

GREENHOUSE GAS SCENARIOS FOR SOUTH AFRICA'S SURFACE PASSENGER TRANSPORT SECTOR

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ABSTRACT

The performance and structure of South Africa's transportation system can be largely explained by the country's legacy of Apartheid policies. Apartheid had far-reaching impacts, even extending deep into the country's transportation and energy system. Largely as a result of the past political paradigm, the country's contributions to global greenhouse gas (GHG) emissions are high compared to those of other African nations in both aggregate and per capita terms. Overall, the Apartheid legacy is sprawled land use, inflated travel demand, poor public transit services, growing use of cars, and use of high-carbon fuels. The challenge is thus to devise policies and strategies to redirect these behaviors and investments to create a more economically, environmentally, and socially beneficial transportation system. Numerous policy options exist to reduce GHG emissions from the transportation sector. These policies affect when, how, where, and why people travel. But vehicle emissions are not a high priority in South Africa, which is one of the few countries that does not regulate motor vehicle emissions. However, current political leaders are motivated to improve mobility, accessibility, and road safety, and reduce traffic congestion. Many of the strategies targeted at these goals will restrain GHG emissions. This paper highlights two transportation scenarios designed for South Africa -- one that yielded higher GHG emissions by 2020, and one that yielded lower emissions. The authors concluded that strategies in the low-emissions scenario are not necessarily costly, but they do require strong political will and commitment. If such will is demonstrated, South Africa is set to repair its public transit system with benefits for society, the economy, and the environment.

KEY WORDS

GREENHOUSE GASES/ PASSENGER TRANSPORTATION/ TRANSIT/ SOUTH AFRICA

1. INTRODUCTION

South Africa is a relatively large producer of greenhouse gases (GHG), especially among developing countries. According to the national GHG emissions inventory completed in 1999, South Africa was responsible for over 1 percent of global emissions in 1990. Emissions per capita were estimated at 10 tons of carbon dioxide equivalent per person per year – well above the global average of 7 tons per person per year, though considerably lower than the 20-ton average of the United States (National Committee on Climate Change, 1998). South Africa's relatively high contribution to global GHG emissions can be attributed to its past policies, especially its dependence on coal for

energy and liquid fuels. Overall the combined effect of the Apartheid legacy is inflated travel demand, inefficient land use, poor public transit services, growing use of cars, and use of high-carbon fuels. Official estimates indicate that the transportation sector accounts for only about one-tenth of South Africa's GHG emissions (Department of Environmental Affairs, 1999). But these estimates do not include upstream emissions, for example from oil refineries and coal processing facilities. When upstream emissions associated with transport fuels are reassigned to the transportation sector it is estimated that it would account for about one-fifth of the country's total GHG emissions. The challenge is thus to devise policies and strategies to redirect behaviors and investments to create a more economically, environmentally, and socially beneficial transportation system.

2. BACKGROUND

South Africa is burdened by many problems typical of developing countries, including a high demand for social services, limited tax base, limited skills in the labor force, and low productivity, but also special circumstances evolving from decades of Apartheid. South Africa's legacy of Apartheid had far-reaching impacts, even extending deep into the country's transportation and energy system. Some of the transportation and energy effects of Apartheid include:

- inefficient land use policies based on race and ethnicity. Black residential areas – called townships - were moved to the outskirts of growing urban areas and beyond to what became known as homelands. To address the problem of limited access to employment and other services, the government subsidized bus and train transit, resulting in long commuting distances for most of the black poor.
- Energy investments in innovative coal-based synthetic fuel processes. South Africa has little petroleum, but large reserves of coal. In 1950, the South African government financed the formation of the Sasol Company to produce synthetic oil from coal. Investments were greatly expanded following international sanctions during the 1970s and 1980s.
- Import substitution economic policies promoted the domestic motor vehicle manufacturing industry. Economic policies prescribed the domestic content in terms of the value of each car, while large tariffs on imported cars protected the domestic auto industry from lower cost imports.
- Generous company car allowances and subsidized car schemes nurtured a market for private cars to support the domestic auto industry. These policies stimulate car ownership, tilt demand toward large and less fuel-efficient cars, and increase car use.
- Public transportation services designed to serve long-distance commuters with low levels of service inspired black entrepreneurs to create informal minibus services for the many unserved travel needs. These services tend to be provided with inefficient vehicles resulting in higher energy consumption and emissions.

Largely as a result of these policies, the country's contributions to global greenhouse gas (GHG) emissions are high compared to those of other African nations in aggregate and per capita terms.

3. SOUTH AFRICA'S PASSENGER TRANSPORTATION SECTOR

3.1. Private Car Use

The number of private cars has been increasing steadily and somewhat faster than the population in South Africa. The increase is due in part to cars being kept longer before

they are scrapped, but also the fact that urban commuters start to rely almost exclusively on cars at incomes as low as R30,000 per year (Moving South Africa, 1998). Even under a scenario of slower economic growth, the number of cars is thus expected to continue to increase in South Africa. Cars are highly attractive. They provide unprecedented comfort, convenience and also status. In South Africa, cars have extra appeal because of diffuse land use patterns, uncomfortable and poor quality transit services, and generous company car incentives. But the increased use of cars to satisfy South Africa's transport needs will result in more casualties, energy use, pollution and GHG emissions.

3.2 Public Transportation

Urban areas are served by public and private buses, minibuses and, in the six largest cities, rail transit.

3.2.1 Rail Transit

South Africa has an extensive network of railroads that serve freight and passenger traffic - both urban and inter-city trips. Urban rail travel has, however, declined rapidly since the early 1980s. This is partly attributable to reduced levels of government support, high levels of unemployment among the very poor who have to rely on rail travel, and greater use of private cars. But more importantly, this decline can be attributed to the deregulation of the minibus industry, which resulted in many commuters switching from rail and bus to minibuses. A recovery has been underway in recent years. Urban passenger rail revenue increased from R353 million in 1994/95 to R561 million in 1997/98. Market share, measured in number of trips, recovered from a low 16 percent, reaching 21 percent in the late 1990s. Rail subsidies are diminishing, but still cover about two-thirds of total operating costs. In 1998, the national government entered into an exclusive concession with MetroRail to provide commuter rail services in South Africa's six major metropolitan areas for five years. The contract will be put out for competitive bidding in 2003 (South Africa Department of Transport, 1998).

3.2.2 Bus Transit

Most bus routes were originally designed and subsidized to connect urban employment centers with outlying townships and homelands. Services were provided by large private white-owned companies. Subsidies grew rapidly and by the 1990s soaring bus deficits were overwhelming the resources of the financially strapped government. In addition, urban "white only" and "black only" bus services were operated and subsidized by local authorities. They focused their operations on the financial and commercial areas of the downtown areas, and provided services between city centers and white suburban areas. Both black and white services were well patronized.

The current bus sector is a mix of public and private companies, which are still predominantly white-owned. Like rail transit, scheduled bus services have also been declining since the 1980s. From 1988 to the mid-1990s, ridership plunged by about 30 percent. This decline is tied to the deregulation of the minibus sector, which led many commuters to switch from rail and bus to minibuses.

Most scheduled services and routes continue to receive large subsidies. From 1992/93 to 1996/97, annual local and national government subsidies for bus transit almost doubled from R800 million to R1,5 billion (Saint Laurent, 1998). The government is currently replacing the cost-based subsidy system with competitive bidding for concession

contracts. Bus operators must bid to provide service on a particular route. The provincial governments will make up the difference between the tendered cost and the income from fares (South Africa Department of Transport, 1998).

3.2.3 Minibus Transit

Beginning in the 1950s black entrepreneurs started to provide un-metered, unsubsidized, and unscheduled services in large sedan cars in townships. In 1977, regulation of these unscheduled services was relaxed, first permitting operators to carry up to eight and later (in the early 1980s) 15 passengers. Minibus transit has since come to dominate the provision of passenger transportation services in South Africa. They are private and almost totally owned by black South Africans. In only two decades, minibuses have expanded to account for two-thirds of all public transportation services and over one-third of total passenger travel in South Africa. In 2000, about 127,000 minibuses operated in South Africa, of which about 36,000 were illegal (Minister of Transport Dullah Omar, 2001). They are expensive relative to bus and rail transit, but ubiquitous, providing service to many poor travelers. Financial problems in the minibus industry have led to increasingly old, dilapidated, uncomfortable, and unsafe vehicles, resulting in higher energy consumption and GHG emissions. The government is now attempting to organize and regulate the minibus sector. Measures include registering associations and operators; enforcing permit requirements, vehicle roadworthiness, and traffic rules; and replacing the aging 16-seater gasoline minibus fleet with more suitable 18- and 35-seater diesel vehicles.

4. POLICIES AND STRATEGIES

Numerous policy options exist to reduce GHG emissions from the transportation sector. These policies affect when, how, where, and why people travel. Vehicle emissions are, however, not considered a major issue in South Africa, which is one of the few countries that do not regulate vehicle emissions. However, leaders are motivated to improve mobility, accessibility, and road safety, and reduce traffic congestion. Many of the strategies targeted at those goals will restrain GHG emissions:

- *Improve accessibility and mobility.* Given lack of access to employment and economic services by a large proportion of South Africans, improved public transportation is the most efficient means of enhancing mobility and accessibility. A major review of the national transportation policy that culminated in the Moving South Africa document emphasized the need for: (a) more efficient urban land use patterns by promoting the location of housing settlements and commercial activities along transportation corridors; (b) investments in transit infrastructure in these transportation corridors, including dedicated bus lanes to facilitate express transit bus services; (c) promoting public transit services through road space management and favoring public transit services, and (d) restructuring the public transportation system to ensure better integration of modal services and the optimal deployment of transportation modes based on levels of demand and distance (Moving South Africa, 1998). Enhanced public transportation would restrain growth in the use of private cars, with associated reductions in the growth of GHG emissions.
- *Improve road safety.* Road safety is a serious concern in South Africa. In 1997, 505,988 traffic accidents resulted in 9,691 deaths. The economic costs of these accidents were estimated to be equivalent to 1.8 percent of the South African GDP (Pretorius et al, 2000). Policies that improve road safety, such as enforcing speed limits, scrapping older cars, and improving car maintenance could help reduce GHG emissions.

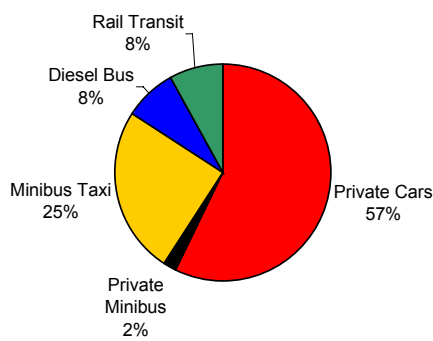
- *Reduce traffic congestion.* Congestion is increasing in all major metropolitan areas and expected to become a major problem shortly. Since South Africa does not have the funding to build many more roads, an improved public transportation system will be vital to ensure mobility for the vast majority of its people. The country's first rapid commuter rail system is currently in the planning phase.
- *Increase government revenue.* Two large sources of government revenue are car and fuel taxes. Increasing taxes and expanding the charges on private car usage would help pay for social expenditures and raise the cost of private car use. Charging options include parking fees and taxes, fuel levies, area pricing and electronic road pricing. It is also conceivable that the revenue raised could be used to improve public transit. Such taxes and charges will restrain the ownership and usage of personal cars, thereby reducing energy consumption and GHG emissions.

5. SCENARIOS FOR THE FUTURE

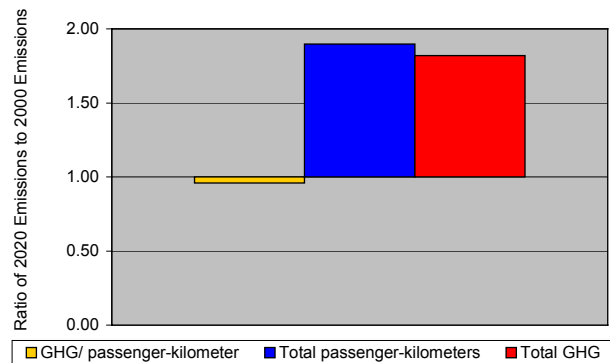
The list of South Africa's transportation-related challenges is long but related. It includes past land use policies, increased urbanization, greater car usage, declining bus ridership necessitating increasing subsidies, low quality public transit services, deteriorating traffic safety, limited road investments, increasing congestion, and local air pollution. Vastly different outcomes are possible depending on the path chosen. Two transportation scenarios were designed for South Africa -- one that yielded higher GHG emissions by 2020, and one that yielded lower emissions.

The higher GHG scenario assumes a continuation of observable and emerging trends. In this "business-as-usual" scenario, the government is entangled in crisis management. It focuses on health, education and social unrest related to skewed income distributions, and ignores transportation concerns. Residual land use policies from Apartheid continue to aggravate transportation problems. Cities remain divided and land developers give little consideration to the implications of long commuting distances. The automotive industry remains a pillar of economic development. Personal car use and minibuses continue to satisfy mobility and accessibility needs, and coal-based synthetic fuels continue to provide 40 percent of the transportation fuel needs.

Under this scenario, the car population grows at 4.1 percent per annum, similar to growth rates between 1980 and 1990. The minibus continues to accommodate the business aspirations of black entrepreneurs. The already over-saturated market and generally low levels of passenger comfort, however, slow the growth of minibus acquisitions. The fleet grows at 2 percent per annum, only slightly above the population growth rate. Attempts to formalize the industry and to convert the gasoline minibus fleet to diesel fail due to conflict between government and the minibus industry. Vehicles remain the unsuitable 16-seater variety and conversion to larger 18- and 35-seater custom built public transit vehicles does not occur. Bus passenger-kilometers grow at 1.1 percent per annum, while increased rail ridership results in 5-percent annual growth in rail passenger-kilometers.



Modal Share (passenger km)



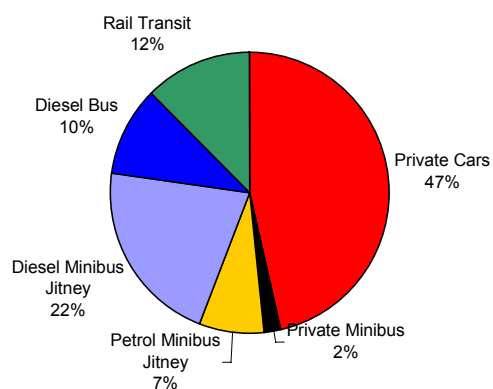
GHG Emissions from Passenger Transportation

Figure 1 – High Greenhouse Gas Scenario (2020)

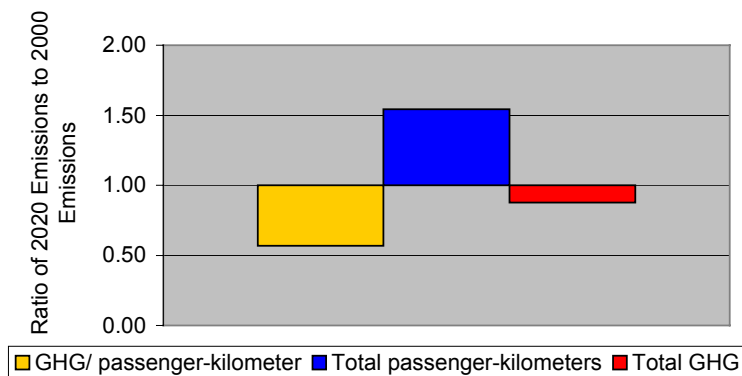
In this scenario, private cars increase their share of total passenger-kilometers from 51 percent in 2000 to 59 percent in 2020, while public transit's share decreases from 49 to 41 percent. Minibuses retain 60 percent of the public transit modal share. The effect on GHG is significant: South African emissions associated with passenger transportation increase by 82 percent from 2000 to 2020.

In the lower GHG scenario, the motivation for change and government action are driven by mobility, accessibility, and safety concerns. The government plays an active role in land use policies and surface passenger transportation. Land use and housing policies are adopted that promote more efficient urban land use patterns, gradually correcting spatial imbalances and reducing travel distances. The government promotes public transportation, restructuring the taxi, bus, and commuter rail sectors. Under the new structure, trains serve the routes with the densest population, buses serve the secondary routes and taxis provide feeder or local services. The sustainability of the public transportation system is ensured through revenues raised from dedicated taxes on car buyers and users. South African auto manufacturers are provided with incentives to design and build buses and minibuses appropriate to the local market. Sasol starts to use natural gas as feedstock in the production of synthetic fuel.

Even with restrictions on the use of private cars, private car ownership increases by 2.1 percent per annum – similar to the growth in ownerships between 1995 and 2000. The total seating capacity of the minibus fleet remains constant, but recapitalization results in a different composition of the vehicle fleet. Bus passenger-kilometers increase 1.5 percent per year, and rail passenger-kilometers increase 6.3 percent annually.



Modal Share (passenger km)



GHG Emissions from Passenger Transportation

Figure 2 – Low Greenhouse Gas Scenario (2020)

The low-emissions scenario leads to enhanced quality of life and more efficient use of resources -- urban land and energy -- and decreased GHG emissions. The modal share of private cars and public transit remains approximately constant at 48 and 52 percent, respectively, but minibuses suffer large declines in public transit modal share, from 65 percent in 2000 to 56 percent in 2020. Bus and rail transportation account for the remaining share of public transit mode share at 19 and 25 percent respectively. The result is a 12-percent decrease in GHG emissions -- despite the fact that passenger-kilometers increase by about 54 percent. The strategies in the low-emissions scenario are not necessarily costly, but they do require strong political will and a commitment by South African leaders.

6. CONCLUSIONS

South Africa faces difficult challenges in the coming years. Transportation and the environment are among those challenges. Past land use policies forced large numbers of poor people to commute long distances to jobs, creating a problem that remains today. This problem is currently exacerbated by land use practices that locate new low-cost housing on inexpensive land at the periphery of cities, far from urban centers. South Africa is also experiencing increased use of cars. It is widely anticipated that car usage will continue to increase over the next 20 years due to social aspirations, an expanding black middle class, the treatment of the auto industry as a major contributor to economic development, incentives to use cars, and not least, the lack of an attractive public transportation system.

The objective of this paper was to demonstrate that many initiatives aimed at improving mobility and accessibility, containing urban sprawl and car use, enhancing public transportation, and changing to cleaner feed stocks in fuel production, could provide economic, social, and environmental benefits, GHG reduction would be a side benefit of many of these initiatives. The strategies highlighted in this paper were identified and are in line with two Department of Transport publications: the White Paper on National Transport Policy and Moving South Africa. These actions are not necessarily costly, but they require strong political will and commitment. If such will is demonstrated, South Africa will soon be on the way to repairing its public transit system, with benefits for society, the economy, and the environment.

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