TRANSPORT COST EXTERNALITIES: A DISCUSSION PAPER

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INTRODUCTION

Modern transport systems are essential to exploit expanding agricultural, commercial and mining activities for the public good. Railway development and road improvements have gone hand in hand. During the 19th and early 20th century, railways expanded rapidly to provide low cost transport over great distances and to handle high traffic volumes over busy corridors and arterial routes. Roads were at first merely feeders to railways, expediting the collection and delivery of goods. As motor vehicle technology and road construction techniques improved in the 1920's the road became an alternative to the railway which came under increasing competitive pressure, particularly in the matter of lighter traffic density rural branch lines. Railway administrators in South Africa tended to view these lines in isolation, often ignoring their value in generating main line traffic. Because of this a programme of branch line closures began in the 1980's which led to an accelerated growth in road transport, not only in urban and rural areas but later for long-haul arterial traffic as well. But at what cost? This study investigates 'external' costs which are recognised as an important consideration in determining full transport costs of the overland transport modes. Unfortunately, many studies which have been undertaken during the last 20 or more years have approached the issues from different perspectives with varying methodologies and objectives. This has led to conclusions being expressed which have often been incomparable and misleading.

Environmental matters have become an important 21st Century issue and these cannot be overlooked because of short-term considerations when long-term sustainable development is necessary. For this reason various transport cost externalities which impact on society in general have been considered. Because of a serious lack of local information this study has investigated external transport costs in a number of countries where localised or general conditions are considered to be similar to South Africa. To achieve a representative cross-section of South African transport a group of rural branch line railways and roads in KwaZulu Natal as well as the high density rail and road corridor route between Durban and Gauteng have been examined and conclusions drawn that can then be used to make comparisons on other important corridors or in rural areas serving agriculture production.

This discussion paper has been completed in the hope that it will create interest and raise debate over future transport policy. Decision makers must take cognisance of the fact that rail traffic in South Africa is continuing to be transferred to road and once this happens it is difficult to reverse the trend since major investment in alternative modes must be made. Industry has to make long-term plans in respect of development, expansion and related transport matters. For example, there are numerous private sidings in industrial areas which are not being utilised, while road traffic congestion in urban areas continues unabated.

Government wishes to see a return of traffic to rail but users cannot be pressured as they were in the past. However, once the full costs of transport are understood and appreciated, decisions can be made which will be in the long-term interests of South Africa. It is hoped that this document will generate interest and raise questions which must be addressed most urgently.

EXECUTIVE SUMMARY

The issue of transport cost externalities has become a matter of concern because of the increasing dependence on liquid fuels to provide haulage for marine, air and overland transport. This discussion document highlights the significance of the so-called 'hidden costs' of transportation which can benefit one transport mode at the expense of another. Efficient, low-cost transportation is important for general logistics and the competitiveness of commerce and industry

– all of which are vital for the growth and development of a country's economic potential and the wealth of its people. But a better understanding of the hidden costs associated with each transport mode is becoming ever more important when judging long-term investment priorities and sustainable cost outcomes, as well as the ultimate environmental and related social issues that affect us all.

This study examines some of the matters which should be considered when judging the value and cost of each transport mode in terms of long-term sustainability, energy efficiency and environmental issues, as well as service quality to the user. Unfortunately, many of the costs of providing freight and passenger transport services have been externalised and passed on to the public in general – including non users of transport. This can be seen as a de-facto form of cross-subsidisation which can place one mode at a disadvantage when competing with another mode. This can lead to decisions being made in respect of infrastructure investments which may seem appropriate in the immediate short term, but which can have unanticipated and negative effects in the long term.

Transport externalities which have been quantified in a number of studies include:

- Accident costs
- Congestion costs
- Exhaust emission and pollution costs including Greenhouse issues
- Noise costs
- Traffic policing costs
- Space usage
- Energy efficiency and resource consumption

In the past, little research has been done in South Africa in respect of these matters but comparisons with various international studies can be made. Conditions in Australia, and to a certain extent Canada, are quite similar to South Africa. European reports might not be considered to be relevant for South African conditions since the European population is more urbanised, having higher general population densities. Nevertheless, issues related to urban congestion and related exhaust emissions are similar in South African urban areas. Consideration is now given to these issues and their relevance to South African conditions.

The following Background material is meant to provide insights into earlier studies and reports that have appeared but are often not well known. Extracts from these reports appear in the appendices and detail the specific issues and background to the conclusions expressed by the researchers.

In addition to external costs, transport infrastructure development and maintenance costs, including the short-term recovery of and long-term consequences of these costs are being studied for each overland mode and will appear in the near future.

BACKGROUND

A number of studies dealing with external transport costs were completed by various organisations during the 1990's. The University of Iowa Public Policy Center completed a report during 1998, titled "External Costs of Truck and Rail Freight Transportation." In South Africa, also in 1998, the Department of Transport released a report, "Land Transport Pricing in South Africa – Cost Responsibility Study," undertaken by the CSIR African Transportation Division. Unfortunately, this study largely concentrated on infrastructure provision issues and not externalities.

The first comprehensive South African study where externality issues were the main focus was funded by the US Agency for International Development as part of the SEGA (Support for Economic Growth Analysis) Program for South Africa, and completed in March 2000 for the Department of Transport. The Study Team consisted of Engineers, Economists, Energy and Environmental specialists, and a Steering Committee which included representatives from the SA National Roads Agency, the SA Chamber of Business, Spoornet and others.

Extracts from the study include the following: *"In international literature a consensus seems to emerge that motor vehicle dependent transport systems are costly in terms of the provision and maintenance of road infrastructure and parking facilities, congestion, accidents, land costs, energy security and pollution, which are not directly paid for by the users of the system."* The study continues: *"It was these concerns that gave rise to the present study, which represents the first serious attempt to assemble actual data concerning motor vehicle costs, [light and heavy] especially the external costs…*

…The reason to ask is probably: why be concerned about the external costs/ externalities. Two reasons seem to exist. Failure to account for external costs associated with motor vehicle use will:

- *Result in the inefficient allocation of resource, and*
- *Have a negative impact of the use of alternative modes of transport, such as public transport."* (The paper later referred to rail transport as well.)

Unfortunately, the report contained some serious omissions and misleading claims. It claimed that "…motor vehicle use is fairly efficiently priced." But how such a claim could have been made is surprising as the issue of road infrastructure provision and maintenance costs, as well as land use was not addressed. However, the document went on to state that "heavy vehicles are responsible for 46 % (R7,3-bn) of the total external costs imposed on society" but in numbers, heavy vehicles constituted only 4% of the total motor vehicle fleet. The report also stated that 74.5% of air pollution, 13.0% of global warming trends, 71.1% of noise, 14% of congestion and 13% of energy security was attributed to heavy vehicles.

The issue is not just whether general motor vehicle use is "efficiently priced" but whether the various types are priced fairly. In private discussions with one of the study team members recently, the opinion was expressed that too small a budget and too little time was allowed to properly complete this study. The final version of the report was not submitted to all study members for review and because of the gaps in essential information the conclusions drawn have questionable credibility.

To illustrate, the report stated:

"Given the purpose of the study, however, it seems reasonable to conclude that the rough approximate cost estimates are sufficient in indicating orders of magnitude of the costs incurred as a result of motor vehicle use. Doubts about the accuracy of the data that has been used or the classification of the impacts that have been adopted are unlikely to be serious enough to dispute the overall conclusions."

Nearly ten years have now passed since this study appeared and much international research has taken place since that time. Coincidentally, also in March 2000, the European Union published a comprehensive study titled: "External Costs of Transport – Accidents, Environmental and Congestion Costs of Transport in Western Europe," completed by two leading academic organisations, Infras Zürich and IWW Karlsruhe. This report was very well detailed and comprehensive and can be viewed as the 'benchmark' study of its type. The present writer refers to statistics from this and the update study in this Discussion document.

In Australia, respected academic researcher Dr Philip Laird completed a number of external transport cost studies including "Land Freight External Costs in Queensland" for the Queensland Government in 2002. During the same year, the Railway Association of Canada issued a research paper titled "Heavy Goods Vehicles – Infrastructure Costs and Revenue." In December 2006, the Victoria Transport Policy Institute (Australia) issued another report, "Transportation Costs and Benefit Analysis."

In South Africa, TMT Projects of Durban undertook a number of studies between 2003 and 2008, where transport externalities were considered as part of an overall assessment of the value of rail

transport. These are referred to in this Discussion document, and it is hoped this will provide much food for thought and future discussion.

Extracts from the various reports appear in the Appendix and support the preliminary conclusions contained in the Discussion document.

GENERAL TRANSPORT PRELIMINARY FINDINGS AND COMMENTS

Road transport services are fast and flexible. Operators utilise the nation's extensive road system to provide transport services to virtually every corner of South Africa. In the past, railways served major industrial and commercial development areas as well as rural communities around the country. Over 2 000 stations and 3 000 private sidings were open where both freight and passenger services were catered for. In addition, the railway administration provided road transport connecting services for communities not linked to the national railway system.

As private road transport services expanded and transport deregulation came about, the rail mode lost significant volumes of general traffic, and in particular for small consignments and parcels traffic. In recent times, bulk traffic such as domestic coal, grain, and minerals such as chrome and manganese, liquid fuels and chemicals have been lost to road. This report examines the importance of external costs which should be borne by the rail and road modes when judging the value of each. The preliminary results of this examination are detailed:

- Road transport of freight traffic provides services to all parts of South Africa. It has grown dramatically in recent years, taking up almost all new growth while reducing the rail market share significantly.
- Rail transport of freight traffic is suitable for high volume bulk export traffic, as well as on high density corridor routes where intermodal systems can be used. It can also be used to promote agricultural and general development in rural areas.
- When externalities such as accident, congestion, exhaust emission and policing costs are considered, commercial road transport operators would incur increased costs of at least 26% to 31%. Rail costs would, however, increase by about 5%.
- Road transport operators do not pay for their full road infrastructure costs, even on toll roads. The fuel levy is paid by both rail and road operators and is not a road user charge, but a general tax paid into the exchequer. Government then provides funds for road maintenance. In contrast, rail operators must fund and maintain infrastructure from their own resources without government assistance.
- The current deteriorating condition of roads is due to the fact that government is not spending as much on road maintenance as it should, considering particularly the fact that South Africa allows the heaviest heavy road freight vehicles in the world which have unlimited access to all the country's roads. Railways have been forced to reduce track maintenance budgets, with resulting deterioration of infrastructure. This has compromised the competitive equality between the modes.
- Government, as sole shareholder in Transnet and its business unit Transnet Freight Rail (TFR – formerly Spoornet) has stipulated that it must be run on business principles and not as a national transport undertaking with social obligations. Because of this, large volumes of general traffic have been diverted to road.
- This has led to a greater dependence on imported petroleum products for transport requirements with resulting balance of payment problems. In contrast, most of the South African mainline rail network uses electric energy for transport purposes.
- Rail should be more attractive to users in terms of costs but government must appreciate the effect of years of under-investment in their asset and take cognisance of the extent of road externalities and the under recovery of road provision costs from road freight operators which have made rail less competitive.
- By employing modern Intermodal systems, rail can provide improved long-distance service levels and road can be used for the shorter haul or for other specialised services. This should be a win-win outcome for both.

EXTERNAL TRANSPORT COSTS

For the purpose of this study, where freight transport movements are the focus, an external cost per tonne kilometre appears an appropriate measure. It is, however, difficult to estimate these costs since available data has generally not been published in a format where it can be extrapolated.

It will be necessary to study various transport routes in detail to obtain accurate statistics on each of the externalities. For example, the number and severity of accidents, places where congestion occurs, where exhaust emissions present a threat to the environment and the health of all living creatures, as well as where noise levels create an unacceptable level of discomfort. Traffic control and policing costs should be evaluated along each route, while space usage and the extent of land required by the different modes must be considered. Finally, energy efficiency and resource use must be considered for transport on different routes.

The International Union of Railways (UIC), Paris, commissioned an in-depth study on the external effects of transport which appeared in 2000. This study was updated and appeared in 2004, using the year 2000 as the base year. Information from 17 EU states, as well as Switzerland and Norway was interpreted and published in two outputs – total and average costs for the region, and by social marginal cost pricing. The updated report, completed in 2004, detailed total external costs, excluding traffic congestion, at € 650 billion or 7.3% of the total GDP in the region. Accident costs were 24% of the total, air pollution 27%, climate change 30%, noise 7%, up-and-down stream processes 7%, nature and landscape 5%. Road transport generated 83.7% of the total, air transport 14% and rail only 1.9% of the total, the balance being inland water transport. Two thirds of the costs were attributable to passenger transport, while one third was from freight transport.

The term “social marginal cost pricing” used in the EU study (See Appendix A8) may seem confusing. By definition, a marginal cost is the change in total cost by a unit change in output. In the case of accidents and put in transportation cost terms, it is a new method for describing the costs of “additional vehicles using the road network which may have positive or negative effects. It is possible that:

- Drivers are disturbed by the growing traffic and therefore the number of accidents increases more than proportional, [of a higher rate measured against volume*] or
- That average speed slows down with increasing traffic and thus the number of accidents increases slower than the traffic volumes, [decreases relative to volume*] or
- A shift from severe to slight accidents occurs with slower average speeds on congested roads.” (* Author’s interpretation)

It was further stated: “Overall decreasing accident rates could be observed in Europe during the past 5 years. This might imply that marginal accident costs [were] decreasing in the same period. However, in the last decade new security relevant technological improvements such as antilock braking systems or air bags have become popular in new cars. Therefore it is difficult to separate the effect of improved safety technology and the effect of increasing traffic volumes on accident rates and safety of roads.”

This statement reveals how difficult it is to quantify some transportation cost externalities but it is essential to continue the process and to develop and refine it in the long term interests of sustainable transportation.

ACCIDENT COSTS

It is generally agreed that rail accident costs for both passenger and freight transport are very small when compared to road. This is because trains operate on their own dedicated right-of-ways and are controlled by elaborate and highly sophisticated signalling systems. An Australian report claimed that rail accident costs were less than 10% of road – and a significant portion of this was due to level crossing accidents. This has been corroborated by European Union and American research.

Road accident costs in per capita terms of the vehicle population in South Africa are frequently quoted in the media and are very high by international standards. Accidents are usually described in terms of being fatal or by having serious, slight or no injury, but not by specific vehicle type or distance travelled between accidents. For example, the March 2000 report "A Quantitative Analysis of the Full Costs Associated with Motor Vehicle Use in South Africa," stated that a conservative estimate of external accident costs was R 5,04 billion in 1998. Of this, R 2 520 000 000 was attributed to cars, R 1 210 000 000 to light trucks, R 706 000 000 to heavy trucks and R 605 000 000 to buses and minibuses. This equates to 50% for cars, 24% for light trucks, 14% for heavy trucks and 12% for buses and minibuses. Unfortunately, the reference made to the motor vehicle population in South Africa and the average distance travelled by each type appears highly inaccurate by today's measure. This is discussed in Appendix A1.

A 2004 Department of Transport (DoT) report "The estimation of unit costs of road traffic accidents in South Africa," investigated human casualty costs as well as vehicle accident costs. The report stated that the average cost in human life for a fatal accident in a rural area was R 669 207 although the Motor Vehicle Accident Fund stated that the average payout for such an accident was R 898 924. Compared to overseas reports, the South African accident cost estimates are much lower for fatal accidents. In Canada for example, an accident fatality is valued at C$ **4 050 000** Canadian Dollars. In South African Rands, this is equivalent to **R 27 783 000** at an exchange rate of C$ = R 6.86. In Australia, a figure of **A$ 1 900 000** has been given. This is **R 11 799 999** in South African Rands. In European Union countries a figure of 1.5 million Euros has been estimated to be **R 15 450 000 in South African currency.**

Unfortunately, as was stated earlier, the 2004 South African report made no reference to the number and severity of road accidents per vehicle kilometre driven or the type of vehicle and this was a serious shortcoming. To achieve a more complete and balanced overview it has been necessary to use information obtained from the European Union, Canada and Australia and to interpret and extrapolate this in an attempt to relate to South African conditions. In addition, an analysis of accident types and costs on the N3 has been undertaken and appears in Appendix A3.

The EU report indicated an average cost of accidents for heavy vehicles to be 7 South African cents per ton kilometre at an exchange rate of R 10.30 to the Euro. If this were factored into South African operating costs it would add an additional 12 % to 13% to average heavy vehicle operating costs. Australian studies have indicated costs which vary from 4.1c to 9.7c in South African currency. A preliminary South African investigation of the N3 indicated a figure of 2.3c per tonne kilometre but this is thought to be seriously understated. It is important to take cognizance of the fact that many accident costs are not recovered – particularly clean ups after accidents, policing costs and resulting congestion costs incurred by other motor vehicle operators. This could increase South African total accident costs to 6 cents or more per tonne kilometre, considering the high accident rate on local roads.

CONGESTION COSTS

The awareness of congestion costs has become a recent concern, particularly in urban areas. It is, however, a factor on the open road as well because large road rigs share highways with other users and frequently cause congestion on steep up and downhill sections when there are inadequate or no overtaking lanes. When such vehicles have to pass through towns and cities congestion can also occur which may affect other motorists and increase transit times for them, also increasing their vehicle operating costs. Economist Tony Twine has estimated that "if motorists in the country use 10 per cent more fuel because of traffic congestion, it would cost an extra R 13 billion a year. Annually, motorists spent more than R 75 billion on petrol and R 57 billion on diesel.

Studies undertaken in EU countries reported that the cost of road traffic congestion was about 0.5% of European GDP. The average congestion cost of heavy vehicles in the 17 EU countries was equivalent to 5.387 South African cents per tonne kilometre (metric nomenclature) at an exchange rate of R 10.30 per Euro. An Australian congestion cost finding study indicated an equivalent cost of only 0.1863 South African cents per tonne-km at an exchange rate of A$ = R

6.21. The Australian figures are very low compared to the EU figures which are, no doubt, because of the much higher traffic volumes and shorter length of haul existing in Europe.

The latest EU update study defines total congestion costs "according to economic welfare theory by the deadweight loss measure, which represents the costs arising from the inefficient use of existing infrastructure. For the EUR 17 countries, total and average road congestion costs, revenues extracted from their internalisation via road pricing systems and an "engineering" measure of additional time costs have been estimated for the year 2000. Due to the chosen welfare-economic approach, congestion costs by definition only appear for transport modes where single users decide on the use they make of infrastructure. Consequently, rail and air traffic are not affected by this kind of congestion…"

For the South African rural environment, each route will have to be examined in greater detail to determine its local operating conditions and related congestion, particularly on narrow roads having few overtaking lanes in hilly areas. For the purpose of this study, a figure of 2.5c per tonne-km is suggested but this figure will have to be further investigated as a matter of urgency.

EXHAUST EMISSION AND POLLUTION COSTS INCLUDING GREENHOUSE ISSUES

Unless diesel powered heavy road vehicles are kept in good condition with correctly tuned engines, serious pollution from emissions can result. This may not seem a major problem in the rural areas but once the vehicle enters the urban area it can become a serious and highly visible problem. EU studies indicate that heavy road vehicle traffic generate 8 times that for rail in freight service. The average cost of air pollution caused by large road vehicles in EU countries during 1995 was € 0.0324 per tonne kilometre. This is 33.372 South African cents per tonne kilometre. Rail by comparison in the EU contributed € 0.004 per tonne km to air pollution. This is 4.12 South African cents per tonne kilometre.

Early Australian road transport studies referred to air pollution but did not consider Greenhouse gasses. The latest Australian study includes Greenhouse Gases and that, together with air pollution in metropolitan areas totals 6.3854 South Africa cents per tonne km. Exhaust emissions in rural areas can easily penetrate nearby urban areas because of the movement of large air masses. Taking this into consideration, this could cost up to 8c per tonne kilometre.

NOISE COSTS

Studies made in EU countries indicate that rail freight traffic creates considerably less noise than road but this depends on the closeness of railway lines to built-up urban areas and whether electric or diesel traction is used. The EU study indicated that rail freight noise was 12% of road.

A recent Australian study quantified average noise costs for road at 0.4347 South African cents per net tonne kilometre, a relatively small amount but it would vary depending on the route travelled and the urban areas through which vehicles operate. The costs of constructing sound barrier walls between residential areas and transport corridors must be considered, as well as social issues where heavy road traffic is routed through urban areas in places such as Beaufort West and Empangeni.

TRAFFIC POLICING COSTS

Traffic policing costs are generally associated with road traffic but apart from highway safety and speed compliance, the cost of traffic lights, surveillance cameras and increasingly sophisticated traffic monitoring equipment must also be considered. These may all be considered to be external or hidden costs.

In the railway mode signalling and train control systems are an item of expenditure but which are internalised as part of operating costs. Because individual railways have direct control over their operations, very few accidents for the tonnage conveyed take place.

SPACE USAGE AND ROUTE CARRYING CAPACITY

It is generally accepted that rail has a much higher capacity to move traffic than a road. It has been claimed that a single track rail line can handle 4 to 8 times the traffic volume that a two lane bi-directional road can carry, but railways require additional yard and terminal areas for marshalling wagons into train loads. Large road transport operators usually have their own depot areas as well, but they often use the public space in urban areas to load or offload consignments and this can impinge negatively on other road users. With increased road traffic in recent years, many areas have been set aside such as “Truck stops,” where drivers can rest and obtain refreshments and meals. These must also be considered when judging the space usage of the overland modes.

In terms of space occupation, a double track railway line usually has a ‘reserve’ of 30 metres, while a four lane divided highway has a ‘reserve’ of 95 – 100 metres. Considering property value and route construction costs, a 4 lane road can cost 2 – 3 times that of a double track railway per kilometre. A recent report, “The Cost of Freight Transport Capacity Enhancement – A Comparison of Road and Rail,” suggested that a 600 km dedicated dual-lane truck highway could be constructed between Durban and Gauteng and that it would be capable of handling 72 million net tonnes of traffic per year. At an average payload of 30 tonnes for a Class 4 Vehicle (5 – 8 axles) carrying general freight, this would necessitate the movement of 6 575 vehicles in both directions per day. This is 274 vehicles per hour, or 137 vehicles in each direction if the traffic is evenly split in both directions (which it is not). This volume is approaching the theoretical limit of heavy vehicle movements which has been calculated to be up to 180 vehicles an hour, considering speed, safe following distances and weather conditions. Even on a dedicated truck highway, it would not be possible to have a “convoy-type” movement of heavy vehicles since there are so many vehicle types having different engine sizes and gear ratio drive characteristics. On a railway by comparison, a single train may consist of 40 or more closely coupled wagons, with a single set of locomotives controlled by sophisticated operating and signalling systems.

The current double track railway line between Durban and Gauteng has a capacity of 95 to 111 trains in each direction per day, depending on the section. Taking the lower figure of 95, it can accommodate 50 wagon air-braked trains carrying 3 000 tonnes of dry-bulk commodities and minerals, as well as a 50 wagon container trains carrying 2 000 tonnes of merchandise. At an average of 2 500 tonnes per train, 350 days per year (allowing for track maintenance requirements) this is 83 125 000 tonnes in each direction, compared to the 36 million tonnes suggested for road. With minor infrastructure improvements this can be increased to 120 trains in each direction over the entire route, or 105 000 000 tonnes a year. Introducing more state-of-art train control technology, which allows for closer safe following distances, rail can increase its capacity still further.

Considering actual space usage, a four lane divided highway would occupy 95 000 square meters (m^2) per kilometre, or 95 hectares of land. A double track railway would occupy 30 000m^2 by comparison, or 30 hectares of land. This is about one-third the space of the road, yet the railway could move some 210 million tonnes of traffic, compared to 72 million for road. The rail mode can, therefore, move nearly three times the traffic over the route while only occupying 38% of the space. In land use, this is over six times the productivity of road.

Considering export coal traffic, the present Richards Bay coal line has a theoretical capacity of 74 trains a day in each direction, running at an interval of 19.5 minutes. This is 25 900 trains per 350 day year. At 20 000 tonnes per export coal train, this is 518 million tonnes, considerably more than the Durban – Gauteng route which caters for lighter general freight trains in both directions. This gives a more accurate picture of the higher inherent capacity of rail when compared to road.

ENERGY EFFICIENCY AND RESOURCE CONSUMPTION

Diesel fuel consumption for railway locomotives is more than 30% less than that of road per tonne kilometre hauled. The most modern railway diesel locos are currently saving a further 25% in fuel consumption. This has resulted railway diesel use of 50% or less than that of road, although rail distances are often greater than comparable road and this must be factored in when making comparisons.

It should be noted that most main lines in South Africa are electrified so diesel use is eliminated, except for some local shunting requirements. The consumption of coal for electricity generation must be considered but it is a domestic resource and does not cost the country valuable foreign exchange. However, cognisance must be made of the environmental costs associated with thermal power stations. This matter is currently under investigation but in terms of pollution and more specifically, the "Carbon Footprint," the use of electric energy generated from coal by railway locomotives when compared to diesel road vehicles, is considered to be much more environmentally friendly.

In terms of actual fuel use, a single road freight vehicle carrying a 30 net ton load, uses between 280 and 300 litres on a single trip between Durban and Gauteng. If the projected 72 million tons were achieved on the proposed 600 km truck route (see "Space usage and Route Carrying Capacity,") some 2.4-million single trips would be required per annum, resulting in a consumption of over 700-million litres of diesel fuel. If a significant portion of this traffic is diverted to rail, it will eliminate such a significant reliance on imported energy sources and save valuable foreign exchange.

EXTERNAL TRANSPORT COSTS QUANTIFIED

After reviewing various local and international research data the following add-on costs to cover present externalities are suggested. A number of different report findings have been shown and these can be used as inputs in a sensitivity analysis to obtain more reliable conclusions. Each section of road and competing railway can be analysed on a route basis such as the N3 road and Natcor rail corridor, or a geographic area such as the Natal Midlands forestry area. This is currently being done and the detailed results are expected to be released in the near future.

Summary: Quantified External add-on costs (Used in the following tables)
(Note: all figures are in South African cents per tonne kilometre)

Road Accident Costs *(Alternatives considered)*
- South African estimate is based on DoT Report at 2.3c/tonne-km.
- Suggested South African rate of 6.0 per tonne-km (Used)
- EU report figure of 7.0c per tonne-km.
- Australia Queensland report figure of 4.0986c/tonne-km.
- Australia Austroad figure of 9.685c/tonne km

Rail Accident Costs *(supported in various reports)*
- Australia Queensland report figure of 0.1242c/tonne km (Used)

Road Congestion Costs *(Alternatives considered)*
- Australian report figure of 0.1863c/ tonne km
- South African estimate of 2.5c/tonne-km (Used)
- EU report figure of 5.387c/ tonne km

Road Exhaust Emission and Pollution Costs *(Alternatives considered)*
- Australian Queensland report figure of 6.3854c/ tonne km (Used)
- EU report figure is 33.372c/ tonne km

Rail Exhaust Emission Costs *(supported in various reports)*
- Australian Queensland figure of 1.4415c/tonne km for diesel traction. Suggest 25% reduction for electric traction to 1.0811, including thermal power station emissions.

Road Noise Costs *(accepted for this survey)*
- Australian Report figure of 0.4347c/tonne km

Rail Noise Costs *(accepted for this survey)*
- Australian Queensland Figure 0.2484 (less 33% for electrified sections) is 0.1639c/tonne km

Road Traffic Policing Costs *(accepted for this survey)*

- Australian Queensland Report figure of 0.3105c/tonne km

Space and Energy Efficiency Costs

- South African calculations will be used but they have not been finalised at this stage

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External Cost Examples in South Africa

The following two tables estimate the financial effects of external costs that are currently not directly recovered from users. Utilising the quantified external add-on cost figures, thought to reflect local conditions, the tables detail the effect of each of these. The first table deals with forestry traffic in the Natal Midlands, and the second with general traffic on the N3 corridor.

It is important to appreciate the fact that the Natal Midlands forestry traffic is one-way short to medium haul at an average charge out rate of 60c per tonne-km, while the N3 Corridor traffic is long haul at 50c per tonne-km, with an opportunity to obtain return loads (back haul) which can reduce the rates by 25% or more. The charge-out rate is very sensitive to fuel costs and virtually varies from month to month even where contracts are in place.

In order, from the top row, the following are detailed:

Estimated Total External Costs for KwaZulu Natal Forest Industry
Roundwood Traffic (2006 figures)

	Sector	**Railway**		**Roads**	
	Present charges	*		**	
1	**Av rate per tonne-km**	**30c**		**60c**	
	External Costs		**% of Increase**		**% of Increase**
2	**Accidents**	**0.12c/t-km**	**6.63**	**6.00c/t-km**	**38.22**
3	**Congestion**	***		**2.50c/t-km**	**15.93**
4	**Emission**	**1.44c/t-km**	**79.56**	**6.39c/t-km**	**40.76**
5	**Noise**	**0.25c/t-km**	**13.81**	**0.43c/t-km**	**3.18**
6	**Policing**	**Nil**		**0.31c/t-km**	**1.91**
7.	**TOTAL**	**1.81c/-km**	**100.00**	**15.63c/t-km**	**100.00**
	Revised Rate	**31.81**		**75.63c/t-km**	
	Percentage increase	**6.03%**		**26.05%**	

* This is an average siding to siding charge, which excludes road short-haul from plantation to the rail loading point which can cost over R 1.20 per tonne. Loading to rail can cost an additional
R 8.00 per ton.

** The charge of 60c per ton kilometre was an average road transport charge during 2006 for forest to mill traffic from the KZN Midlands area. It includes profit for the operator.

*** There is possible congestion at some level crossings but programmes in recent years have all but eliminated such crossings on important provincial roads.

Forestry industry pulpwood or roundwood transport is generally over modest distances, usually not exceeding a lead distance of 300 km. It is also one-way traffic, with no return-leg or back-haul. The cost per kilometre, is therefore, higher than long-haul general traffic, particularly where return-leg traffic is the norm, such as on the Durban – Gauteng N3 corridor. It must be noted that most forestry traffic is over district and provincial roads where no toll fees are charged. Such roads generally have shallow pavements which are far more susceptible to damage from high axle load vehicles.

A considerable investment has been made in recent years to allow large road vehicles to reach plantation loading points, whereas when rail is used smaller tractor-trailer combinations can operate over less expensive roads, although there is an extra loading cost at the railway siding.

Estimated Total External Costs: Durban – Gauteng Corridor (2006 figures)

	Sector	**Railway**		**Roads**	
	Present charges	*		**	
1	Av rate per tonne-km	30c		50c	
	External Costs		% of Increase		% of Incease.
2	Accidents	0.12c/t-km	8.82	6.0c/t-km	38.22
3	Congestion	***	-	2.5c/t-km	15.93
4	Emission #	1.08c/t-km	79.41	6.4c/t-km	40.76
5	Noise #	0.16c/t-km	12.17	0.5c/t-km	3.18
6	Policing	Nil	-	0.3c/t-km	1.91
7.	TOTAL	1.36c/-km	100.00	15.7c/t-km	100.00
	Revised Rate	31.36c		65.7c/t-km	
	Percentage increase	4.5%		31.4%	

* The legal payload of a seven-axle Interlink or equivalent vehicle ranges from 36 to 40 tons, depending on the truck type and commodity hauled. For the purposes of this table, it has been assumed that a great number of trucks on the N3 route will he hauling import/export goods, much of which is containerised. Two containers can add up to 7 tons of non-payload weight to the combination, which in the case of Interlinks, averages about 20 tons unladen. The average payload, therefore, has been estimated to be 30 tons.

** The charge of 50c per ton kilometre is based on a single load with no return haul. When a return load is realised (most of the time) transport costs can be reduced considerably, depending on extra time required to secure such a load.

*** There are no level crossings over the National road on the railway line between Durban and Gauteng

Rail is reduced because electric traction is used throughout

The real cost of road transport externalities (excluding infrastructure costs) are about four times that of rail when diesel traction is used in South Africa. When electricity is the source of energy, even considering power station emission costs, rail improves this even more.

<u>It is clear that more research is urgently required to confirm figures for road and rail infrastructure costs.</u>

GENERAL CONCLUSIONS

- When based on full cost accounting calculations for each mode, including energy resource consumption and other transport cost externalities, the rail mode has important financial and environmental advantages over road.

- Road transport is fast and flexible, a great benefit to many users who are able to reduce warehousing and other logistics costs as a result. However, operators use an infrastructure funded by government to which it is generally accepted that they do not pay adequate external costs and for provision and maintenance costs. It has also been claimed that road toll fees are skewed to the benefit of large vehicles while light motor vehicle operators significantly subsidise the large vehicles.

- The under-recovery of road costs has generally been accepted by government since good roads and efficient transport generate development and business opportunities. This, ultimately, creates income and profits that produce revenue for government via taxes. It

must be pointed out that rail benefits are considerable, including the payment of taxes as well, and these must be considered in an effort to better appreciate total costs.

- The road transport industry has strived to present a good public image but the negative aspects must be factored into the total value of the mode.

RECOMMENDATIONS

- External transportation costs must be more fully investigated in the South African context.

- The cost of these externalities must be factored into the total cost of transportation – to the operator, the user, the State and society in general.

- Only then will it be possible to make decisions regarding infrastructure investment priorities and net benefits to the country as a whole.

APPENDICIES

A Transport Cost Externality Study extracts
- A1 "A Quantitative Analysis of the Full Costs Associated with Motor Vehicle Use in South Africa," (2000)
- A2 "The Estimation of Unit Costs of Road Traffic Accidents in S Africa," (2004)
- A3 "Pietermaritzburg Branch Line Cluster Study, (2008)
- A4 "The Cost of Freight Capacity Enhancement – A Comparison of Road and Rail (2005)
- A5 "Revised Land Freight External Costs in Queensland" (2004)
- A6 "Estimating the Total Costs of Accidents" (Canadian Report), 2007
- A7 "External Costs of Transport" (EU Report) 2000
- A8 "External Costs of Transport – Update Study (EU Report) 2004

B International Rates of Exchange

C References and Literature Consulted