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**GOVERNMENT NOTICE**

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**DEPARTMENT OF ENERGY****No. 204****8 March 2011****PETROLEUM PRODUCTS ACT, 1977****DISCUSSION DOCUMENT ON THE REVIEW OF FUEL SPECIFICATIONS AND  
STANDARDS FOR SOUTH AFRICA**

The Minister of Energy hereby publishes a Discussion Document on the review of Fuel Specifications and Standards for comment.

All interested parties are hereby invited to comment in writing on the Discussion Document to the Director-General of Department of Energy at—

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Comments must be submitted before 06 May 2011. Comments received after the closing date may not be considered.

## DEPARTMENT OF ENERGY



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### DISCUSSION DOCUMENT ON THE REVIEW OF FUEL SPECIFICATIONS AND STANDARDS FOR SOUTH AFRICA



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**DRAFT POSITION PAPER ON FUEL SPECIFICATIONS AND STANDARDS**



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**ACRONYMS**

BLSN	Botswana, Lesotho, Namibia, Swaziland
CF1	Cleaner Fuels One
CF2	Clean Fuels Two
CFCs	Chlorofluorocarbons
CO <sub>2</sub>	Carbon Dioxide
CRW	Certificate for Road Worthiness
CTL	Coal-to-Liquids
DEA	Department of Environment Affairs
DEAT	Department of Environment Affairs and Tourism
DME	Department of Minerals and Energy
DoE	Department of Energy
DoT	Department of Transport
FVI	Flex Volatility Index
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GTL	Gas-to-Liquids
IOC	Inter-State Oil Committee
MMT	Methylcyclopentadienyl manganese tricarbonyl
NAAMSA	National Association of Automobile Manufacturers of South Africa
NEMA	National Environmental Management Act
NO <sub>x</sub>	Nitrogen Oxide
PAH	Polycyclic aromatic hydrocarbon
PetroSA	Petroleum, Oil and Gas Corporation of South Africa
PPM	Parts Per Million (equivalent to milligram per kilogram)
RVP	Reid Vapour Pressure
SAPIA	South African Petroleum Industry Association
USA	United States of America

## EXECUTIVE SUMMARY

This document serves to outline the direction which Government intends to follow in further improving the quality of transport fuels. It is a continuation of the process which, amongst others, resulted in the prohibition of the addition of lead into all grades of petrol and the reduction of the level of sulphur in diesel from 3000 parts per million (ppm) to 500 ppm in 2006.

Government is of the view that South Africa should migrate directly from the current fuel specifications and standards (CF1) which are compatible with Euro 2 emissions standard to CF2 which is equivalent to Euro 5 emissions standard on targeted key parameters (i.e. identified key elements of fuel specifications and standards for the South African environment). It would, therefore, be prudent for the oil industry to invest in refinery modifications in a once-off manner rather than by making piecemeal investments which could ultimately prove to be costly.

This Paper consequently recommends the tightening of fuel specifications by further reducing the levels of sulphur in both petrol and diesel as well as the reduction of benzene and aromatic levels in petrol to levels equivalent to the Euro 5 emissions standard. It is therefore recommended that the sulphur content in both petrol and diesel be reduced from 500 ppm to 10 ppm; benzene from 5% to 1% as well as aromatics from 50% to 35% by 2017.

It has been noted that the technologies involved in the production of cleaner fuels are well established. There is extensive experience that has been gained in the EU, Japan and the USA with regard to refinery modifications that are needed to produce cleaner fuels. Actual experience indicates that extensive refinery modifications for the production of cleaner fuels (Euro 4 or stricter) would require a period of four (4) to six (6) years, starting from the beginning of 2012.

### Investments Required

The estimated total capital investment required by the South African oil industry to upgrade the facilities to produce fuels that are compatible with the

CF2 specifications and standards is \$3.7 billion (Q1 2009 figures,  $\pm 40\%$  accuracy).

A separate determination of the estimated costs of the envisaged (new) fuel specifications and standards and the financing thereof will have to be undertaken. A common approach that is being followed by most governments around the world is to differentiate taxes applicable to automotive fuel sales thereby creating relative advantage for a particular higher quality fuel. These differentiated fuel taxes are normally used to reflect the environmental benefits of transport fuels. Cleaner and less polluting transport fuels are taxed at a lower rate in order to create an incentive for the uptake of these fuels as the tax difference is often and ultimately passed onto consumers in differentiated pump prices. Differentiated taxation and pricing have been applied in Asian countries such as China, India, Malaysia and the Philippines.

From the perspective of a differentiated tax policy, National Treasury's fuel tax policy allows for the application of differentiated tax rates on transport fuels to reflect the environmental benefits of different fuels. It is in this respect that biodiesel is taxed at a lower rate compared to conventional, fossil-based diesel. Accordingly, the National Treasury will play a leading role in discussions regarding fuel tax differentiation for cleaner fuels. However, the fact that South Africa has a regulated liquid fuels market needs to be factored in when considering lessons that have been learnt from other jurisdictions.

In conclusion, South Africa is not operating in isolation; it cannot be against the current global trend of lowering the maximum limits of sulphur content of fuels and other parameters such as the aromatics and benzene content of petrol. It is imperative that South Africa migrates to the CF2 specifications and standards by 2017 in order to make it possible to introduce vehicle technology that will improve the ambient air quality, offer health benefits and ensure long-term sustainability of the oil and motor manufacturing industries. This is crucial given the country's strategic objectives and its vast and somewhat deep socio-economic challenges.

The introduction of cleaner fuels is in line with the country's policy framework as articulated in IPAP2, the Green Economy as well as the New Growth Path. These documents seek, among others, to promote the creation of decent and sustainable jobs.

DRAFT POSITION PAPER FOR PUBLIC COMMENT

## 1. Introduction

Climate change / global warming has emerged as the greatest global environmental challenge in recent times. This is being caused by the very high levels of greenhouse gas emissions that are emanating largely from the operations of the industrial, electrical and transport sectors. In 2007, the electricity and transport sectors combined, produced nearly two-thirds of the global carbon dioxide (CO<sub>2</sub>) emissions. This has prompted various countries to make commitments to implacably reduce their contribution to greenhouse gas emissions in a bid to reduce global warming. South Africa, as part of the global community of nations, has to align its policies with global imperatives. This has to be done in a manner that takes its own national objectives and challenges into account.

South Africa is a coal based economy and, as a result, it ranks amongst the world's highest emitters of greenhouse gases, particularly carbon dioxide (CO<sub>2</sub>). It is in this respect that the South African Government has committed itself to reducing greenhouse gas emissions. Government's latest commitment was made at the Copenhagen Conference where South Africa committed itself to reducing emissions by 34% in 2020 and by 42% in 2025 and this was predicated on condition that the developed countries provide the requisite finance, technology as well as capacity building. This also requires that a legally binding climate deal be agreed upon.

According to the International Energy Agency (IEA), electricity generation and heating processes contributed about 64% of South Africa's total CO<sub>2</sub> emissions in 2007. The transport sector is also a significant contributor to greenhouse gas emissions due to the high concentration of vehicles in the cities. This poses a risk both to human health and the environment. Consequently, stringent fuel specifications and standards should be in place to reinforce measures that are aimed at achieving the reduction of emissions from vehicles as well as improved air quality.

However, the fuels specifications and standards are not solely driven by environmental concerns. Other considerations underpinning the setting of fuel specifications and standards include:

- The promotion of international trade, with particular emphasis on enabling the South African vehicle manufacturers to export technologically advanced vehicles to international markets;
- Extending benefits to the motorists in the form of fuel efficiency and lower vehicle maintenance costs;
- Keeping abreast with global trends in vehicle technology in a manner that is supported by enabling fuels;
- Supporting Government's industrial development efforts, which are geared towards employment creation, by supporting sustainable local vehicle and component manufacturers as well as the refining industry in general. These efforts are encapsulated in the current Industrial Policy Action Plan (IPAP2), the New Growth Path and the Green Economy policy papers; and
- Alignment with Government's key priorities that are expressed in the twelve (12) Outcomes. For example, Outcome 10 emphasizes that all South Africans have the right to an environment that is not harmful to their health or well-being and that the environment has to be protected for the benefit of the present and future generations.

It is with due regard both to the environmental and the socio-economic challenges that the Petroleum Products Amendment Act, 2003 (Act No. 58 of 2003) was crafted to empower the Minister of Energy to regulate the specifications and standards of petroleum products. Accordingly, in 2006, Government promulgated Regulations regarding Petroleum Products Specifications and Standards (hereafter referred to as the "2006 Regulations") in Notice R. 627 of Government Gazette No. 28958.

These Regulations included, amongst others: the banning of the addition of lead (for octane enhancement) in all grades of petrol; the reduction of the permitted sulphur concentration in diesel from 3,000 parts per million (ppm) to 500 ppm; the creation of a niche diesel grade with a maximum sulphur



concentration of 50 ppm; as well as permitting various blends of bio-diesel up to a level of 100% bio-diesel. The latter highlights one important aspect of the specifications and standards, being that of enabling the blending of bio-fuels (both bio-diesel and bio-ethanol) into the mineral fuel pool.

Prior to the 2006 Regulations, the oil industry had been subjected to self-regulation which was based on the relevant voluntary specifications and standards that were stipulated by the South African National Standards under the auspices of the South African Bureau of Standards (SABS). Self-regulation was possible largely because of product swaps among the industry players. However, the successful implementation of the aforesaid regulation of fuel quality [now referred to as Cleaner Fuels One (CF1)] was not viewed as an end in itself, but rather as an enabling step towards further improvements of fuel quality.

Since 2008, the Department of Energy has engaged various key stakeholders in the development of this Discussion Paper on the review of fuel specifications. These include the South African Petroleum Industry Association (SAPIA) and its individual members as well as the National Association of Automobile Manufacturers of South Africa (NAAMSA). The work of Government was coordinated by an Inter-Departmental Task Team (IDTT) under the leadership of the Department of Energy. Members of the IDTT included the National Treasury, the Department of Environmental Affairs (DEA), the Department of Trade and Industry (DTI), the Department of Transport (DoT) and the South African Bureau of Standards (SABS).

It has now become imperative for Government to outline a road map on future fuel specifications and standards particularly in a bid to keep pace with improved vehicle engine technology and to address environmental degradation caused by harmful emissions from vehicles. Sustainable domestic production and supply of cleaner fuels is essential in order to realise a competitive South African economy since liquid fuels remain the most prominent energy carrier for transportation in the country.

## 2. Focus and guiding principles

The current initiative, referred to as Cleaner Fuels Two (CF2), seeks to further tighten fuel specifications and standards in an effort to align them with improved vehicle technology and the regulation of emissions that emanate from vehicles. This alignment is aimed at reducing the negative health and environmental impacts emanating from fuel combustion in vehicle engines. This will happen with due regard of the country's technological and socio-economic context.

The guiding principles for the proposed (new) specifications and standards are centred around chemical constituents and elements of fuel which have an adverse effect on health and the environment. Accordingly this has necessitated the focus on, among others, the reduction of aromatic and benzene (a known carcinogen) content of petrol and a further reduction of the sulphur content of diesel. Particulates, sulphur oxides, nitrogen oxides, volatile hydrocarbons, carbon monoxide and dioxide, as well as harmful odours contribute to air pollution. In South Africa, air pollution may also be exacerbated by emissions from poorly maintained vehicle engines. It is in this respect that new specifications and standards are being considered.

A holistic and integrated approach to achieve the reduction in vehicle emissions should necessarily encompass, among others, vehicle (engine) technology; fuel quality; and periodic vehicle inspections and maintenance. There is therefore need for proper alignment of fuel specifications and standards; vehicle (engine) technology; as well as the regulation of emissions from vehicles.

These new specifications and standards will:

- Be mandatory and applied on a national basis. However, this does not preclude future consideration of more stringent fuel specifications and standards that are aimed at addressing air shed-specific environmental conditions;

- Apply to all fuels that are sold in the Republic of South Africa, irrespective of whether or not they have been imported or locally produced. Local refiners must demonstrate the ability to produce the mandated quality fuel without having to import the blending components that are meant to bring their fuel to the required standard. Any reference to the local industry's readiness and capacity to supply fuel of the mandated quality should exclude assistance thereto from imports of either finished products or blending components unless otherwise indicated;
- Facilitate the introduction of bio-fuels into the South African liquid fuels market; and
- Be compatible with relevant international or internationally accepted standards in order not to impede competition and trade.

Closely linked to the cleaner fuels initiative is the identification and promotion of opportunities for industrial development that are in line with the Industrial Policy Action Plan (IPAP2) and other Government imperatives / programmes such as the empowerment of the previously disadvantaged South Africans, the creation / protection of sustainable job opportunities as well as poverty alleviation. The harmonisation of the South African fuel specifications and standards as well as vehicle emission standards with international ones, would enable the effective adoption of new vehicle engine and emission(s) control technologies. This could bolster the local vehicle manufacturing industry.

It is imperative to ensure that local content and local skills development take centre stage with respect to plant modifications made by refiners to produce fuels of the required standard. The creation and leveraging of specific opportunities need to be continuously explored. This could include exploring opportunities for the local beneficiation of manganese to produce methylcyclopentadienyl manganese tricarbonyl (MMT) for octane enhancement. This takes into consideration that the South African petrol pool is expected to be further octane-constrained. An integrated approach to value creation throughout the entire value chain is essential, taking into cognisance

of other energy policy imperatives. These include the promotion of bio fuels (bio-ethanol and bio-diesel) as transport fuels and liquefied petroleum gas (LPG) for thermal use in households. The principles of CF1 which included giving consumers / end users a choice and minimising the regulatory burden, administrative complexity and cost to the economy, wherever applicable, have invariably been retained.

### **3. The South African liquid fuels market**

It should always be borne in mind that the South African liquid fuels market currently includes the markets of Botswana, Lesotho, Namibia and Swaziland (BLNS countries) as well as the southern parts of Zimbabwe. In 2009, South Africa exported about 1.3 billion litres of petrol and 1.2 billion litres of diesel to BLNS countries. Petrol is mainly exported to Botswana, Lesotho, Namibia, and Swaziland which translated to 2.3%, 0.3% and 12% respectively. Similarly, diesel exported to Botswana, Lesotho, Namibia, and Swaziland which equates to 2.2%, 1.1% and 15% respectively. It is therefore crucial that proper consultations are made and partnerships forged with these countries. One avenue that is being used by the DoE for such consultations is the Inter-State Oil Committee (IOC) which comprises the BLNS countries and South Africa.

### **4. Fuel specifications and standards**

The current South African fuel specifications and standards are perfectly suited to meeting Euro 2 emissions standard. Most developed countries have implemented Euro 5 equivalent emissions and fuels standards, while developing countries are moving towards Euro 5 emissions and fuels standards.

The originally envisaged path towards cleaner fuels was to attain Euro 2 standards as from 2006; Euro 3 from 2008 and Euro 4 from 2010. In view of the fact the full implementation of the tighter fuel specifications and standards will only come into effect in 2017, it is proposed that CF2 specifications and

standards should largely be compliant with the Euro 5 emissions standard on the targeted key parameters as outlined in the table below.

Parameter <sup>1</sup>	Unit	Euro II Spec	RSA (CF1) Spec	Euro IV Spec	Euro V Spec	RSA (CF2) Spec
<b>Petrol</b>						
Sulphur	mg/kg	500	500	50	10	10
Aromatics	Vol %	50	50	35	35	35
Benzene	Vol %	5	5	1	1	1
RVP	kPa	45 - 75	45 - 75	45 - 60	45 - 60	45 - 65 <sup>2</sup>
Olefins	Vol%	No max	No max	18	18	18
<b>Diesel</b>						
Sulphur	mg/kg	500	500 / 50 <sup>3</sup>	50	10	10
Polycyclic Aromatic Hydrocarbons (PAH)	% m/m	11	No max	11	11	11
Cetane Number	none	45	45	51	51	51
Distillation						
T90, max.	°C	N/A	362	N/A	N/A	N/A
T95, max.	°C	360	N/A	360	360	360

Table 1: Fuel Specifications in terms of European Emissions standards and Proposed South African Fuel Specifications

Notes: (1) Unless otherwise stated all figures indicate maximum allowable levels.

(2) Vapour pressure shall be 65kpa maximum with a 5 kPa waiver allowed when ethanol is used

(3) \* = niche grade specification

(4) "Euro" refers to European Emissions Standard

#### 4.1 Key parameters

International experience which has been drawn from countries such as Japan, Europe and the USA indicates that, from the perspective of the environment, health and vehicle technology enablement, the following fuel parameters were the most important:

- For petrol: reducing sulphur; benzene, aromatics, olefins and volatility; and

- For diesel: reducing sulphur; Poly Aromatic Hydrocarbons (PAH), Distillation and Cetane Number.

The proposed changes to the fuel specifications and standards for South Africa entail changes to the afore-mentioned key parameters. These key parameters are briefly outlined hereunder.

#### **4.1.1. Sulphur content of petrol and diesel**

This key parameter is applicable both to petrol and to diesel and has the biggest environmental and health impact.

Sulphur is inherent in the production process of petrol and diesel as it occurs naturally in crude oil from which these fuels are derived. Sulphur is toxic and harmful to the environment. It causes what is commonly referred to as "acid rain". The sulphur content of fuel is directly linked to the emissions that emanate from the combustion of that fuel in a vehicle's engine. Generally the higher the sulphur content of fuel, the more will be the particulate matter that is produced during its combustion. With respect to health impact, particulate matter is known to contribute to respiratory-related diseases. People with lung disease may not be able to breathe as deeply or as vigorously as other people, and they may experience symptoms such as coughing, chest discomfort, wheezing and shortness of breath. Particulates can also cause nose and throat irritation, lung damage as well as bronchitis.

Sulphur poisons petrol engine exhaust three-way catalytic converters, which are the most important aspect of the technology that is used to reduce tailpipe emissions in order to meet the regulation limits. This effect is also known to be reversible, although affected catalysts may never fully regain their efficiency loss. The European vehicle emissions regulations require that an ageing test be performed to determine the deterioration factor at 80 000 km, which is then applied to the emission test results which themselves must comply with the specified limits to attain homologation (the certification of a product or specification to indicate that it meets regulatory standards). In the long-term, high sulphur levels degrade the efficiency of the catalyst and, therefore,



require vehicle manufacturers to apply additional or higher levels of emissions control to meet the durability requirement.

With the introduction of fuels that comply with Euro 4 and Euro 5 emissions standards in international markets the world has seen significant reduction of sulphur level in petrol. This is being translated into better and improved air quality standards. New petrol engine technologies that are aimed at improving fuel efficiency and achieving lower emissions, such as direct petrol injection systems, require low sulphur levels. The current European requirement is a maximum sulphur content of 10 parts per million (ppm) in petrol.

It should be emphasised that synthetic fuels, which make up about 30% of fuel production in the country, from Sasol's Coal-to-Liquids (CTL) operations in Secunda and the PetroSA's Gas-to-Liquids (GTL) operations in Mossel Bay are virtually sulphur-free and are in compliance with Euro 5 emissions standard in so far as the sulphur content is concerned. However, lower sulphur diesel has low lubricity and blending it with biodiesel would invariably help to address this lubricity challenge.

#### **4.1.2. Aromatics content of petrol**

Aromatics occur naturally in crude oil and are also produced in some refining processes. Aromatics are molecules containing carbon and hydrogen with a simple benzene ring structure. They are high octane petrol components but are the primary source of toxic exhaust emissions. Besides aromatics, other sources of octane enhancement include oxygenates and isomerised hydrocarbons. Aromatics that are common in petrol include benzene (specifically discussed below), toluene and xylene. Heavy aromatics promote engine deposits, which cause fuel inefficiencies. People that are most affected by the vapour releases of aromatics from petrol, outside of the refinery boundaries, are petrol attendants and petrol delivery truck drivers.

In order to achieve required public health and air quality benefits, aromatics in petrol need to be monitored and regulated effectively. The most volatile



aromatic component is benzene and it has the greatest impact, among aromatics, on human health.

#### **4.1.3. Benzene content of petrol**

Benzene is the simplest type of aromatic occurring naturally in crude oil and is also produced in some refining processes. Benzene is a known carcinogen. It is also a base molecule for all aromatics and thus partially combusted aromatics often contain high levels of benzene. Vehicles emit benzene through evaporation from their fuel systems and through their exhausts.

International practice in recent years has been to lower limits on benzene in response to health and air quality concerns. It is in this respect that South Africa has to align itself with international best practice by specifying benzene limits. Benzene is also a useful source of octane. Reducing allowable benzene levels will mean other high-octane constituents or additives will need to be used. However, reducing the benzene content of petrol is seen as a priority over the reduction of other aromatic compounds such as toluene and xylene, which have lesser negative health effects but are also good sources of octane.

#### **4.1.4. Volatility of petrol**

Volatility of petrol is measured in terms of its Reid Vapour Pressure (RVP) and Flex Volatility Index (FVI). Petrol is more volatile than diesel, jet fuel and illumination paraffin because of its lighter base components. The desired volatility depends on the ambient temperature. In hot weather, petrol components of higher molecular weight and therefore lower volatility are used; whereas in cold weather, too little volatility results in cars failing to start. In hot weather, excessive volatility results in what is known as "vapour lock", where combustion fails to occur because the liquid fuel has changed to a gaseous fuel in the fuel lines, rendering the fuel pump ineffective and starving the engine of fuel particularly in older vehicle models. Vapour lock is almost not a problem in new technology vehicles with fuel injection.

However, volatility needs to be regulated, particularly in large cities, in order to reduce the emission of unburned hydrocarbons. The final control of volatility in a refinery is often achieved by adjusting the blending of butane (which is a component of LPG) into the petrol streams. The blending of bio-ethanol, a relatively volatile octane enhancing oxygenate, into the mineral petrol pool has to be promoted whilst taking into account its contribution to volatility and LPG demand. Hence the 5 kPa waiver is allowed when ethanol is used.

#### **4.1.5. Olefin content of petrol**

Olefins are not typically present in crude oil but are produced in the refinery components upgrade processes. Excessive olefins in petrol contribute to evaporation emission and tend to be the most reactive precursor species in the photochemical formation of ground level ozone (i.e. smog). They also reduce the engine's reliability and durability as they cause gum formation and deposit build-up in the engine.

#### **4.1.6. Polycyclic Aromatic Hydrocarbons (PAH)**

PAH are natural components in crude and therefore occur in diesel. They have high energy content but poor combustion characteristics leading to poor auto-ignition quality (cetane) increased thermal cracking, peak flame temperature and delayed combustion process. They lead to increased exhaust emissions of particulates. From a health perspective, particles smaller than 10 microns diameter (PM10) are of greatest concern as they are prone to entering the lungs and consequently causing respiratory problems. Furthermore, particulates from diesel vehicles are a significant source of brown haze which contributes to environmental pollution.

#### **4.1.7. Diesel Distillation T95**

T95 is the temperature at which 95% of diesel evaporates. It gives an indication of heavy components in diesel (i.e. the tail / back end of the distillation of diesel) which tend to form particles upon combustion of diesel. This specification, therefore, limits the formation of particulate matter that

would be released when diesel is combusted in a vehicle's engine. Reducing this phenomenon has a positive effect on PAH content and Cetane Number.

#### **4.1.8. Cetane Number of diesel**

The Cetane Number of diesel is a measure of its propensity for auto ignition (ability to start easily). A higher Cetane Number, therefore, will have the effect of reducing carbon emissions. The changes mentioned above are deemed suitable in a bid to ensure the alignment of South African fuel standards with international fuel specifications and vehicle technology requirements. This is happening whilst consideration is being given to the environmental challenges and the consequent South African socio-economic situation.

#### **4.2. Carbon dioxide (CO<sub>2</sub>) emissions**

Although carbon dioxide is not necessarily a key parameter, it is nevertheless the main product of combustion and the main component of exhaust gas emissions.

Whilst the focus of specifications has tended to be on toxins like lead and benzene (a known carcinogen), greenhouse gas (GHG) emissions (which are primarily the by-products of fuel combustion that threaten the environment), particularly carbon dioxide (CO<sub>2</sub>), must never be neglected. This is especially the case at the current juncture when the globe is faced with the immediate dangers of climate change.

Besides other emissions, the transport sector contributes about 973 kg of CO<sub>2</sub> per capita emissions (IEA: 2009). It is against this background that the overarching problem of global warming, which is being compounded by harmful odours and other pollutants, compels South Africa to keep abreast with the latest trends in the international markets in a bid to reduce environmental pollution.

One of the primary determinants of CO<sub>2</sub> emission from mobile sources is the amount of carbon in the actual fuel. CO<sub>2</sub> emission, therefore, is linked to engine fuel consumption or inversely related to engine fuel efficiency and matters related thereto. Properly maintained latest engine technology vehicles are more fuel efficient than the earlier versions but require appropriate cleaner fuels to achieve the stipulated level of efficiency. It is, therefore, imperative that the fuels of appropriate quality be made available to the end users in order to reduce CO<sub>2</sub> emission from vehicles.

#### **5. The impact of greenhouse gas emissions on health**

Although most of emissions are emanating from a variety of sources, research reveals that the emissions that are generated from transport are more dominant and comprise the majority of air pollutants such as CO<sub>2</sub>, NO<sub>x</sub> and others. One of the obvious factors driving governments across the world to implement new environmentally friendly fuels is the desire to have cleaner air. This is especially important in the case of major cities in South Africa. High levels of pollution through vehicle emissions may pose a serious health risk to the country's citizens; it may lead to significant productivity losses through personnel's frequent visits to hospitals – which often lead to admissions – as well as asthma and other respiratory related diseases.

The car pool (or parc) is evolving and already there is significant number of cars on the road that will benefit from the low sulphur fuel. NAAMSA has confirmed that even old cars will benefit from the low sulphur fuel. It is the view of the oil industry that the majority of South Africans will not benefit from the envisaged and improved quality fuels as their cars are older than ten (10) years. The South African car parc is in the order of 9 304 508 and in this regard vehicles that are older than ten years are in the order of 3 894 440 (courtesy of figures released by the Department of Transport). This shows that the majority of vehicles on South African roads are relatively new and that there is possibility to take advantage of cleaner fuels to reduce harmful emissions. Furthermore, from 1996, there was a progressive introduction of

vehicles that are fitted with catalytic converters and, by 2008 all newly homologated vehicles, as per legislation, were fitted with catalytic converters.

The problem caused by the emissions that are emanating from vehicles is being exacerbated by the old vehicle fleet that continues to roam South African roads. It is further compounded by the poor maintenance practises of the new vehicle fleet owners. The Department of Transport (DOT) is responsible for ensuring that vehicle owners are held accountable for the emissions caused by their vehicles. The DOT is in the process of finalising mechanisms for ensuring that all motor vehicle categories are subjected to smoke tests at Vehicle Testing Stations. Furthermore, roadside checking / inspections of vehicles will also be done.

The DEA fully supports the review of the current fuel specifications and standards. The DEA is playing a leading role with regard to environmental regulation / control aspects of CF2, particularly when taking account of all the health related consequences of harmful emissions from vehicles within the context of CF2.

A study conducted by the World Bank, in conjunction with the African Refiners Association, on Sub Saharan Africa refineries and health related issues found that there is reduction in harmful air emissions and concomitant negative health impacts that emanates directly from the use of quality transport fuels. The study also found that there was an increase in health related benefits that are associated with the reduction of air-pollution which translates into, among others, improved mortality rates. The study estimated that the refineries in Sub Saharan Africa would have to invest 6 billion USD to improve the quality of fuels and place them almost on par with the Euro 4 emissions standard. In return; there would be an estimated health saving of 43 billion USD over a period of ten (10) years ending in 2020. In the same study, a comparison is being made between the refinery investment costs versus health benefits over a period of 10 years to 2020 which indicates that the latter exceeds the former in all cases.

## **6. The role of improved fuel specifications on the economy**

### **6.1. Trade**

Since South Africa is participating in international markets, it is important that it should conform to international standards with regard to fuel specifications and standards. It is expected that changes to fuel specifications and standards will have a direct impact on both the refining and car manufacturing industries. These in turn would have a spill over effect on other industries. Consumption and production decisions may change throughout the economy, particularly if there are significant consequent changes to fuel prices. This would particularly affect fuel intensive industries such as the transport sector with a rippling effect to other downstream industries. The impact would also be reflected in the indicators related to the gross domestic product (GDP), trade, employment as well as inflation.

### **6.2. Employment**

The review of current fuel specifications is likely to have a positive impact on job creation thus contributing to achieving the targets that are outlined in Government's Outcome 4 which speaks to employment creation. The DoE is of the view that refinery upgrades could trigger employment opportunities that will permeate to sectors that are outside the oil industry. They will also protect jobs within the industry by enabling the long-term sustainability of the petroleum industry and contribute to capacity building, particularly if local content is prioritised.

The Automobile sector is playing a major role in the creation of employment in the country. This sector comprises light vehicle assemblers, the medium and heavy commercial vehicle sector, the component sector as well as the retail sector. Vehicle production declined in 2007, a phenomenon that was caused by the decline in car sales and the continued growth of the share of imports. Aggregate employment in the automobile manufacturing industry currently amounts to about 38 700 persons whilst employment in the component manufacturing industry is in the order of 81 000 employees. Total employment



in the trade area, namely in the vehicle sales and vehicle maintenance and servicing fields, currently amounts to about 200 000 persons.

## **7. Technological developments**

The South African economy is not immune to the vagaries of technological developments that are taking place around the globe. Technological developments and innovation are crucial for the success of the South African economy. Vehicle manufacturers and engine makers are taking advantage of technological advances to produce world class vehicles. Accordingly, improved engines require enabling fuels that contribute to fuel efficiency and reduction of emissions.

For this sector to introduce new vehicle technology that will enable the automobile sector to compete effectively in international markets and contribute to the improvement of the ambient air quality, there should be enabling fuel to support the introduction of such new vehicle technology. If such fuel is not available, vehicle manufacturers will be tempted to move their manufacturing plants to other countries that can provide the fuel of the required quality standard. This will have a detrimental effect on the South African economy and will, in particular, deal a severe blow to the urgent challenge of creating decent and sustainable jobs. With the current unemployment rate of about 25.3% South Africa cannot afford any further job losses. It is, therefore, imperative for Government to facilitate the introduction of new cleaner fuels that are compatible with the latest and the envisaged vehicle technologies.

The South African automotive industry's total contribution to the country's gross domestic product (GDP) was in the order of 6,9 % in 2007. The sector's exports, as a percentage of total South African exports, had increased more than threefold from the 4.1% in 1995 to 13.7% in 2007 (NAACAM directory 2009).



## 8. Investments required

Although there is a considerable variance in exhaust emission requirements from Euro 2 to Euro 5, the National Association of Automobile Manufacturers of South Africa (NAAMSA) has indicated its readiness with vehicle technology that requires fuel compatible with Euro 5 emissions standard. The South African Petroleum Industry Association (SAPIA) has indicated that it supports a quantum leap approach in new vehicle technology by moving from Euro 2 specifications to Euro 4 or Euro 5 emissions standards on a predetermined future date provided, amongst others:

- Sufficient time is allowed for plant modifications to be made to produce fuels according to the new fuel quality requirements. A lead time of about four to five years has been mooted by the industry to invest in refineries in order to produce the required cleaner fuels. Hence the proposal by the DoE for compliance to Euro 5 emissions standard by 2017;
- The specifications take cognisance of the pace of transformation of the South African vehicle parc; and
- There is an incentive or compensation for investments made for such modifications.

South Africa has a total refinery nameplate capacity of about 708 000 barrels per day (bb/d), with 513 000 bb/d from crude oil, 150 000 bb/d from Coal-to-Liquids and 45 000 bb/d from Gas-to-Liquids. It appears that none of these refineries can yet produce the type of fuel that is aligned to Euro 5 emissions standard or produce fuel of the quality that is compatible with the vehicles that are fitted with the latest engine technology available in the market.

In this regard SAPIA acquired the services of a consultant to estimate the amount of the capital investment that would be required to produce high quality fuel. This exercise has indicated that a capital expenditure of roughly \$3.3 billion (approximately R26.40 billion at an exchange rate of R8.00/\$1.00,

Q1 2009 figures at  $\pm 40\%$  accuracy) is required to enable the South African refineries to produce fuel that is complying with the Euro 4 emissions standard and \$3.7 billion (approximately R29.60 billion at an exchange rate of R8.00/\$1.00, Q1 2009 figures at  $\pm 40\%$  accuracy) for fuel complying with the Euro 5 emissions standard. Nevertheless, contextually, the cost of migrating from CF1 to fuel quality compatible with Euro 5 emissions standard is not significantly different from that of migrating from CF1 to fuel quality compatible with Euro 4 emissions standard: this being R3.2 billion.

However, the methodology used in the determination of the estimated costs submitted by SAPIA to the Department is a "broad brush". It does not indicate the varying circumstances of each refinery nor does it specify which option was used to develop the cost estimate. For example, there are broadly, two basic investment options for the reduction of the sulphur content of both petrol and diesel. These are Post-Treatment and Pre-Treatment. The former requires Hydrotreaters to remove sulphur in the product streams whereas the latter requires a Hydrocracker to remove sulphur in the Gasoil stream that is fed to Gasoline and Diesel producing units. These two options will invariably require different capital expenditures.

With all things equal, the capital investment would be for the cost of doing business to be borne by refiners unless passed through to consumers and incorporated into the pricing structures. Even when the costs of such investments are passed onto the consumer, in the end there is need for the initial capital outlay. The cost for such transition will vary according to the different requirements of the affected refineries; it is difficult to accurately determine the investment amount that is required unless information is obtained from individual refiners. Therefore, there must be a separate determination of the capital cost required for the envisaged new fuel specifications and standards and the incorporation thereof in the fuel pricing structures.

With respect to other socio-economic objectives of Government, it should be ensured that the said investments are done in a manner that yields maximum

possible benefit to the South African populace. Challenges pertaining to strengthening of state and private institutions; ensuring security of supply; economically empowering the historically disadvantaged South Africans; skills development and training; local beneficiation; regional cooperation and development; etc. should be holistically addressed.

A matter for urgent attention is the need to conduct an independent audit of the investments that industry players allegedly made with regard to compliance with CF1 in 2005/06. The determination of investment costs associated with CF2 should exclude investments that were supposed to have been done for CF1.

If South Africa is not doing anything while the whole world is moving ahead with the development of new technology, countries with advanced technology and cleaner fuel standards could use this country as a dumping ground for their inferior grade fuels and consequently old technology vehicles. However, the introduction of CF2 fuels could negatively affect the security of fuel supply in the intervening period if it is not closely managed as outlined below.

#### **9. Cost Recovery Mechanisms**

A separate determination of the estimated cost of the envisaged new fuel specifications and standards and the financing thereof has to be undertaken. However, it is the understanding of the Department of Energy that cleaner fuels initiatives internationally have not received substantial subsidies from host governments as reported by the Asian Development Bank.

A common approach among governments around the world has been to differentiate taxes on automotive fuel sales, creating relative advantages for higher quality fuel. These differentiated fuel taxes are normally used to reflect the environmental benefits of transport fuels. Cleaner, less polluting transport fuels are taxed at a lower rate in order to create an incentive for the uptake of these fuels as the tax difference is often passed onto consumers in differentiated pump prices. Differentiated fuel taxes in favour of clean fuels

send a clear price signal to motorists concerning the relative environmental and social costs of different fuels.

Differentiated taxation and pricing have been applied in Asian countries such as China, India, Malaysia and the Philippines. For instance, the People's Republic of China has raised the retail prices in Beijing on gasoline and diesel by a margin greater than that of other cities to compensate refining companies for the increased cost of providing Euro 3 compliant fuels in its capital city.

Internationally, these tax incentives have been applied most extensively to phase out leaded gasoline. Tax differentials have also been used to help introduce unleaded gasoline in Asian countries; although not in all instances. In 1993, Finland also used a tax differential to facilitate the introduction of diesel with 50 ppm sulphur content while the rest of Europe was still at the 500 ppm sulphur content limit. In the first year of introduction of the 50 ppm sulphur diesel, its market penetration was 70% but it rapidly improved to 80 – 100% in subsequent years.

The fact that South Africa has a regulated liquid fuels market needs to be factored into the lessons that have been learnt from other jurisdictions. However, from a differentiated tax policy perspective alone, National Treasury's fuel tax policy allows for differentiated tax rates on transport fuels (to reflect the environmental benefits of different fuels). In South Africa, the following fuel taxes apply to petrol, diesel and biodiesel: (a) general fuel levy; (b) road accident fund levy; (c) customs and excise levy; and (d) equalisation fund levy. In respect of the general fuel levy, National Treasury has applied differentiated tax rates on fuels by taxing biodiesel at a lower rate compared to conventional, fossil-based diesel.

Other alternatives for cost recovery could involve the direct recovery of incurred investments costs in the pricing structures of the liquid fuels. Such direct recovery might not have the desired impact of promoting the uptake of higher quality fuels.

The National Treasury will play a leading role in further discussions on fuel tax differentiation for cleaner fuels and will, in conjunction with the DoE, consider the most appropriate cost recovery mechanisms to employ.

## **10. Managing the switch to cleaner fuels in the economy**

There are potentially positive and negative impacts in switching to cleaner fuels, requiring proper management to minimise the anticipated negative impact as well as to maximise and leverage the positive effects.

### **10.1. Security of supply**

During the transition (of lead removal) in January 2006 the country experienced fuel supply challenges. The national shortage of liquid fuels, especially diesel and petrol, experienced in December 2005 and January 2006 may be basically attributed to the inadequacies in the planning when migrating from self-regulation to the 2006 Regulations. The envisaged transition from the current fuel specifications and standards to the cleaner fuels aligned to Euro 5 emissions standard will require comprehensive and decisive planning to avoid future fuel supply shortages. This is primarily the case because extensive modification of refineries would be required to upgrade them to produce fuel that is compatible with Euro 5 emissions standard. Notwithstanding the investment in refinery hardware, the introduction of cleaner fuels will reduce petrol production output from local refineries due to octane limitations which will be imposed by tighter specifications on octane-rich or octane-enhancing components of petrol. This would, if left unattended, result in an increase in the importation of expensive blending components like reformat.

### **10.2. Regulatory framework review – roles of various government departments**

The Draft Revised Regulations regarding Petroleum Products Specifications and Standards that will be applicable in 2017 are hereto attached as **Annexure 1**. However, a holistic and synchronised review of the Regulatory



framework is required to ensure a smooth and progressive transition to cleaner fuels. For instance, the Department of Transport will have to promulgate Regulations regarding Vehicle Emissions Testing to complement the Regulation on Fuel Specifications and Standards which will be done by the Department of Energy. The availability of cleaner fuels will complement the Motor Vehicle Carbon Emissions Tax which was introduced by the National Treasury in September 2010 and consequently encourage the introduction of less carbon intensive engine technologies.

Progressive regulations will still need to be developed to ensure that automakers fit vehicles with the requisite technology for the reduction of emissions. In order to reduce emissions and improve the overall engine performance, the DEA will have to set clear vehicle emissions standards for automakers to comply with. Clean performance technology offers a range of benefits which include, firstly, the optimal efficiency of engine at the highest level; secondly, the reliable protection of engine; thirdly, maximum engine reliability; and lastly, reduction of running costs. Finally improved technology should be used in tandem with upgraded vehicle fuel quality in order to realise envisaged benefits.

The National Environmental Management Act, 1998 (Act No. 107 of 1998) [NEMA] requires manufacturers of vehicles to demonstrate that the emission control devices are durable and function efficiently for the expected useful life of the vehicle. This can be attained if the ongoing in-service conformity tests are performed on a regular basis on the vehicles. More importantly, vehicle manufacturers should engage their clients and encourage them to use fuel of the required quality.

#### **11. Road map for tightening of fuel specifications and standards**

It is imperative for Government to set out a road map for the envisaged fuel specifications and standards for South Africa in a bid to afford the oil industry sufficient time to plan and make the requisite investments.

### 11.1. Timing of the introduction of cleaner fuels

The technologies involved in the production of cleaner fuels are well established. There is extensive experience in the EU, Japan and the USA with regard to the refining modifications that are required to produce cleaner fuels. The actual experience indicates that extensive refinery modifications for the production of cleaner fuels (Euro 4 or stricter) would require about 4-6 years. It will require about 1-2 years for financing and engineering; 1-2 years for acquiring requisite permits and a further 2 years for construction. Additional time may be required for contingencies.

A significant portion of the total time is needed for acquiring requisite permits, financing as well as the public input. To the extent that this portion is expedited, shorter time for compliance may be sufficient. Refineries which have already begun to upgrade will, of course, need less time. Installations for the limited number of properties such as sulphur content or retrofits of existing equipment would require less construction and the time for compliance could be reduced.

Europe allowed a period of 4-6 years, USA 6-7 years and California 2-5 years and Singapore gave a lead time of only 2 years. Among the developing countries, India announced, in October 2003, a phased programme for introducing Euro 2-4 emission and regulation by 2010. According to the Indian Emission Standards for four-wheeled vehicles, Euro 3 was introduced in April 2005 in 12 Cities and in 2010 Euro 3 emissions standard compliant fuels were availed nationwide.



## 11.2. The proposed phases of the road map

Taking into consideration the above experiences, the suggested schedule for a phased tightening of fuel specifications and standards is outlined below:

### 11.2.1. Phase 1

#### Period: 2011

Engagement with relevant and affected stakeholders to discuss and finalise future fuel specifications required for the country. A Task Team comprising relevant stakeholders and chaired by the Department of Energy will be formed to ensure smooth implementation. This will be from the beginning to the end of the program in 2017. The team will be responsible for ensuring constant reporting with regard to progress on the implementation of the new fuel specifications. This will help to ensure that the security of supply is not compromised during the process of upgrading the refineries to produce improved quality fuels.

#### *Security of supply*

The lead time of four (4) to six (6) years will be allowed to afford the oil industry sufficient time to plan properly for the specification changes to avoid major fuel supply disruptions. Import capacity will have to be optimised to mitigate stock-outs. There should be transparent communication between Government, SAPIA, NAAMSA and other stakeholders with regard to the planning of refinery shutdowns and other logistics related to the implementation of the road map. Refinery shutdown planning and matters related thereto shall be centrally coordinated by Government to ensure the non-overlap of shutdowns, effective utilisation of shutdown labour crews and efficient start-ups.

### 11.2.2. Phase 2

#### Period: 2013

The introduction of the latest vehicle technology hinges on the availability of enabling fuels in the economy. In order to encourage early introduction of this

technology while awaiting the required fuels as mandated by legislation in 2017, an additional niche grade of petrol and diesel with sulphur concentrations of 10 ppm should be made available. Noting the fact that the country is already in a net importing position with regard to petroleum products, the early introduction of enabling fuels will, at best, be achieved through importation as an interim measure while building domestic capacity.

The introduction of this transitional fuel needs to be properly managed to promote its gradual volume growth up to 2017. This will be done with a view to eliminating the postponement of investments until the very last moments as experienced with CF1 in 2006.

### **11.2.3. Phase 3**

#### **Period: 2015**

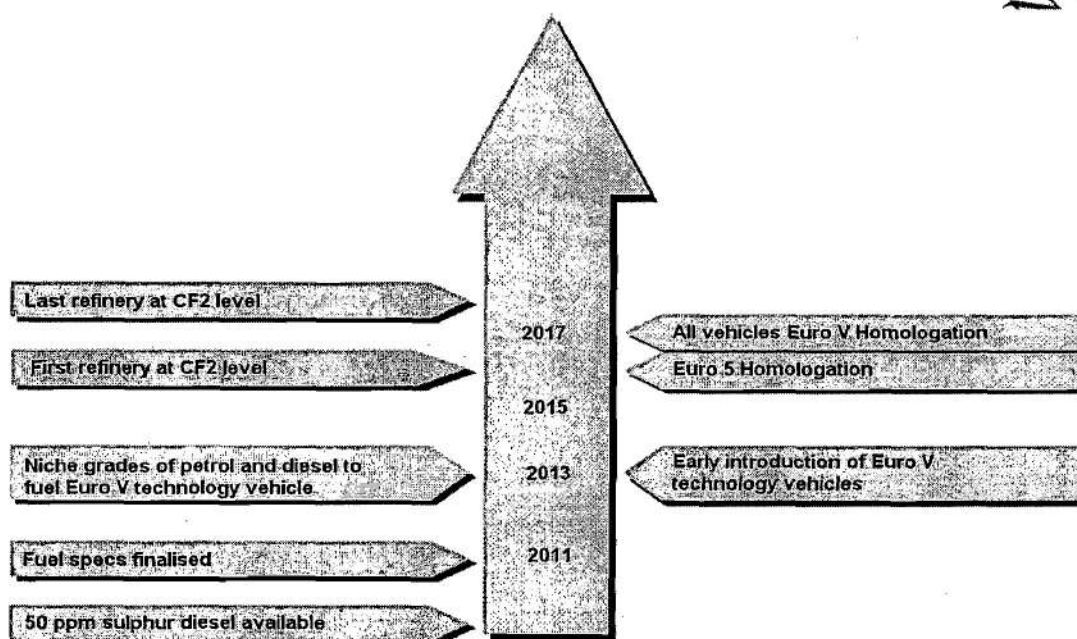
This Phase builds on the preceding phase and aims for a situation where, at least, one refinery has been upgraded to produce fuels compatible with Euro 5 emissions standard. Fifty (50) ppm diesel will become the standard grade and 10 ppm diesel will be the niche grade.

By legislation all refiners will be mandated to reconfigure their refineries to be in a position to produce fuels compatible with Euro 5 fuel specifications and standards by 2017. It is recommended that, at least, one refinery should be ready to produce such fuel well before 2017. This will be done as part and parcel of the scheduling of refineries to produce fuel that is compatible with Euro 5 emissions standard. A technical committee serving under the aforementioned Task Team will be formed to monitor the implementation process from the onset up until the conclusion of the programme.

#### 11.2.4. Phase 4

##### Period: 2017

This will entail having all refineries producing fuel compatible to Euro 5 emissions standard by 2017. It is envisaged that by this time all new homologated vehicles will have engine technologies that require fuel that is compliant with Euro 5 emissions standard. Hence all refineries will be required by legislation to produce fuels that meet Euro 5 emissions standard.



Summarised Road Map

## 12. Maintenance, monitoring and enforcement

Emissions control can also play a significant role in minimising the overall pollutant levels stemming from tailpipe exhaust systems. This could be attained either by retrofitting some form of emissions control system or by taking the old, non-complaint vehicles out of circulation since some of these vehicles were not designed to run on modern fuels. However, if enforcement and monitoring mechanisms are not properly adhered to, the whole legislation could be rendered ineffective. Government, through the Department of Transport (DoT), is planning to enforce the maintenance and vehicle testing of

vehicles. The proposed initiative by DoT envisages the implementation of periodic vehicle testing for motor vehicles with, at least, ten years of operation. These vehicles will undergo a roadworthy inspection each time their license disc expires. Through this process, vehicle owners will be required to produce a Certificate for Road Worthiness (CRW) before they can be allowed to purchase the licence discs. It is further proposed that emissions testing be conducted at the time when the vehicle owner rocks in for the renewal of the CRW.

### **13. Public awareness and education**

It is important that the public at large be informed about the latest developments regarding fuel specifications primarily due to the fact that they are directly affected by these changes. Public information has to be designed in order to raise awareness about the benefits of new fuel specifications.

### **14. Recommendations**

It is recommended that Minister of Energy introduces new specifications which, to a certain extent, will be equivalent to Euro 5 standard fuel by 2017 to decisively deal with harmful emissions from vehicles. This will take into cognisance that:

- At the UN Climate Conference in Copenhagen in December 2009, South Africa committed itself to reducing emissions by 34% by 2020 and by 42% in 2025, provided that technical and financial support is received from developed countries;
- There is a link between vehicle carbon emissions and fuel quality, instead of fuel consumption alone;
- Government does not require immediate compliance with the Euro 5 emissions standard but a phased approach.
- Vehicle engine technology requiring fuels that comply with Euro 5 emissions standard is already available.
- It is the view of the IDTT that piecemeal refinery investments by the industry without a clear ultimate target by Government could prove

expensive to the economy. It is their considered view that it would be prudent to make a once-off investment in a specific area of a refinery rather than several piecemeal investments that are cumulatively more expensive.

## 15. Conclusion

It is imperative that Government, in collaboration with the industry and other relevant stakeholders, should embark upon the CF2 programme in a phased manner in order to ensure that, by 2017, our liquid fuels are compatible with Euro 5 emissions standard and that these are produced and supplied in the South African market. This drive should holistically incorporate other strategic objectives of Government and this should be done without sacrificing the imperatives of energy security.

Issues contained in this document have to be discussed within the broader South African context, taking into consideration the political, economic, social, technological, environmental as well as legal conditions.

DRAFT POSITION PAPER FOR PUBLIC COMMENT

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