FUEL EFFICIENCY MEASURES FOR SOUTH AFRICA

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ABSTRACT

Oil represents the single largest item on the Country's import account. Gasoline and diesel fuels which are almost exclusively used for the transportation of goods and services form a significant proportion of these imports. It is well known that transport, especially road transport, is a very serious source of pollution, affecting human health and the environment. Increased fuel efficiency will reduce the pollution per vehicle-kilometre (www.dme.gov.za) and mitigate this impact.

The Government is concerned that higher oil prices and hence higher fuel prices increase the difficulty of reducing the rate of inflation and maintaining low levels of inflation, thereby jeopardising the inflation targets set for the economy[1]. Oil price volatility impacts negatively on decision- making and planning for investments.

A study was carried out between September 2003 and October 2004 identifying possible fuel efficiency measures and the effect thereof. This paper provides an overview of the financial and TDM (Travel Demand Management) measures identified.

1. BACKGROUND

Nearly 80% of the primary energy supply imported into South Africa is in the form of crude oil. This represents the single largest item on the country's import account. Gasoline and diesel fuels, which are almost exclusively used for the transportation of goods and passengers, represent a significant proportion of these imports.

After a period of relatively low prices for crude oil, there have been significant price increases during 2004. This has caused economic and social hardship throughout the community and has put pressure on the government to seek ways to reduce prices on fuels and refined products. The outlook for oil prices is uncertain, with most commentators predicting further increases. This allied with possible volatilities in the Rand/Dollar exchange rate make the setting of economic targets extremely difficult for government.

According to the Department of Minerals and Energy (DME), a high level of government consideration and attention is being placed on vehicle fuel efficiency, measures to limit the use of fossil fuels and the environmental impact of vehicular emissions worldwide. Internationally, significant success has been achieved in the reduction of the use of fossil fuels through appropriate means and interventions. These measures have, however, received little attention in South Africa.

[1] The government in 2000 decided to set an inflation target range and the Reserve Bank has formally adopted an inflation targeting monetary policy framework

OIL PRICES AND INFLATION

World oil prices have fluctuated significantly in recent years. In late 1998 oil prices fell to their lowest levels in many years, to approximately $10 per barrel, but then increased to levels above $30 dollars per barrel following production cuts by the Organisation of Oil Exporting Countries (OPEC). They are now close to the historic high of $50 per barrel.

Petrol prices are regulated at the retail level while diesel and illuminating paraffin prices are quasi-regulated at the wholesale level. It has been suggested that the contribution of administered prices to inflation is higher than that of non- administered prices. The retail fuel price, although a regulated price in South Africa, is not strictly an administered price. It is influenced by market forces, such as the exchange rate and the international dollar denominated oil price. Both these variables are outside the government's control.

www.dme.gov.za

These concerns led to a request from the Cabinet to the DME to investigate measures to mitigate and ameliorate the impact of higher oil prices and oil price volatility on the economy. This paper presents a summary of the study undertaken to address these concerns as well as additional work undertaken to ascertain the energy effect of a broad range of transport efficiency measures.

2. STUDY APPROACH

In order to meet the above requirements the following underlying principles were adopted for this study:

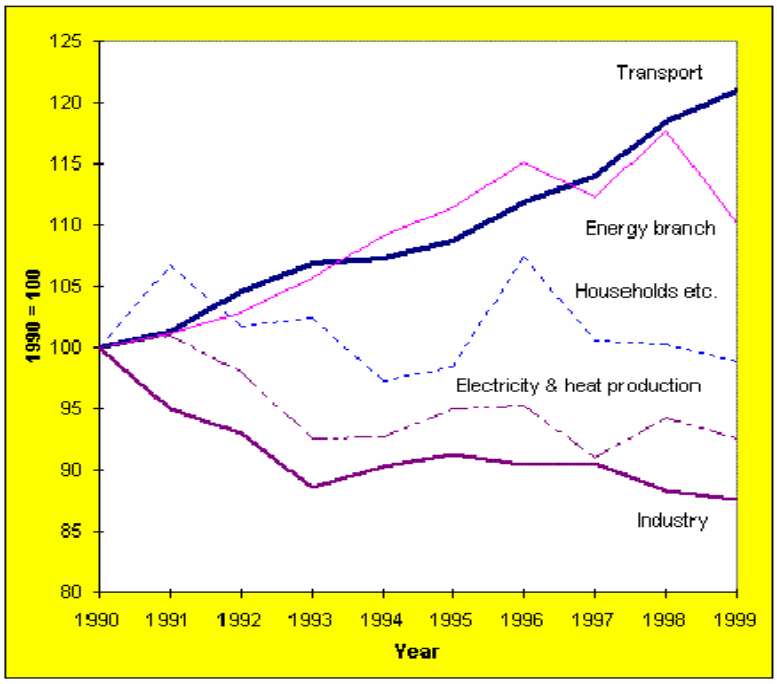
- A scan of internationally adopted options was initially undertaken to enable appropriate informing parameters to be taken forward;
- Research of local work/legislation/regulations was incorporated in the breadth of the study or else integrated within it;
- Practices used elsewhere and synchronous local practices were assessed in terms of their feasibility for future efficiency strategies; and,
- From available data, an estimate of the energy effect of options was calculated to ascertain the effectiveness and suitability of feasible options. The estimate was carried out for the year 2010, which allows a reasonable timeframe for a more mature vehicle market.

In drawing any conclusions or recommendations, the study has relied on available data and, where possible, adapted the reported energy or other effect based on an assessment of likely local conditions rather than scientific proof.

3. EUROPEAN PRACTICE WITH REGARDS TO FUEL CONSUMPTION

3.1 Vehicle Requirements

As part of the EU type approval process for cars the fuel consumption/CO_2 emissions need to be measured. The requirement to measure fuel consumption goes back to the 1980's while for CO_2 it dates to the late 1990's. The aim is to minimise car ownership and car use via taxes, as private cars contribute largely to the negative aspects of road transport such as: congestion and pollution (CO_2 emissions and the like). Figure 1 provides a profile of CO_2 emissions from various industry sectors in Europe. It is clear from this graph that the transportation sector is the major contributor. The growth in CO_2 emissions is mainly attributable to mobility growth other factors being general economical and population growth in the shown period.



Source: EUROSTAT

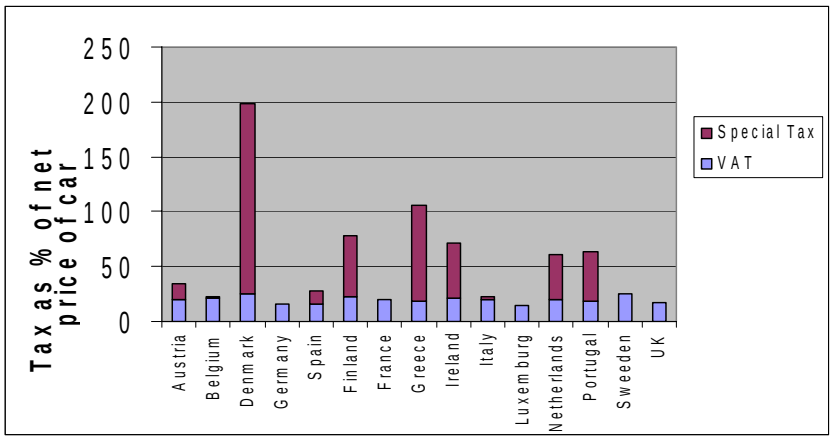
Figure 1. CO2 emission from fossil fuels (EU 15).

Technical standard also exist for the 'regulated' pollutants – carbon monoxide (CO), hydrocarbons (HC), nitrogen oxides (NOx) and for diesel vehicles particulate matter (PM).

3.2 Fiscal Measures

In general, the types of taxes imposed in the EU zone (SEPA, 2002) are:

Purchase tax; All EU countries apply VAT to the purchase of motor vehicles and transportation fuel. This is a general tax applied to all goods (with a few exceptions) throughout the EU, and is used to raise revenue. In addition to VAT, 12 (out of a total of 15) EU countries have a registration tax (i.e. a tax or charge with a revenue raising function) payable at the time of first registration of a vehicle. These tend to be focused on passenger cars, motorcycles (12 countries), buses (7 countries) and trucks (6 countries) and are reduced for buses and trucks. In addition, some Member States also levy a registration fee payable on registration with the national vehicle register. Table 2 summarises the ownership taxes in the EU zone.



Source: TAX GUIDE)03_EU

Figure 2. Total tax as a percentage of the price of a car (EU).

Annual circulation taxes; (e.g. the vehicle excise duty in the UK); Many EU countries have used differentiated registration taxes to promote cleaner vehicles. In general, a system of rebates or tax credits has been used instead of a formal system of vehicle taxation classes.

Euro I for all new passenger cars came into effect from 31st December 1992. Six EU countries (Germany, Netherlands, Denmark, Greece, Belgium and Luxembourg) promoted the purchase of catalyst-equipped vehicles prior to 1992 by offering rebates on registration tax. Germany was the first country to do this in 1985. In the UK, where no economic incentive was offered, purchasers could buy cars fitted with catalysts, but at an additional cost. They were not willing to pay this cost (Ford UK only sold 200 cars with a catalyst fitted as an optional extra over a period of several years; annual Ford UK sales were approximately 250,000 per annum at that time; i.e. less than 0.01% of sales). As a consequence, by 1998 virtually all German petrol cars in the fleet had catalysts fitted, whereas only about 50% of the UK fleet did.

A more recent example of the success of the use of differentiated registration taxes for cleaner vehicles is the German system to promote Euro III and Euro IV vehicles. All new cars registered after 1st January 2001 and 2006 respectively, must meet the standards. The German government offered rebates/tax credits for petrol passenger cars meeting the new standards early (table 1).

Table 1. German economic incentives for cleaner cars.

Standard		Rebate	From	Until
Euro III	Petrol	€ 500	July 1997	End 1999
	Diesel	€ 125	Jan 2000	End 2000
Euro IV	Petrol	€ 500	July 1997	End 2004
	Diesel	€ 300	Jan 2003	End 2004

Source: www.steuer-office.de

It should be mentioned that EU legislation specifically allows fiscal incentives to be used, but incentives must be less than the cost of meeting the new emission standard. It is often difficult for governments to determine the cost of meeting new emission standards (industry would clearly want the incentives to be as high as possible). An overview on the ownership taxes in different European countries is provided in table 2. Although other countries have some special incentives for special vehicles (electric cars etc.), only 3 countries: Denmark, Germany and the UK have a general system that is based on pollution or fuel consumption.

Circulation Taxes; All EU countries impose circulation or ownership taxes. For cars, taxes are based on a range of parameters, including vehicle weight, horsepower, age and engine capacity. In Germany, taxes are based on emissions (CO_2 and toxic emissions), on CO_2 emissions in the UK (from April 2001) and on fuel consumption in Denmark (SEPA, 2002). In Sweden, Environmental Class 1 vehicles are exempt from circulation tax for the first 5 years of their life.

Table 2. Ownership tax in different European Countries.

TAXES ON OWNERSHIP	PASSENGER CARS Based on	COMMERCIAL VEHIICLES Based on
Austria	HP/kW	Max. auth. Gross weight
Belgium	CC	Deadweight
Denmark	Fuel consumption, weight	Weight
Germany	CC, pollution	Permissible total weight, pollution, noise
Spain	HP	Payload
Finland	€ 84 – 117	Weight
France	None	Axle + suspension + weight
Greece	CC	Payload
Ireland	CC	Deadweight
Italy	kW	Weight & number of axles (>12t)
Luxemburg	CC	Weight
Netherlands	Deadweight, province, fuel	Deadweight
Portugal	CC & age	Gross weight, axles
Sweden	Weight	Weight, axles, fuel
UK	CO_2 emissions	Laden weight

Source: TAX GUIDE)03_EU

The German scheme for cars is highly differentiated. A non-catalyst car charge is approximately five times more than the charge for a current Euro III car. Cars with very low CO_2 emissions meeting future emission standards and electric cars are exempt for a period of time. This system was introduced at the same time as the differentiated registration tax for cleaner vehicles (see section iii above), and the joint impact is described above.

In the UK scheme, there are 12 tax classes depending on CO_2 emissions and fuel, with varying rates. There has been no analysis to the author's knowledge of the impact of this circulation tax since its introduction in April 2001.

Europe has many other fiscal incentives like fuel duties, congestion charging and scrappage incentives. These measures are not further discussed in this paper.

3.3 Driver/Consumer Education

Driver/Consumer education is widely recognised as having an influence, albeit fairly minor, on fuel consumption.

The main types of consumer information available include:

- Purchase of more fuel efficient new vehicles;
- Driving style; and,
- Vehicle maintenance.

4. THE US CAFÉ SYSTEM

Carbon dioxide emissions are directly proportional to fuel economy: each one-percent increase in fuel consumption results in a corresponding one-percent increase in CO_2, according to the US Environmental Protection Agency[2]. The US federal regulators therefore initiated the CAFE (Corporate Average Fuel Economy) in the late seventies to link fuel consumption targets with fiscal disincentives.

The law requires that every manufacturer achieves a standard level of miles per gallon (mpg), across all new vehicles sold. The standard has changed over the years. In 1978 the US government limits were set at 14mpg for passenger cars (about 20.2 l/100 km). Currently the requirements are 27.5mpg for passenger cars (about 10.3 l/100 km).

An effort to impose tougher CAFE standards - 36 miles per gallon for both passenger cars and light trucks - was defeated in the US Senate in March, owing to a lack of political will and the auto industry's lobbying clout.

Adding to its list of environmental firsts, the state of California is on the verge of introducing a bill to curtail vehicle tailpipe emissions, dealing automakers one of their biggest setbacks in decades.

California Governor Gray Davis, who has said he feels the state needs to take the lead on the issue, signed the bill July 22, according to a spokesman. "I'm going to sign that bill. We simply have to take responsibility for emissions that come out of our cars," Davis recently told San Francisco radio station KGO.

The bill - the first such in the nation - authorises the California Air Resources Board to introduce regulations providing for the "maximum feasible reduction of greenhouse gases" by passenger cars and trucks by 2005. In practice, automakers would have until 2009 to comply with the new tougher restrictions.

http://monitoring.iafrica.com/newsbriefs/995456.hpm

The CAFÉ requirements have not eliminated high consumption vehicles (termed ‘guzzlers’ from here onwards) from the American market as the limit is an average requirement for the fleet of vehicles produced by a manufacturer. (This often leads to the offering of special prices on manufacturers most fuel efficient models). Manufacturers that only produce ‘guzzlers’ can use the air quality surplus from manufacturers that produce ‘sippers’ or alternatively accept fines. Although no details of the impact of this intervention are available, in general, it has been concluded that the CAFÉ system has reduced (the growth of) fuel consumption and air pollution.

5. FEASABLE SOUTH AFRICAN INTERVENTIONS

The research undertaken, a selection of which is detailed in this paper, indicates that a wide range of options and technologies have been implemented worldwide. Similar interventions, such as environmental measures, are in the process of being considered in South Africa. Indeed, options, such as differentials in fuel levies, are already in place. In order to contextualise the potential impact of any efficiency measure or intervention, the following interventions were considered, without limitations relating to time or costs, which

[2] http://motoring.iafrica.com/newsbriefs/995456.htm

could be incorporated into a South African fuel efficiency strategy. Clearly, options presented are within the bounds of this study; that is, they are not exhaustive and are limited in number.

These are detailed in Table 3 and include the estimated fuel effects and an indication of the assumptions made.

If all suggested measures are implemented concurrently, the total estimated fuel consumption saving for South Africa would be 56.4% (the authors realise that this is very unlikely). If congestion charging is implemented it could have an additional estimated local effect of about 10%. Local authorities should investigate the possibilities to introduce congestion charging (Oscar Faber, 1999, City of Cape Town, 2001 and Litman, 2004).

TRANSPORT TO GEAR UP FOR 2010 WORLD CUP

Cape Town - The government planned to introduce "Intelligent Transport Systems" to deal with growing congestion on South Africa's urban roads and drastically improve public transport ahead of the 2010 soccer World Cup, transport minister Jeff Radebe has said.

In written answers to questions from the national assembly, Radebe said a pilot intelligent transport system would start trials on the N1 Ben Schoeman Highway between Tshwane and Johannesburg soon.

SASITS Newletter, December 13, 2004

It is important to recognise that policy measures need to recognise both external and internal factors. External factors are identified as issues such as manufacturers R&D costs and trends overseas, because the market in South Africa is small and will not dictate large scale redevelopment. Internal factors are defined as the availability of technology, sources of fuel and expertise as well as demand.

Table 3. Summary of estimated effect of options considered[3].

Option	Fuel Saving Estimate at 2010 (% consumption)	Assumptions/ comments
Fuel efficiency		
Improved Vehicle Economy	3.2% (new vehicles)	Assumes 20% share of new vehicle sales
Fuel Efficient tyres	1% (all vehicles)	Assumes 27% of cars and 32% of LCV's are under-inflated.
Maintenance practices	0.3% (all vehicles)	Improvement from air filter up to 10%, oil filter up to 2%
Diesel Vehicles	27.5%(new vehicles)	Assumes a 25% share of new vehicle market

[3] The percentages are partly based on California Energy Commission and California Air resources Board, 2002

Table 3. (Continued)

Option	Fuel Saving Estimate at 2010 (% consumption)	Assumptions/ comments
Fuel Displacement		
Fuel Cells	0%	Probably will not be commercial before 2010. Otherwise up to 90% saving.
Electric Battery (EV)	2%(new vehicles)	Assumes EV's will form 2% of market share of new vehicles by 2010.
Grid-connected Hybrid (HEV)	2.4% (new vehicles)	Assumes HEV's will form 4% market share by 2010 and a 60% reduction in consumption.
CNG vehicle	2% (new vehicles)	Assumes conversion kits and infrastructure freely available.
LPG vehicle	4% (new vehicles)	Assumes no levies imposed, retention of LPG from refining process and infrastructure available[4].
Flexible Fuel Vehicle (FFV)	5% (new vehicles)	Assumes infrastructure available, acceptance.
Biodiesel	4% (new vehicles)	Assumes availability of infrastructure/ fuels
Fiscal		
Fuel Tax	-	Inelastic demand, would be most effective but has negative impact on CPI.
Pay-at-the-pump insurance	3.5%(all vehicles)	Assumes approximate levy of 30c/l and no fixed cost insurance.
Fees and Rebates	Depends on imposts (can be up to 0.5% for a 10% feebate)	Needs FCR system. Revenue neutral system assumed. Implemented at point of sale.
Travel demand and others		
Expanded Public Transit	1% (all vehicles)	Assumes strategy of PT initiatives to increase transit.
Land-use planning	0.5% (all vehicles)	Assumes packages of measures in place.
Telecommuting	0% (results inconclusive)	Based on current research, likely to be a relatively small number of users.
Reduce speed limits	0.5% (all vehicles)	Based on research. Assumes policing and enforcement.
Scrappage programmes	-	Limited impact from research. Link between age and fuel consumption is tenuous.
Congestion charging	10% reduction in commuter traffic in CT.	Depends on level of charge, requires policing and enforcement.

[4] However current government policy, supported by the industry, promotes LPgas as the optimal alternative thermal fuel for Low Income Households and consequently support for LPGas for automobiles (AutoGas) is not likely to be a high priority in the short to medium term.

5.1 Fuel Efficiency

Diesel is readily available in South Africa surpluses are exported to neighbouring countries. Moreover, it is possible, within fairly tight parameters related to the type of crude and configuration of a refinery, to change the percentage of petrol and diesel refined from a barrel of crude oil. The estimated fuel saving if more vehicles use diesel, is 27.5%.

5.2 Fuel Displacement

Fuel displacement provides a fuel consumption saving of between 0% and 5% depending on the promoted technology. Vehicles using alternative fuels are slowly becoming available on the market. Clearly, from a R&D point of view, South Africa plays a minor role and thus the promotion of fuel displacement can only be achieved via fiscal incentives and legislation to improve market penetration.

5.3 Fiscal

In recent years, pay-at-the-pump (PATP) insurance has attracted a great deal of attention as an alternative to the current insurance market. PATP insurance proposals have historically been proposed so that at least some portion of insurance is covered through a higher fuel tax, with the rest paid either as an increment to registration fees or directly to an insurance company. The current levy imposed for the Road Accident Fund (26.5c/l, at October 2004) is not seen as being sufficiently high to make a significant impact on behaviour.

All else being equal, the more miles driven, the greater the risk of accidents. The current pricing system is inefficient since insurance is perceived by motorists as a fixed cost, whereas at least a portion of accident risk is a variable component related to miles travelled. Therefore through more efficient pricing of insurance, PATP has potential welfare benefits.

Feebates is a term coined to signify the combination of fees and rebates. In the cases studied, Feebates were targeted at the sale of new personal vehicles, based on fuel efficiency or emissions of carbon; the analysis presented here examines the effects of a feebate system based on fuel efficiency.

The effect of any fees and rebates imposed clearly depends upon the type of intervention as well as its quantum.

For this study, a range of imposts from 1% to 20% levies were tested and seven scenarios were modelled in detail:

1. Base case, no intervention
2. Tax guzzlers @ 5%
3. Tax guzzlers @ 10%
4. Tax guzzlers @ 20%
5. Tax guzzlers, rebate sippers @ 5%
6. Tax guzzlers, rebate sippers @ 10%
7. Tax guzzlers, rebate sippers @ 20%

The results of a selection of these scenarios are shown in figures 3a and 3b.

Clearly, the effect is dependent on the actual levels of imposts. However, it can be seen from Figure 3b that greater savings can be obtained by the imposition of a fee and rebate system in combination rather than a fee only system. Modelled results indicated anomalies

at levels of taxation of 20% and above. These could either be due to modelling tolerances or inelasticties. For the purposes of this exercise, scenario 5 was used for the comparison (Table 3).

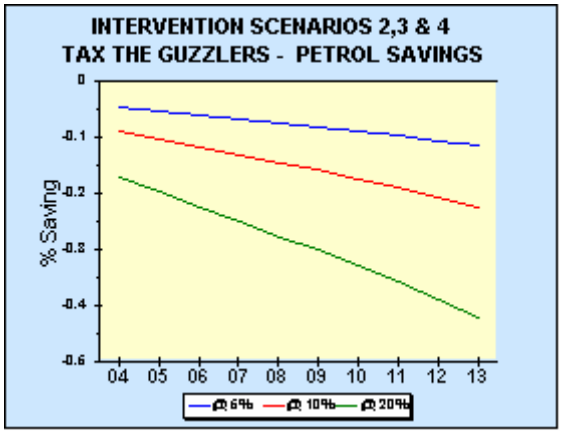


Figure 3a. Introducing a Guzzler Tax.

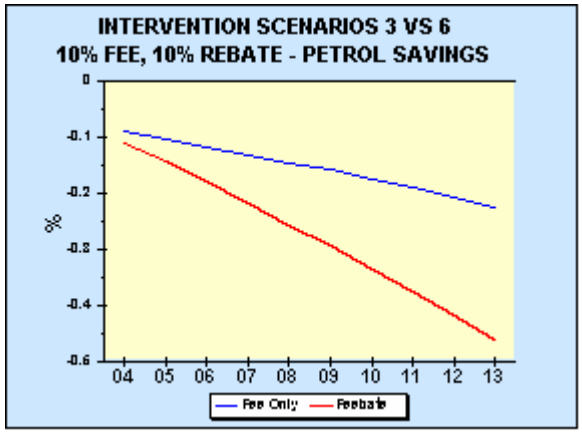


Figure 3b. Introducing a 10% Feebate.

5.4 Travel Demand

Travel demand management is a broad term for various strategies that increase transport system efficiencies. Measures can have a number of benefits, including speed reduction, reduced congestion, road and parking facility cost savings, pollution reduction and more efficient land use[5].

6. SUMMARY AND CONCLUSIONS

Transport consumes a significant proportion of the imported crude oil into South Africa. Worldwide, measures are in place to reduce the transport element of oil consumption. The question is: can similar measures be introduced here to effect fuel efficiency and conservancy, should they be and if so, how can they effectively be achieved? The answer to the first two parts of the question is clearly yes, especially in the light of the recent oil price increases, its likely fluctuations, because fossil fuels are finite and to reduce the environmental impact of emissions.

To achieve an effective strategy, policies should be multi-faceted with both short and long term objectives. In the short term, it is estimated that through the promotion of diesel vehicles, displacement of fuels and other measures mentioned in table 3, a saving of more than 55% of fuel consumed could be achieved by 2010.

A broad range of strategies should be promoted to allow the development of best practice options but with a priority being placed on fuel cell technology because of its anticipated efficiency and pollution free nature.

The most effective option, in the short term, is the promotion of diesel vehicles. This is especially the case given that diesel vehicles form around 50% of many European countries vehicle population. The market is, therefore, well developed. Diesel fuel quality, which was a concern, is now coming in line with European standards and ownership costs of diesel vehicles should also come in line with their petrol equivalents. Increased market penetration should therefore be encouraged as this can result in around a 25% fuel

reduction in new vehicle consumption from purchase. From the study undertaken, it is estimated that a 25% diesel vehicle market share would result in a saving of around 33.75 million litres of fuel per annum at 2010.[6]

The study also identifies that probably, the most effective option after the promotion of diesel engines and fuel displacement would be to raise fuel taxes further. However given the likely social and inflationary consequences of this intervention, this is seen as an option that would not be palatable and is thus not recommended

As already mentioned, South Africa does not play an active role in the R&D with regards to fuel displacement. Due to the size of its market, currently, South Africa is forced to follow worldwide developments. Nevertheless, fiscal incentives and legislation could accelerate the penetration of special vehicles using alternative fuels into the South African market. This is seen as the best longer term option to reduce consumption.

The remaining options, such as TDM measures and maintenance practices have merit, but need extensive governmental expenditure, administration and policing to ensure their effectiveness which seems nominal in comparison to the above. It would probably be difficult to justify such expenditure given the greater social needs of this country.

7. REFERENCES

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[5] www.vtpi.org/tdm/tdm59.htm

[6] Assumes new vehicle sales at 300,000, average consumption at 9l/100km and average travel distance of 20,000km p.a.