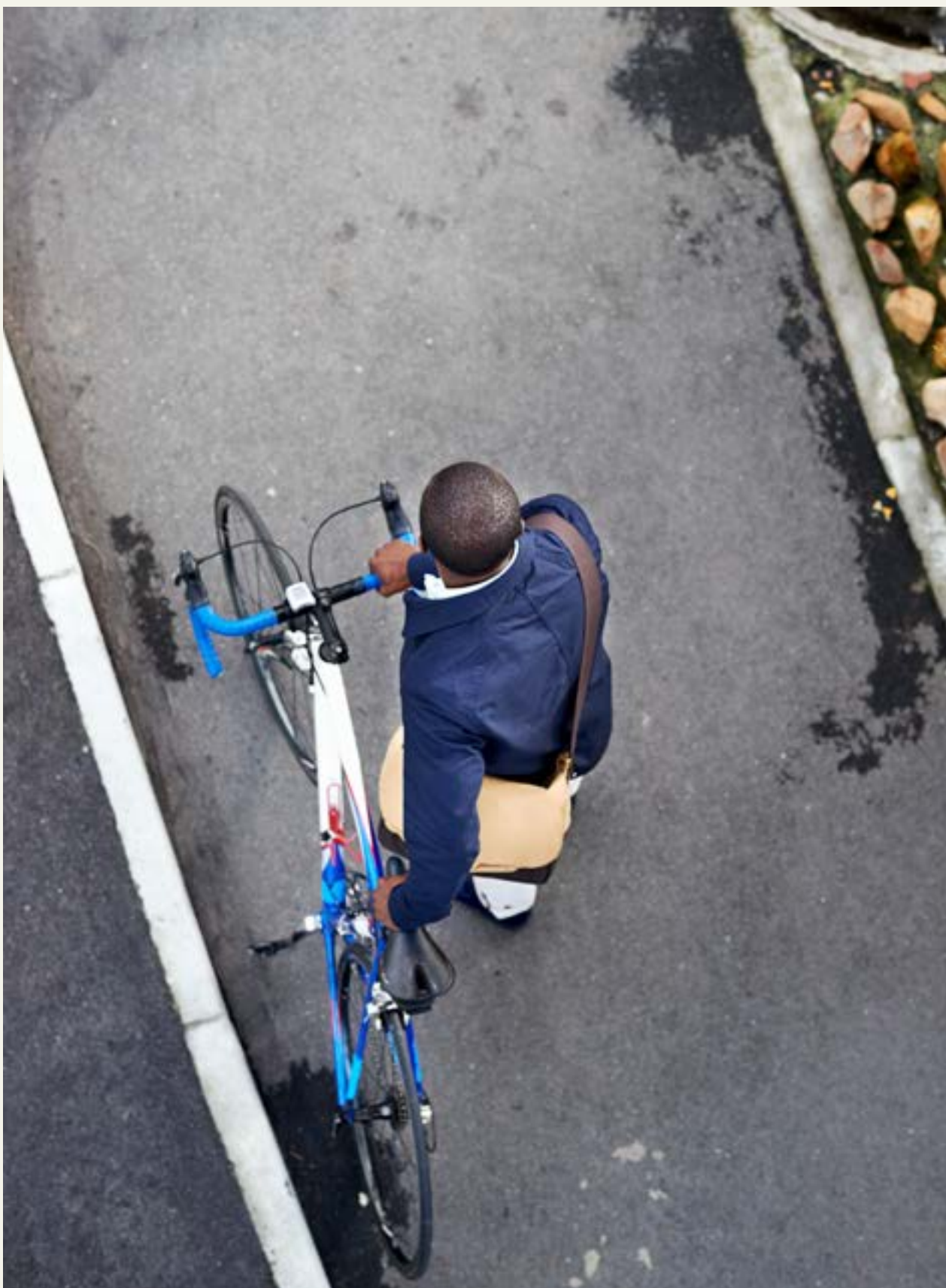


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IMPROVE

PRASA's planned capex over 2016–2019 is R46.6 billion, with 34% going to improving customer services in relation to reliability, safety and efficiency.

Equity issues

This briefing paper documents the wide range of options that are available in the passenger transport sector for reducing greenhouse gas emissions. Reducing emissions clearly requires a multi-pronged approach, with the specific options suitable for implementation varying widely from city to city and country to country.

Given the inequalities prevalent in South Africa, different challenges present themselves in different income groups. At the high-income end, there are typically high levels of transport access, with associated high levels of greenhouse gas emissions, which lend themselves to mitigation interventions. At the low-income end, there are low levels of access, potentially suppressed demand (as a result of transport access and equity issues) and low carbon intensity. Here a growth in emissions as a result of increased transport access might be seen, and the challenge is thus to provide access to transport with the lowest possible growth in emissions. You can find an analysis of greenhouse gas emissions in Gauteng by income band at http://www.wwf.org.za/what_we_do/transport/.



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SHIFT

Apps and online resources are putting lower carbon transport choices in travellers' hands

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This is one in a series of publications produced by WWF South Africa's Transport Low-Carbon Frameworks programme. Other publications in the series include those that document transport greenhouse gas emissions in Gauteng by income band, address greenhouse gas mitigation in the freight sector, and present a series of low carbon transport case studies from around the world. To download these publications go to http://www.wwf.org.za/what_we_do/transport/.

The transport project aims to provide a platform, expertise and perspectives to support labour, business and government in engaging with the challenges implicit in the shift to a low-carbon economy. Consideration is given to the three tiers of interventions which will be required to effect the transition of this sector, being to **reduce** movement of goods and people, **shift** to low-carbon modes of transport, from private to public, from road to rail, and **improve** mobility services, and energy and fuel efficiency. We seek solutions for emitting fewer greenhouse gas emissions and enabling a flourishing South Africa, which delivers developmental outcomes and social equity, located within the context of South Africa's economic geography.

WWF

WWF South Africa's Policy and Futures Unit undertakes enquiry into the possibility of a new economy that advances a sustainable future. The unit convenes, investigates, demonstrates and articulates for policymakers, industry and other players the importance of lateral and long term systemic thinking. The work of the unit is oriented towards solutions for the future of food, water, power and transport, against the backdrop of climate change, urbanisation and regional dynamics. The overarching aim is to promote and support a managed transition to a resilient future for South Africa's people and environment. The organisation also focuses on natural resources in the areas of marine, freshwater, land, species and agriculture.

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The Green House

The Green House is a technical sustainability consulting firm with experience working on a wide range of energy, carbon and sustainability-related projects, including strategic energy planning, carbon footprinting, and life cycle assessment. The Green House has significant experience in energy, transport, urban systems, bioenergy, biofuels, industry, commerce, agriculture, municipal waste management, mining and minerals.

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