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**CONTENTS • INHOUD**

<i>No.</i>	<i>Page No.</i>	<i>Gazette No.</i>
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859 Energy Security Master Plan - Liquid Fuels .....	3	30285
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**DEPARTMENT OF MINERALS AND ENERGY**  
**DEPARTEMENT VAN MINERALE EN ENERGIE**

**No. 859**

**12 September 2007**

**ENERGY SECURITY MASTER PLAN – LIQUID FUELS**

I, Ms. Buyelwa P. Sonjica, Minister of Minerals and Energy, hereby issue the Energy Security Master Plan – Liquid Fuels, which elucidates South Africa's energy security strategy and includes the integrated energy modelling and planning approach, approved by Cabinet at its ordinary meeting held in Pretoria on 08 August 2007.



**the dme**

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Department:  
Minerals and Energy  
REPUBLIC OF SOUTH AFRICA

# **Energy Security Master Plan**

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## **Liquid Fuels**

## Abbreviations

ACSA	Airports Company of South Africa
AEO	Annual Energy Outlook
CCGT	Closed Cycle Gas Turbine
CTIA	Cape Town International Airport
CTL	Coal-to-Liquids
DME	Department of Minerals and Energy
DOE	US Department of Energy
EIA	US Energy Information Administration
FSSTT	Fuel Supply Strategic Task Team
GDP	Gross Domestic Product
GTL	Gas-to-Liquids
IEA	International Energy Agency
IEP	Integrated Energy Plan
ISEP	Integrated Strategic Electricity Plan
LFTT	Liquid Fuels Task Team
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
MTOE	Million tons oil equivalent
NEMS	National Energy Modeling System
NERSA	National Energy Regulator of South Africa
NIEMS	National Integrated Energy Modelling System
NIRP	National Integrated Resource Plan
NVE	Norwegian Water Resources and Energy Directorate
OCGT	Open Cycle Gas Turbine
OPEC	Organization of Petroleum Exporting Countries
ORTIA	Oliver Reginald Tambo International Airport
PPP	Public Private Partnership
SAPIA	South African Petroleum Industry Association
TPED	Total Primary Energy Demand

## Table of contents

Executive summary .....	5
1 Introduction .....	11
2 Energy security .....	12
3 Role of energy in the economy .....	16
4 Analysis of current situation .....	17
4.1 National perspective .....	17
4.2 International context .....	21
5 Desired end-state .....	22
6 Options to achieve supply energy security .....	24
6.1 Capacity - market matrix analysis .....	25
6.1.1 Competition in capacity markets .....	25
6.1.2 Competition for capacity markets .....	26
6.2 Price-based competition .....	26
6.3 Cost-based regulation .....	27
6.4 Preferred capacity expansion approach .....	27
7 International benchmarking .....	28
8 Evaluation of strategic options .....	30
8.1 Integrated energy security framework .....	30
8.1.1 Local manufacturing/production .....	30
8.1.2 Climate change .....	31
8.1.3 Standards and specifications .....	32
8.1.4 Crude oil sourcing and transportation .....	32
8.1.5 Import and export policies .....	33
8.1.6 Demand management .....	33
8.1.7 Energy infrastructure planning .....	34
8.1.8 Petroleum strategic stock .....	34
8.2 Short-term strategic options .....	35
8.2.1 Improvement of petroleum pipeline performance .....	36
8.2.2 Rail improvement intervention .....	38
8.2.3 Ports operational improvements .....	39
8.2.4 Storage depots improvements .....	41
8.2.5 Integration issues – short term .....	43
8.3 Medium- to long-term strategic options .....	44
8.3.1 NMPP .....	44
8.3.2 New refining capacity .....	46
8.3.3 Integrated energy modelling and planning .....	47
9 Recommended plan of action .....	52
9.1 The infrastructural recommendations: .....	52
9.1.1 Pipeline capacity constraints: .....	52
9.1.2 Port capacity constraints: .....	53
9.1.3 The proposed Multi Product Pipeline from Durban to Gauteng .....	53
9.2 Policy and governance recommendations .....	54
9.2.1 The proposed energy modelling and analysis agency .....	54
9.2.2 Local refining capacity to augment energy security .....	54
9.2.3 Importing of petroleum products .....	54
9.2.4 Improving Energy Efficiency .....	55

10	Conclusion.....	56
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### **Index of Figures**

Figure 1 - South African fuel demand patterns .....	18
Figure 2 - South Africa's demand supply patterns .....	18
Figure 3 - Inland pipeline supply capability .....	20
Figure 4: Capacity-Market Matrix.....	24
Figure 5 - Inland Market Demand for Coastal Supply of Refined Products .....	36
Figure 6 - Bridging plan opportunities .....	37
Figure 7: Current Rail Transportation and Future Road Usage .....	38
Figure 8 - Durban port capacity profile.....	40
Figure 9 - Existing depot capacity.....	42
Figure 10: Eskom's OCGTs fuel demand variation with increasing load factors .....	43
Figure 11: Forecast Liquid Fuels Supply shortfall for South Africa .....	46
Figure 12: Interactions between planning, modelling and coordination functions.....	47

## Executive summary

Energy is the blood that runs through the veins of every economy. It is to the survival of an economy what water is to the survival of the human body. The extent of the dependence on energy of any economy is dependent on the structure of that particular economy and the level of development of the economy and country. In some economies, availability is the only real concern whilst in others it is sustainable availability as well as affordability. The different country specific needs have to be included in the definition of the country's energy security.

The definition that has been deemed appropriate for South Africa is "*Energy security means ensuring that diverse energy resources, in sustainable quantities and at affordable prices, are available to the South African economy in support of economic growth and poverty alleviation, taking into account environmental management requirements and interactions among economic sectors.*"

The South African economy, as well as the country's level of development, is heavily dependent on the availability of affordable energy carriers. In the case of liquid fuels, based on a study on strategic stocks conducted by the Department of Minerals and Energy in 2006, it was estimated that the economy would, in the case of total fuel supply disruption, lose **at least R925 million a day** (at 2005 prices), raising a fundamental question regarding the role of government in ensuring security of supply.

This definition supports the energy security framework that is herein proposed and forms part of the Energy Security Master Plan. In the short-term, the Master Plan focuses on developing supply chain solutions to South Africa's liquid fuels supply challenges, management of liquid fuels demand and emergency response tactics. The long-term approach is broader and begins to integrate supply, demand, macroeconomics, geopolitics and climate change. It further seeks to allow for the making of well-informed choices in respect of energy supply, energy carriers, demand sector strategies, as well as energy transformation approaches, cognisant of the need to minimise negative impacts on the environment and the economy. Due to its

complexity, the medium to long-term part of the Master Plan demands extensive modelling capability.

Fuel shortages of 2005 and projected challenges coming out of studies conducted since then, coupled with blackouts and brownouts that have plagued the electricity supply industry, have made it necessary for South Africa to join a great number of countries and change its approach to energy security. In the past few years, and perhaps also in the few more years to come, the major concerns of the G8 countries have centred on energy and its related issues. It is for these and other reasons that the Department has formulated this Energy Security Master Plan. The intended outcomes of the Master Plan are to-

1. In the short term, secure adequate supplies of affordable energy for continued economic growth and development;
2. In the medium term, enable policy- and decision- makers to make informed decisions on these complex inter-dependent energy outcomes; and
3. In the long term, ensure that the strategic planning and subsequent growth and development are sustainable.

In securing energy, a number of options are available and different countries have, over time, adopted different approaches to energy security. In evaluating an appropriate approach, care should be taken to understand the special situation prevalent in each country. Many countries have indicated that they let the market set the price but upon further investigation, it has emerged that in some cases the participants in that market are in fact state-owned entities.

There are essentially two possible approaches to achieving energy security, namely: market signalling or central energy planning. After careful analysis of South Africa's unique situation, it has been recommended that the central planning or coordination approach be adopted. The term central planning here has been used loosely to imply maximum participation of a number of stakeholders in the design of demand and



supply sectors and should never be read as meaning “central government planning” per se.

Taking that view into consideration, a number of strategic options are proposed. The proposed strategic options can be split into two distinct groups, one focusing on the short to medium term interventions and the other focusing more on the medium to longer-term interventions. The short to medium term interventions are essentially infrastructural in nature (and largely security of supply driven) and the long-term interventions more policy and modelling oriented.

The proposed strategic options are listed below:

1. In respect of the manufacturing of petroleum products, it has been recommended that the local production of finished petroleum products be promoted, and specifically, that at least 30% of finished products be manufactured from indigenous raw materials;
2. It is critical that climate change be considered as an important component of integrated energy planning and should therefore be incorporated in the energy modelling process. The incorporation will require data collection and climate change monitoring;
3. There is a need for alignment of our fuels specification and other standards (including housing and building standards) to at least those countries that trade with South Africa. To ensure security of supply, it would therefore be recommended that global fuels specifications be adopted. Such an approach would also ensure that South Africa does not become a “dumping ground” for all low grade fuels;
4. South Africa sources, through private players, more than 80% of its crude oil supply from Iran and Saudi Arabia, putting the country in a precarious position. In order to manage risks associated with such positions, it is therefore recommended that 30% of all crude consumed in South Africa be procured through PetroSA and that South Africa, through its national oil company, acquires its own crude vessel;

5. In the bid to support promotion of local production of liquid fuels, it is recommended that a policy of limited imports be re-endorsed;
6. A major part of energy security is managing the energy demanded by all sectors in the economy. It is therefore recommended that as part of the Energy Security Master Plan, energy efficiency be strongly promoted in all energy consuming sectors of the economy. The energy demand management approach should also include appropriate selection of energy carriers for different applications. At the centre of demand management however are appropriate demand sectors' strategies, starting from the industrial strategy through to appropriate transport strategies. Indications are that oil will run out sooner rather than later and a transport strategy that is over 90% dependent on oil is guaranteed to land South Africa in serious trouble in a few years time. No form of planning will find South Africa oil, when it has all been mined or acquired by those with more might or insight;
7. Problems in the petroleum sector have indicated the need for some level of coordinated planning of infrastructure investments, as it is done in some economies, irrespective of whether it is the state or the private sector making such investments. It is therefore recommended that an "independent energy planning coordinator" be considered;
8. Liquid fuels require some level of redundancy in the system to ensure security of supply of energy. The cost of fuel shortages on the economy has been conservatively estimated at 273 c/l, whilst the cost of such insurance is about 13c/l. In the case of liquid fuels, the approval of such a policy is a subject of a separate approval process, but in considering the energy security framework, it is important to note that the Master Plan is incomplete without strategic reserve considerations. The only way of resolving the problems presented by the peak demand operation of OCGTs in South Africa is through keeping significant petroleum stocks, which could well be higher than those kept for all other operations in South Africa;

9. When it comes to infrastructure investments in the South African liquid fuels sector, in the next 5 years, the single most important recommendation is the approval of a new appropriately sized, properly integrated pipeline, which should come on line in the 2<sup>nd</sup> quarter of 2010 at the latest. For a number of reasons, some practical and others strategic, it is recommended that Petronet builds such a pipeline. The approval of Petronet's NMPP project also seeks an additional approval to make the project work, which is that a maximum of 1c/l security of supply levy be allowed to fund redundancy in the pipeline;
10. In the interim, even with minor modifications in pipeline operations, without improvements in rail operations, the inland region can never be "*kept wet*". It is therefore recommended "block trains", each of which consists of 32 rail tanker-cars, for example, be used so as to improve Spoornet's turn around times from an average of 14 days to a more acceptable global best practice of 4 days for equivalent distances;
11. To address challenges identified at ports and allow optimum utilisation of petroleum handling facilities at the port, it is recommended that the management of the back of the port operations be consolidated under an independent operator. An independently operated port handling facility will also promote access for new participants. Furthermore, the introduction of the bigger NMPP project will demand coordination for optimal operation, which is currently a risk for the NMPP;
12. In order to address the concerns raised in the Moerane investigation, it is recommended that oil industry participants be obliged to hold 28 days commercial stock, which will be paid for by consumers of petroleum products. This requirement is also applicable to ACSA, which holds the stock on behalf of the airline industry, and Eskom for its OCGT operations. These companies shall bear the costs of holding their stocks. The cost of this insurance is expected to be in order of 4c/l, allowing for the installation of new capital and building stocks to the required level. This recommendation is not covered in

detail in this document as it is a subject of another strategy document that will be circulated soon; and

13. Last, but perhaps most importantly, is the development of South Africa's ability to develop properly thought-out energy plans, as well as a tool for evaluating proposed energy policies. Considering that a deliberate effort is required to ensure coordination, there is an urgent requirement to develop an integrated energy modelling capability, which would be instrumental in the development of energy plans and evaluation of options that are proposed by policy-makers. This also implies a clear definition of roles for various players. One of the important areas in this regard is the responsibility for managing the data and models that are used in planning. It is recommended that the approach used by the US Department of Energy in the form of the "*energy information administration*" approach be adopted in South Africa.

## 1 Introduction

In discussing the concept of energy security, it is important to understand that it encompasses a complex wave of policy understanding. It requires the understanding of energy demand, energy supply, national and international relationships. It also requires looking at energy in an integrated manner because of competition amongst various forms of primary energy sources and different energy carriers. It is easier for most economies to view energy security from one dimension, which is mainly supply focused. However energy security has many facets. And energy security can be achieved in the short and long term only if it is viewed strategically from different perspectives. Such perspectives range from the understanding and selection of appropriate industrial & development strategies, growth strategies, spatial layout plans, transport strategies, standards, technologies, partners and energy supply options amongst others.

Despite the complexity and level of development of a country's economy, lack of energy could lead to stagnation, slowing down or total collapse thereof. Recent experiences with blackouts, brownouts and fuel shortages in South Africa and abroad have shown the vulnerability of world economies to energy shortages. Most of the common and affordable energy supply options have serious "side effects," for instance uncharacteristic climate changes are being attributed to the dependency on hydrocarbons for energy supply. In considering energy security it is therefore necessary to investigate ways of mitigating against climate change as well as understanding and adapting to climate changes.

Even though this strategy document marks the beginning of a process aimed at integrating all energy supply options and carriers with various demand sectors, its primary focus is liquid fuels.

## 2 Energy security

Energy security is about ensuring supply of energy through understanding and managing demand as well as supply chains in a manner that is economically, socially and environmentally sustainable. However, there is no single way of achieving energy security because countries or regions typically adopt various ways based on whether they are net importers or exporters of energy.

Net exporters' view of energy security is centred on their ability to secure markets, as well as use "petrodollars" to diversify their economies. As noted in the IEA's World Energy Outlook 2005: *"Concerns among consuming countries about security of supply are matched by concerns among producing countries about security of demand. Consuming countries will continue to seek to diversify their energy mix, while producing countries will continue to seek to diversify their economies."*

The International Energy Agency (IEA), which primarily represents the energy security interests of the Organisation of Economic Co-operation and Development (OECD) countries, which are mainly net importers, emphasizes *"diversity and transparency to ensure security is provided at an acceptable price and quality of service"* defines energy security as: *"access to a sufficient amount of reliable energy at an acceptable price"*.

Yet another view of energy security is based on defining the problem as essentially economic in nature: *"For all conceivable future world oil market conditions, the potential costs of oil dependence to the US economy will be so small that they will have no effect on our economic, military or foreign policies."* This view developed in the US in response to intentions by successive administrations to completely eliminate oil imports or consumption through for instance the use of Biofuels as substitutes. As a result, the approach that has evolved over the years consists of an eclectic mix of policy options, which include *"the management of the US's Strategic Petroleum Reserve (which by the way is largely maintained on the basis of oil imports), the raising of fuel environmental standards, increased use of Biofuels, as well as increased local supply through production from the Arctic National Wildlife Refuge and the exploitation*

*of coal-to-liquids (CTL) and carbon sequestration technologies*". The key driver of the US energy security is to shield the US from the effects of high prices and supply disruptions.

The World Bank's definition of energy security takes into account the need to provide access to modern energy services as a means to alleviate poverty and states that *"energy security means that a country can steadily produce and consume energy at reasonable prices in order to promote economic growth and, by doing so, to reduce poverty and directly improve the population's living standards by expanding access to modern services in the energy sphere"*.

As can be discerned from the foregoing, the traditional definition of energy security has two principal elements, namely physical security (i.e. supply and demand security), and socio-economic considerations (e.g. 'reasonable prices', 'economic growth' and 'poverty alleviation'). With the advent of issues related to climate change playing an increasing role in policy decision-making, a definition that seeks to be more integrative is one espoused by the World Energy Council (WEC), which emphasizes **energy sustainability** by asserting: *"energy sustainability...embraces access, reliability and security, and environmental impacts."* As can be seen, this definition takes into account the complex, and often-conflicting requirements associated with the management of climate change while addressing energy security concerns.

Considering the various approaches outlined in the foregoing, as well as the increasing level of convergence among economic sectors, the following definition of energy security is proposed for South Africa's policy purposes:

***"Energy security means ensuring that diverse energy resources, in sustainable quantities and at affordable prices, are available to the South African economy in support of economic growth and poverty alleviation, taking into account environment management requirements and interactions among economic sectors."***

The various elements of the definition are explained as follows:

- *diverse energy resources*: this part creates a link between this definition and the policy stance that predicates energy security on diversification, as expressed in the Energy White Paper (1998);
- *sustainable quantities*: this seeks to create an implicit link between supply and demand, through the use of the term 'sustainable'. By definition, this also includes efficiency in both production and consumption, as well as economic viability;
- *affordable prices...economic growth and poverty alleviation*: this further seeks to create a link between supply and demand, by fostering security of demand through ensuring affordability, a key consideration given the challenge of poverty alleviation. The focus on economic growth seeks to position energy as a strategic input to a resource-intensive South African economy;
- *environment management requirements*: considering the effect of energy on the environment, and vice versa, it is important that the often conflicting impacts are managed in a balanced manner. This may also include managing the dichotomy of ensuring affordability while attempting to internalise the environmental cost associated with conventional energy production and consumption, as well as introducing cleaner alternatives; and,
- *interactions among economic sectors*: this seeks to emphasise that an integrated approach is required, taking into account the convergence between such sectors as electricity and liquid fuels, between liquid fuels and agricultural commodity markets, as well as impacts on other economic sectors' competitiveness.

This definition supports the energy security framework that is proposed in section 8.1 herein. In the short-term, the Master Plan focuses on developing supply chain solutions to South Africa's liquid fuels supply challenges, management of liquid fuels demand and emergency response. The long term approach however is broader and seeks to



integrate supply, demand, macroeconomics, geopolitics and climate change without excluding supply chain issues. It further seeks to allow for making of well-informed choices of energy supply options, energy carriers options, demand sector strategies as well as energy transformation approaches that will minimise negative impacts on the environment and the economy. Because of its complexity, the medium to long-term part of the Master Plan demands extensive modelling capability.

### 3 Role of energy in the economy

Energy is fundamental to any country's economy, firstly because it tends to be a large input cost into the economy, but more importantly because without energy "the wheels of the economy" literally do not turn. For an economy to employ capital and labour it needs some form of energy, the extent and type of which is dependent on a country's economic structure. Energy is therefore an enabler for economic growth and stability. Energy also contributes significantly to human development. An example in this regard is a World Bank<sup>1</sup> report that showed that there is a correlation between access to energy and human development. To a large extent the cost and availability of energy determines the competitiveness of an economy and the cost of living for a country's ordinary citizens.

Key sectors in the South African economy, namely manufacturing, wholesale & retail trade, hotels and restaurants, transport, storage and communications, mining and quarrying, construction, agriculture, forestry and fishing, which contribute about 59% of the country's GDP, are dependent to a greater or lesser extent on energy. A study on strategic stocks conducted by the DME showed that without petroleum products, the economy would lose at **least R925 million a day** (at 2005 prices). This raises a fundamental question regarding the role of government in ensuring energy security.

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<sup>1</sup> *World Bank Group's Energy Program Poverty Alleviation, Sustainability, and Selectivity*, Topical Briefing to the Board of Directors on Energy, May 2001.

## 4 Analysis of current situation

### 4.1 National perspective

The South African liquid fuels industry has undergone massive structural changes, and is still set for more changes in preparation for its eventual liberalisation and final integration with global markets. During December 2005, ahead of the introduction of cleaner fuels, South Africa experienced a series of interruptions to fuel supplies. There were stock-outs at many locations throughout the country, including shortages of jet fuel at Cape Town International Airport (CTIA). These supply interruptions negatively impacted many sectors of the economy with the severity of the hardship ranging from relative consumer inconvenience to loss of business and reputation damage.

This led to questions been asked as to the economic impact of disruptions incurred by the country. As recorded in a report on petroleum strategic stocks: *"In this context we evaluate the potential downside to the economy if no liquid fuels were available to the various sectors in the economy. By following a conservative approach we quantify the downside to be approximately R 925 million per day in 2005 terms of Gross Domestic Product (GDP) equivalent value over time"*

South Africa is a net importer of oil with approximately 70% of the market demand being met through either imported crude or imported refined products. Fuels produced from indigenous sources satisfy the balance of the demand. South Africa currently sources approximately 80% of its crude supplies from the Middle East, 12% from West Africa and the balance from its own crude production and other regions. There is also refining infrastructure to ensure conversion of feedstock to refined products.

The major demand for fuels lies within the Durban – Gauteng corridor that consumes about 68% of the country's fuel followed by the Cape Town and Eastern Cape areas (see Figure 1). Although South Africa has traditionally met most of its fuel demand through locally manufactured products, it is clear from Figure 2 that from this year onwards the need for imported products will increase if the current economic conditions prevail and the economic and fuel demand projections are realised.

Figure 1 - South African fuel demand patterns

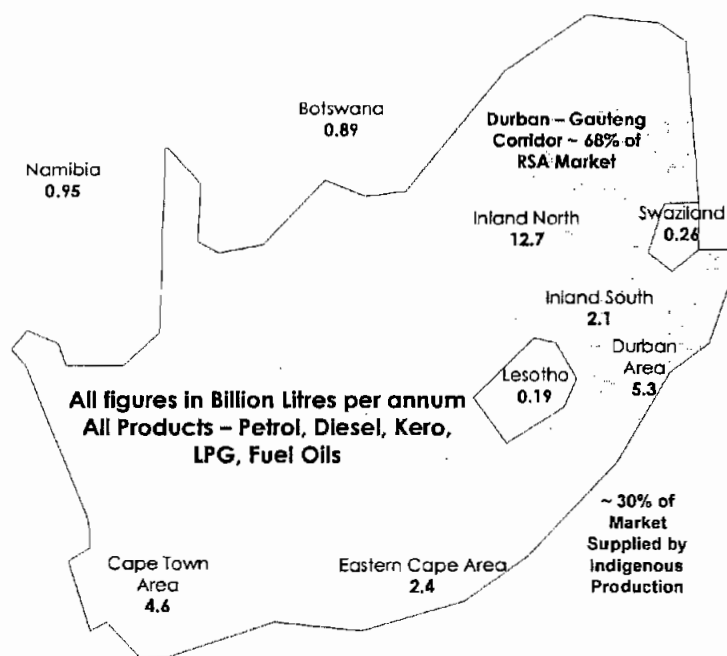
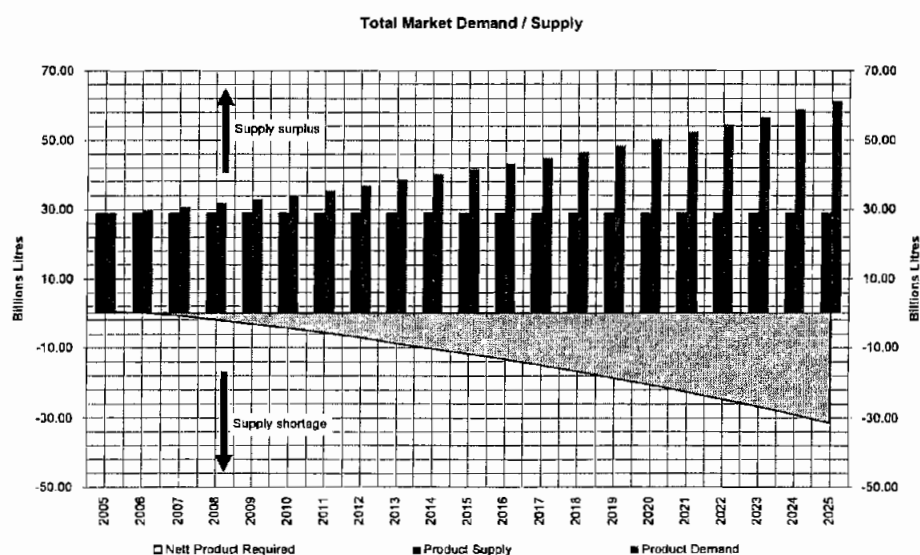


Figure 2 - South Africa's demand supply patterns



The 1990's were characterised by low international economic growth rates, punctuated by crises such as the 1998 stock market crash and the Asian economic meltdown. South Africa did not escape these adverse economic conditions. This low economic growth combined with international refining overcapacity, resulted in low

crude and petroleum product prices. These factors negatively impacted on Industry profitability and consequently investment in both production and logistical infrastructure. Current high economic growth rates, although most welcomed, have caught most participants unprepared, resulting in the inability to respond fully to a sudden increase in demand for petroleum products, which both drive and are driven by economic growth.

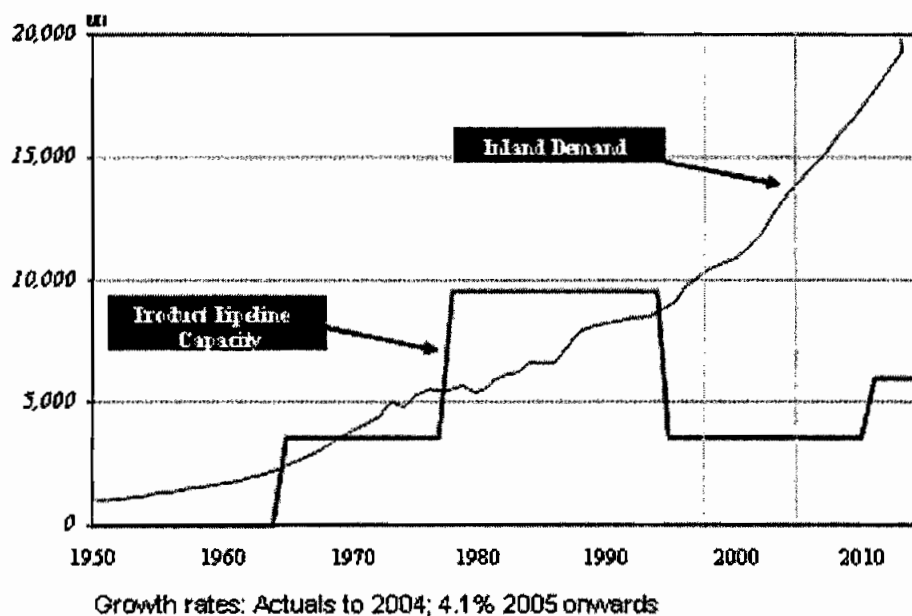
The growth in the demand for liquid fuels is happening in an industry that is undergoing major structural changes, some of which are listed below without detailed discussion. Most of the changes are well documented in the findings of the Competition Tribunal on the "***proposed joint venture / merger between Sasol Limited, Engen Limited, PETRONAS International Corporation Limited and Sasol Oil (Pty) Ltd,***" CASE NO: 101/LM/Dec04.

The key changes are-

1. The termination of Sasol's main supply agreement with the rest of the oil industry. Whilst the agreement was in place, the need for transportation of petroleum products in-land from the coast was limited, but since the termination, only the amounts that other companies cannot transport from the coast is bought from the inland refineries, putting tremendous pressures on the inland's limited logistical infrastructure;
2. Petronet and Sasol signed a new contract committing the so-called Lilly pipeline to gas transportation from the Secunda to the coast, thus constraining the additional capacity that could have potentially been available to transport liquid fuels from the coast to inland. The major challenge in this regard is that the inland market for petroleum products is over 12 billion litres per annum and the capacity of the current pipeline is only 3.5 billion (see Figure 3). If anything happens to inland refining capacity, the industrial hub of South Africa's supply is immediately threatened; and
3. In a bid to reduce the negative impacts of liquid fuels on the natural environment, as well as safety and health, South Africa introduced changes to its fuel specifications in 2006. Further changes to fuels specifications are

planned for the future, which have to be in line with the global standards, especially taking into account the requirement for compatibility during periods in which dependence of imported product is high.

Figure 3 - Inland pipeline supply capability<sup>2</sup>



The petroleum products logistical infrastructure is taking a major strain especially in the areas that are listed below:

1. *Harbours*: Limited fuel offloading infrastructure severely curtails the ability to import product shortfalls;
2. *Oil Companies' Depots*: limited on-loading and offloading infrastructure, as well as limited storage capacity, not only limits the ability of the industry's value chain to absorb supply shocks, but also impacts negatively on the operations of both petroleum pipelines and rail;
3. *Inland transport*: both petroleum pipeline and rail infrastructure are, without major changes, severely constrained in the immediate and medium terms;

<sup>2</sup> Source: Competition Tribunal hearings on Sasol-Engen Merger, January 2006

4. *Liquefied petroleum gas (LPG) supply:* Traditionally LPG in South Africa has, due to high prices and hence limited demand, been supplied only from local refineries. The resulting limited importing capability, coupled with limited LPG storage capacity at refinery level, has left South Africa exposed to significant stock shortages in the event of future demand growth; and
5. *Airports:* The situation at South African Airports presents serious threats to South Africa's fledgling tourism industry. Most of the major airports in South Africa are operating with stock levels of a maximum of 5 days; when global best practice is over 30 days. This means that any slight unplanned refinery outage can potentially result in planes being grounded<sup>3</sup>

## 4.2 International context

The growing demand for energy resources is causing an international rush to secure supplies. The problem is further compounded by resources that are concentrated in a small number of countries, which also tend to be perpetually plagued by geo-political tensions. These areas supply the majority of world oil supplies. Crude oil production has also been found to have peaked in non-Opec countries.

Without appropriate energy demand and supply planning, South Africa and the world over could, in less than 50 years, find itself with cars and beautiful freeways but on a road to nowhere. An integrated energy plan has to include appropriate transport planning, town and district planning, standards, industrial and growth strategies, technologies, foreign partners, energy supply options and other developmental strategies.

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<sup>3</sup> If this possibility was realised, indications are that there is not enough space in South African airports to park all airplanes that are, at any onetime, heading for or in South Africa. The situation in South Africa is worsened by our geographic location and the fuel supply situation in our neighbouring states.

## 5 Desired end-state

As can be seen in sections 8 and 9, this document primarily adopts a bias towards options and plans for consideration in addressing *security of supply* concerns in the short-term. However, and as alluded to in the aforementioned sections of the document, it is important to note that the end-state is one in which *energy security* is a key policy driver, which implies an approach that ensures that aspects such as *security of demand, socio-economic, climate change issues* as well as *geopolitical considerations* are taken into account in a comprehensive manner.

The Energy Security Master Plan is intended to achieve multiple objectives in the next 3 to 15 years. The underlying principle of the strategy is to ensure that the economy continues to grow in a sustainable and shared manner. In the short- to medium-term, energy security means that the energy demands of the economy are going to be met in a cost effective manner, without undermining growth and development.

The objectives of the Master Plan are therefore to-

- Ensure that South Africa has access to reliable, affordable, clean, sufficient and sustainable sources of energy to meet the country's demand;
- Create an environment that encourages investment into energy infrastructure;
- Ensure that there are stable/affordable energy prices;
- Ensure that in the design of the energy demand sectors, like transport, due regard is given to continued availability of particular energy sources;
- Ensure that there is an integrated government wide approach to dealing with energy;
- Promote diversity in the supply of energy;
- Reduce energy usage through energy efficiency interventions;
- Promote a competitive South African economy; and
- Ensure that all stakeholders are prepared to deal with any supply disruptions that may occur.



The achievement of security of supply is predicated on a number of factors, including the ability of industry suppliers to provide the required capacity and outputs, on the one hand, and the affordability of such capacity and outputs by customers on the other hand. The intended outcomes of the Master Plan are therefore to-

1. In the short term, secure adequate supplies of affordable energy for continued economic growth and development;
2. In the medium term, enable policy and decision makers to make informed decisions on these complex inter-dependent energy outcomes; and
3. In the long term, ensure that the strategic planning and subsequent growth and development are sustainable.

## 6 Options to achieve supply energy security

A number of options of countries have, over time, adopted different approaches to energy security. In evaluating an appropriate approach, care should however be taken to understand the special situation prevalent in each country. Many countries have indicated that they let the market set the price but upon further investigation, it is quickly observed that the participants in that market are in fact state-owned entities. There are essentially two possible approaches, namely: **market signalling** or **central planning**.

A simple but useful tool for analysing the options in respect of security of supply is the capacity-market matrix, which is illustrated in Figure 4.

Figure 4: Capacity-Market Matrix

	<b>Competitive market</b> (“Board-room wars”)		
<b>Static capacity utilisation</b> (“existing operations”)	<b>Price-based competition</b> Market-share focus Market-driven productivity ‘Make or buy’ indifference	<b>Competition in capacity markets</b> Capacity lags demand Rising price as signal Capacity creep <sup>4</sup> as response	<b>Dynamic capacity creation</b> (“new investments”)
	<b>Cost-based regulation</b> Asset-base focus Bench-marked productivity ‘Make’ is the difference	<b>Competition for capacity markets</b> Demand lags capacity Rising opportunity cost as signal Capacity expansion as response	
	<b>Regulated market</b> (“Court-room wars”)		

As can be seen from this illustration, the horizontal axis represents a continuum of options for making capacity available. The one end represents the ‘utilisation of capacity’ (i.e. existing operations), while the other end the ‘creation of capacity’ (i.e.

<sup>4</sup> Increased capacity as a result of a large number of small projects

new investments). These options broadly represent improving operational efficiencies (assuming no new investments but providing for refurbishments), and undertaking green-field investments or major brownfields investments (capacity additions), respectively.

The vertical axis represents a continuum of options for organising a sector. The one end represents a 'Competitive market', while the other represents a 'Regulated market'. Due to competition among the participants, the former option is also described as 'board-room wars', while the tendency of the latter to be litigious is the reason for the description 'court-room wars'. Based on these axes, the possible combinations are discussed in the sequel. The decision regarding which option, or combination of options, is suitable depends on the merits of each situation, the maturity of the sector, as well as policy imperatives.

## **6.1 Capacity - market matrix analysis**

### **6.1.1 Competition in capacity markets**

This quadrant represents a scenario wherein capacity is made available as a result of a competitive capacity markets. Some of the key characteristics of this scenario include the tendency for capacity additions to lag demand since participants wait for sustainable price increases before committing to new investments. As an additional way of mitigating risk, such capacity additions are done incrementally, in small steps, over a period of time – hence the term 'capacity creep'. An example is the aggregate increase in US refining capacity of approximately 1% per annum over a period of 10 years that resulted from a number of small refinery projects in that country.<sup>5</sup> Major investments in this case require massive price increases to militate against investment risks. The key question that has been asked in many quarters is: how high would governments allow prices to rise before intervening on behalf of a country's citizen's and economy?

*This is a classical market solution or price signal approach!*

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<sup>5</sup> White Paper on Refining Capacity (Source: [www.ftc.gov](http://www.ftc.gov))

### 6.1.2 Competition for capacity markets

This quadrant represents the scenario in which a competitive process is followed in granting a participant the right to create capacity to service a market. Although the outcome is not a competitive market, the process leading to capacity expansion is competitive, albeit managed or regulated. This scenario has a number of variations, ranging from capacity auctions<sup>6</sup> to private-public partnerships.

The scenario is characterised by the expansion of capacity ahead of demand, using the opportunity cost of disruption to supply as a basis. Due to the potential over-capacity that may result, it is imperative that the pricing and contractual arrangements associated with this scenario provide for the recovery of capital costs, as well as guarantee revenue for the successful concessionaire.

An example in this case is the DME's IPP process, in terms of which the DME went out on public tender to procure peaking generation capacity. Even though in this case Eskom was not allowed to tender, it could be argued that there would not have been anything wrong with the incumbent participating in this process. If anything, an approach such as this, if designed and implemented properly, could allow the innovations of potential new entrants to force the incumbent to 'earn its keep', and thus produce an efficient outcome, regardless of who wins the concession. A similar approach may be followed for pipeline and refining capacity additions.

This approach requires some form of central or "coordinated" planning. The major variation to this approach of course is investment by a state-owned entity.

## 6.2 Price-based competition

This quadrant represents a scenario in which capacity is made available through price-based competition. In this scenario, the focus for participants is on gaining market-share, through primarily self-imposed productivity improvements. Such productive improvements allow the participants to lower prices, with the expectation that the

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<sup>6</sup> Considered useful in increasing efficiency and security of supply (customers), providing better signals to guide investments (pipeline owners) and creation of certainty a number of years ahead of additional production (producers or wholesalers) that firm access to pipelines will be available. Source: Developing a more efficient gas pipeline network: long-term entry capacity auctions ([www.ofgem.gov.uk](http://www.ofgem.gov.uk))

increased market-share will compensate for the reduction in margins. Participants in this scenario also tend to be 'indifferent' to whether they produce outputs themselves or procure them for reselling, their main focus being either maintaining or growing market-share. A good example in this regard is the airline industry, especially in respect of the entry of budget carriers.

*This scenario is only applicable in an over capacity situation!*

### **6.3 Cost-based regulation**

This quadrant represents a scenario in which capacity is made available through cost-based regulation of existing operations. In this scenario, earnings are function of a robust asset-base, which provides the opportunity to earn a guaranteed return. Further gains are achieved from 'bench-marked' productivity improvements, which are imposed by regulators. Participants in this scenario tend to focus on 'making' their own outputs, since cost-recovery is generally guaranteed through regulation.

*This scenario is also only applicable in over capacity situation.*

### **6.4 Preferred capacity expansion approach**

Of the two capacity expansion approaches that are represented by the capacity - market matrix analysis, only the second option seems to be available for South Africa's energy capacity expansion. The key risk in this regard, whether it is the private sector or the state investing in capacity expansion, is a possibility of over investment. *Because of the role played by energy in the economy, one would argue that over capacity, or investment-leading demand is a price that an economy would be prepared to pay for a strategic commodity like energy.* It is on this basis that proper integrated planning, supported by proper energy modelling tools, is being recommended.

## 7 International benchmarking

On the basis of visits undertaken by the DME to the US and Norway, a benchmarking exercise, based on a selected number of key dimensions, was performed and is summarised in Table 1.

Table 1: Benchmarking - US and Norway

Dimension	US	Norway
Energy security	<ul style="list-style-type: none"> <li>• Key driver of national security and foreign policies.</li> <li>• Drive to develop alternatives to fossil-based energy and improve energy efficiency.</li> <li>• Petroleum Reserve plays an important role in securing energy.</li> <li>• Energy security defined as economic issue – therefore focus is to ensure that economy is not vulnerable to supply shocks and/or high prices</li> </ul>	<ul style="list-style-type: none"> <li>• A market-based approach is followed, for instance, the use of prices to manage electricity supply and demand.</li> <li>• Increasing concerns about energy security, as a result of increasing level of electricity imports.</li> </ul>
Legislative support	<ul style="list-style-type: none"> <li>• Act setting up EIA as an independent, single Federal Government authority for energy information.</li> <li>• Act providing for international energy co-operation and emergency responses.</li> <li>• Act focusing on greenhouse gases, alternative fuels and purchases of uranium.</li> </ul>	<ul style="list-style-type: none"> <li>• White Paper on Security of Supply</li> <li>• Water resources management legislation in support of hydropower.</li> <li>• Regulations pertaining to energy planning to address coordination of decentralised planning.</li> <li>• Act providing for the government to take hydropower facilities on licence expiry.</li> </ul>
Energy information	<ul style="list-style-type: none"> <li>• Mandatory submission of energy information to EIA.</li> <li>• Existing sources of information used (e.g. Census information)</li> <li>• Publication of AEO, AER, more frequent reports (e.g. monthly energy outlook) and ad-hoc analysis for</li> </ul>	<ul style="list-style-type: none"> <li>• Role played by policy and regulatory authorities is primarily information provision.</li> <li>• Publication of an updated energy outlook taking into account imports/exports and grid operations.</li> </ul>

Dimension	US	Norway
	Congress.	
Organisational	<ul style="list-style-type: none"> <li>• Even though independent in terms of its legislative mandate, EIA is organisationally part of the DOE.</li> <li>• EIA focuses on modelling only, other parties, including governments, do planning.</li> <li>• Partnerships with universities, private companies, and other external.</li> <li>• Combination of state-owned and private utilities in electricity.</li> </ul>	<ul style="list-style-type: none"> <li>• Planning undertaken locally, regionally and nationally</li> <li>• Deep state involvement, in policy-maker (e.g. MPE), regulation (i.e. NVE), owner (e.g. Statnett SF and Statkraft), coordinator (e.g. managing transmission system) and investment facilitator (e.g. ENOVA SF).</li> </ul>
Systems	<ul style="list-style-type: none"> <li>• NEMS used for integrated modelling at federal level</li> <li>• Additional systems used for specific applications (e.g. district heating planning, transmission system control, etc)</li> </ul>	<ul style="list-style-type: none"> <li>• A number of disparate systems in use historically.</li> <li>• An integrated modelling system for grid operations and electricity market finalised.</li> </ul>

Ireland's Energy White Paper was reviewed and it can be concluded that energy security is central to Ireland's energy policy.

## 8 Evaluation of strategic options

The strategic options that have been considered for implementation are split into short- to medium- term, and medium- to long- term. In the short-term, the focus is on infrastructural interventions, while in the long-term, policy-related interventions and the development of modelling capability is highlighted as the required enabling factors.

### 8.1 Integrated energy security framework

An integrated energy security framework is not only about supply or demand but is a system. To be able to deliver energy security, focus on the following areas is required. It must be noted that these policy positions are discussed in no particular order of importance:

#### 8.1.1 Local manufacturing/production

South Africa currently meets 30% of its liquid fuels demand from synthetic production supported by abundant coal resources and offshore natural gas and condensate production. Sasol uses both the Coal-to-Liquids (CTL) and Gas-to-Liquids (GTL) technologies to produce up to 150,000 barrels per day (bbl/d) equivalent of product. The Petroleum Oil and Gas Corporation of South Africa (PetroSA) produces 45 000 bbl/d of synthetic products using GTL technology. The driver for production of petroleum from indigenous sources in the past was one of mitigating the effect of sanctions. In support of energy security and the balance of payments, there is still a need for the maintenance of a certain level of production from local sources. Although a level of 50% production from local sources would be an ambitious target, ***maintenance of current level of 30% is recommended.***

South Africa has, next to Egypt, the second largest refining capacity in Africa. Major refineries include Sapref (184 000 bbl/d) and Enref (125 000 bbl/d) in Durban, Calref (100 000 bbl/d) in Cape Town, and Natref (108 000 bbl/d) at Sasolburg. Up until



recent, South Africa has been importing cheaper lower grade<sup>7</sup> crude oil, refining it in South Africa. Despite that finished product imports might land in South Africa slightly cheaper than the basic fuels price (BFP<sup>8</sup>), they will still cost the economy a lot more than products manufactured in South Africa from cheaper crudes. Other than the cost to the economy, in terms of balance of payments, crude oil is more readily available in the global market than finished products of appropriate grade.

Security of supply can therefore be better served through crude imports rather than product imports. Liquid fuels, being globally traded commodities, are subject to global prices and therefore any expectation that South African produced petroleum products could be cheaper than imported products is baseless. It would therefore be expected that, during difficult refining times, South African product prices would track global prices. The only difference with local production is that supply can still be guaranteed, as was the case during Hurricane Katrina in the USA. As part of energy security ***promotion of local production*** is therefore considered prudent.

In the past and (to a great extent) in the present<sup>9</sup>, local production has been supported by a petroleum products import policy that allowed only parties that had production capacity in South Africa to import petroleum products. In order to promote local production of petroleum products and reduce reliance of imported finished products, it is recommended that the current practice be retained.

### 8.1.2 Climate change

Climate change, greenhouse gases and economic development are intricately linked both in the short and the long terms. In the short-term, South Africa cannot sacrifice its development at the altar of the environment but in the long-term, unless South Africa, along with the rest of the world, does something about global warming, its own economy is threatened by climate change.

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<sup>7</sup> Most countries use Brent Crude as a benchmark but complex refineries do not actual refine Brent but lower grade crudes like Iranian crude on which most refineries in South Africa were configured. These crude oil blends trade a significant discount to Brent, which has saved the country billions of dollars in foreign exchange.

<sup>8</sup> BFP is the deemed import parity price determined calculation of the level of prices that South Africa would pay if it imported substantial volumes from the refining centres used in the calculation.

<sup>9</sup> The present Guidelines on importation and exportation, which are publicly available, are further attempting to promote participation by Historically Disadvantaged South Africans.

The key concern with developing economies in respect of climate change is the lack of climate change monitoring capability. Most developing countries, including South Africa, do not have the ability to measure climate change impacts and therefore cannot devise appropriate climate change mitigation strategies. Almost all estimates regarding likely climate change impacts on developing countries result from computer simulations conducted by the developed countries.

Without appropriate climate change impact monitoring, it is possible that new investments made in infrastructure could be rendered ineffective in a few years time through rising sea levels, drought encroachment and rivers running dry. Integrated energy planning would therefore be incomplete if climate change issues are not incorporated in the energy modelling process.

Climate change modelling, like all other energy planning processes, will require data and monitoring equipment. The approach that is proposed is a modelling system that has a climate change module, a system which would evaluate projects or investments in terms of their impact on the environment, project possible climate change impacts on projects and allow for evaluation of adaptation possibilities. By way of an example, in the case of biofuels, the climate change module will allow for modelling of likely climate changes on the production of a particular crop. The module should also allow for the development of adaptation strategies for particular areas.

### **8.1.3 Standards and specifications**

South Africa is part of a global neighbourhood and with increased imports coming into the country, there is a need for alignment of our fuels specification and standards to at least those countries that trade with South Africa. To ensure security of supply, it would therefore be ***recommended that global fuels specifications be adopted***. Such a strategy would also ensure that South Africa does not become a “dumping ground” for all low-grade fuels.

### **8.1.4 Crude oil sourcing and transportation**

South Africa sources, through private players, more than 80% of its crude oil supply from Iran and Saudi Arabia, putting the country in an unenviable position. The country

would either have to diversify supply sources or ensure that a significant portion of its crude requirement is done by the state through its national oil company. It is therefore ***recommended that 30% of all crude consumed in South Africa be procured through PetroSA.***

Most developed countries of the world own at least one crude oil tanker that flies the country's national flag but South Africa does not. South Africa's current strategic stocks policy is based on crude oil, which is stored in Saldanha Bay, whilst crude oil refineries are located in Cape Town, Durban and Sasolburg. In times of need therefore, South Africa will not be able to access its crude oil stocks. It is therefore ***recommended that South Africa, through the national oil company, procures at least one crude oil vessel, which will, during peace times, be expected to work like any other vessel.***

#### **8.1.5 Import and export policies**

In the bid to support promotion of local production of liquid fuels, it is recommended that a policy of limited imports, when product is available in the country, be re-endorsed.

#### **8.1.6 Demand management**

A major part of energy security is managing the energy demanded by all sectors in the economy. Largely due to the structure of the South African economy, the industrial sector is the biggest user of energy and the biggest user of electricity. Even without changing the country's industrial and development strategy, major savings could still be realised in the consumption of energy. It is therefore recommended that as part of the Energy Security Master Plan, ***energy efficiency be strongly promoted in all energy demand sectors of the economy.***

Without the use of appropriate energy appliances and technologies, limited progress can be achieved in the demand management space. It is also true that different types of energy carriers can achieve different levels of efficiency. For an example, it does not make sense to use electricity generated from gas for cooking and heating. It however makes more sense, from an efficiency improvement perspective, to use gas directly for

those applications. The energy demand management approach should therefore include an appropriate selection of energy carriers for different applications.<sup>10</sup>

At the centre of demand management however are appropriate demand sectors' strategies, starting from the industrial strategy through to appropriate transport strategies. Indications are that oil will run out sooner rather than later and a transport strategy that is over 90% dependent on oil is guaranteed to land South Africa in serious trouble in a few years time. No form of planning will find South Africa oil, when it has all been acquired by those with more might or insight.

#### **8.1.7 Energy infrastructure planning**

Problems in both electricity and petroleum sectors have indicated the need for some level of coordinated planning of infrastructure investments, as it is done in some economies, irrespective of whether it is the state or the private sector making the investments. Infrastructure planning or supply chain planning, although an important part of integrated energy planning, demands a very different set of planning tools. In some domains, e.g. US and Norway, a private sector company conducts such planning on behalf of an industry. It is therefore recommended that a state owned independent "energy planning coordinator" be investigated.

#### **8.1.8 Petroleum strategic stock**

Liquid fuels require some level of redundancy in the system to ensure security of supply. The cost of not having fuel fully justifies the need for such "reserve margins." For an example in the case of liquid fuels, the cost of fuel shortage on the economy has been estimated at 273 c/l whilst the cost of such insurance is about 13c/l. In the case of liquid fuels, the approval of such a policy is a subject of a separate approval process. But in considering the energy security framework, it is important to note that the Master Plan is incomplete without strategic reserve considerations. The only way of resolving the problems presented by the operation of OCGTs in South Africa is through

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<sup>10</sup> It should be noted however that in some cases, other policy imperatives could well lead to an energy carrier that could result in lower efficiency. The case in point is the promotion of bio-ethanol over crude based petrols for propulsion of motor vehicles. Due to the energy content in bio-ethanol, energy produced from a kilogram of ethanol is significantly less than that produced from ordinary petrol.

keeping significant petroleum stocks, which could well be higher than those kept for all other operations in South Africa.

## **8.2 Short-term strategic options**

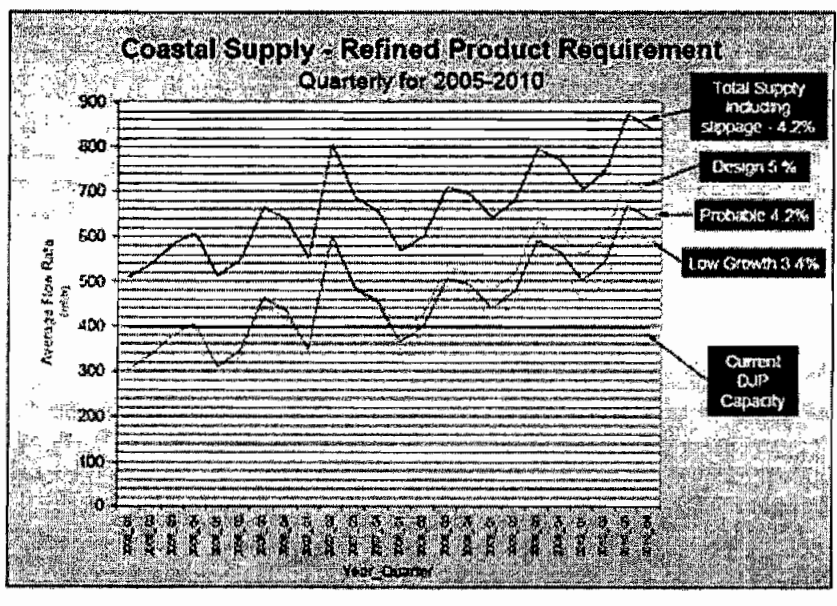
A study to identify supply chain challenges in the liquid fuels industry was conducted last year. The study identified a number of problem areas from the ports operations through to distribution depots. After an extensive stakeholder engagement process, action plans were developed for each identified problem area.

Although challenges were identified in all areas in South Africa, the area which raises the most concern is the inland region, the industrial and economic hub of South Africa, not only because of its importance in the lives of South Africans but because of its physical location away from the natural sources of petroleum products. The need for an interim plan of action to address the supply of refined products (petrol, diesel and jet fuel) to the inland region (Petronet supply region) between 2006 and 2010 became obvious as the studies for the bigger New Multi-Products Pipeline (NMPP) project to determine the future demand for these products progressed.

The NMPP Project will provide greater ability to deliver the projected increased inland demand for refined products once it is installed and commissioned in 2010. However, the demand growth projections developed for the NMPP highlighted that there would be increased volumes that will need to be transported during the period 2006 - 2010 to meet the inland market demand during that time.

The quarterly demand projections for the coastal supply of refined products to the inland region for three different growth rates are shown in Figure 5.

Figure 5 - Inland Market Demand for Coastal Supply of Refined Products



### 8.2.1 Improvement of petroleum pipeline performance

The existing 12-inch Durban to Johannesburg Pipeline (DJP) is already running at "capacity." Significant volumes of petrol and diesel are currently transported inland by means other than pipeline, with the main method being by road tanker<sup>11</sup>. Volumes that are transported inland by any means besides the Petronet DJP are considered to be "slippage" by Petronet.

The 2005 "slippage" volumes equated to an average hourly rate of 204m<sup>3</sup>/h. This has been considered to be constant for the entire bridging period when evaluating the impact of the various opportunities on increased supply to the inland region. This simplification results in the risk that, should it not be possible to continue to deliver the "slippage" volumes, as they are currently being transported, the magnitude of the transport problem increases accordingly.

Following several workshops and subsequent evaluation work, a number of potential opportunities to increase the supply of refined products to the inland

<sup>11</sup> Transportation of petroleum products over long distances presents major environmental and safety challenges and should be avoided as much as possible.

market were identified. These are summarised in Table 2 and have been split into short and medium term categories.

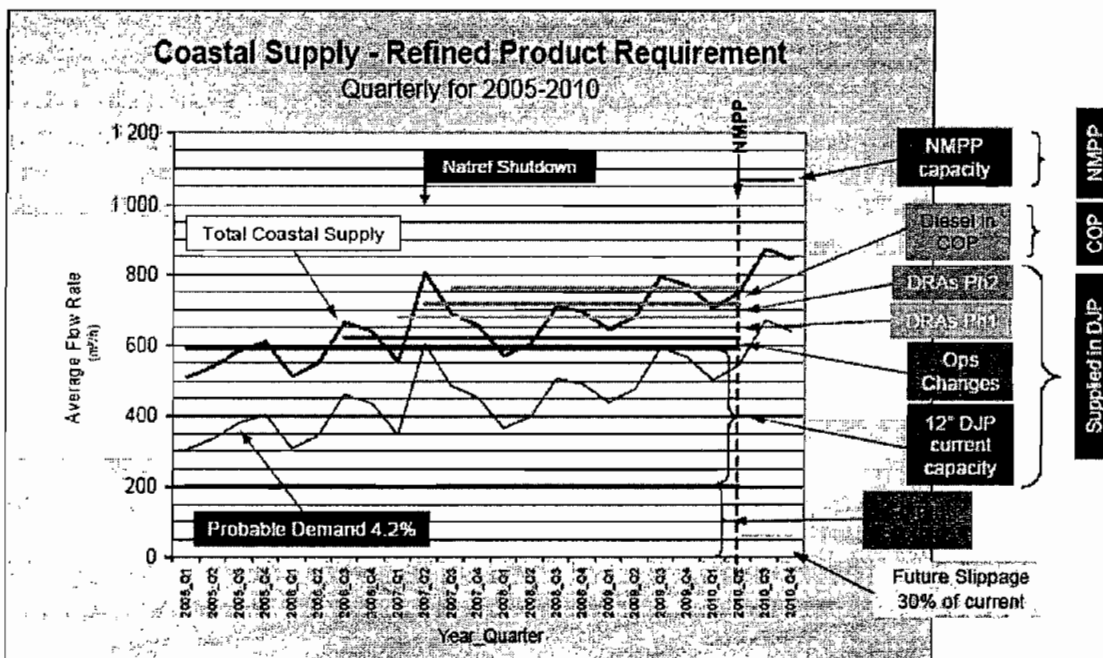
Table 2 - Inland supply-bridging plan

Opportunity	Short Term 2006 - 2007	Medium Term 2008-2012
Operational Changes	Phase 1	Phase 2
Drag Reducing Agents (DRA's)	Phase 1	Phase 2
Diesel in COP (Crude Oil Pipeline) (DIC)	Phase 1	Phase 2

The impact of the bridging plan is indicated in Figure 6. It can be seen, apart from the anomaly in Quarter 2 of 2007, which does not follow the seasonal trends and Quarter 3 of 2009, the opportunities selected will provide the volumes needed. Q3 2009 can be addressed in several ways e.g. stock-piling during the previous quarter or by implementing Phase 2 of the Diesel in COP, which may permit increased transport of diesel to the inland network via Secunda as well as Natref.

It should be noted that the pipeline-bridging plan assumes the continued level of road use, with all its safety implications. Road use can only be minimised through optimisation of rail (discussed in section 8.2.2). The other two key concerns are 1) a probability of Q2 2007 anomaly happening more than once and 2) the economy growing faster than predicted in which cases the bridging plan is inadequate.

Figure 6 - Bridging plan opportunities

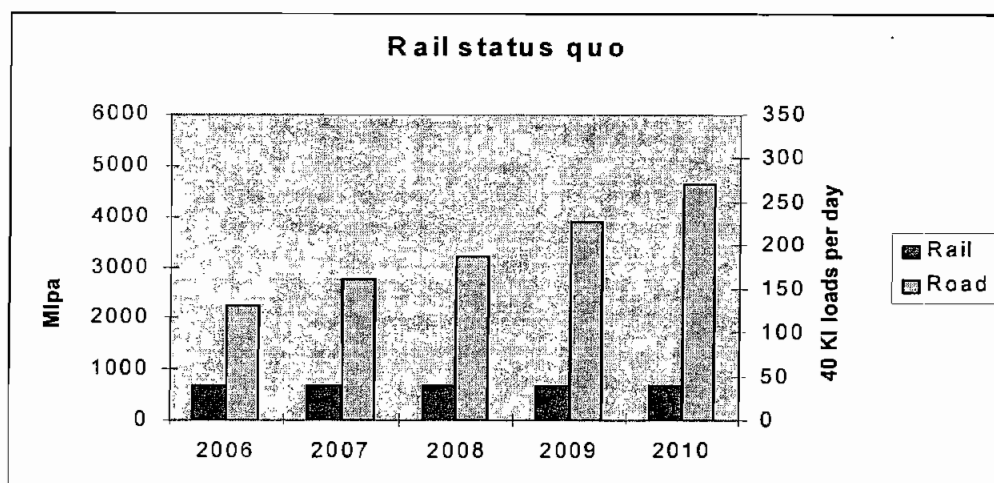


As can be seen in Figure 6, without a new, properly sized and integrated pipeline, coming on line in Quarter 2 of 2010, **the country will be in serious trouble**. It is for this principle reason that the recommendation, which is discussed in section 8.3.1, to have the Petronet NMPP project approved, is proposed.

### 8.2.2 Rail improvement intervention

The FSSTT findings indicated that the movement of petroleum products through rail is the preferred choice after pipelines. However, only about a quarter of petroleum products supplied to the inland are moved by rail (see Figure 7). Given the increased demand for petroleum products and the maximum utilisation of the current pipeline capacity, there is a need to initiate improvements on rail operations to relieve the road congestion particularly from the coast to inland.

Figure 7: Current Rail Transportation and Future Road Usage



In response to the findings of the FSSTT, Spoornet conducted a detailed analysis of their operations to validate the FSSTT findings. Spoornet's analysis indicated that introducing certain operational improvements could alleviate some of the congestion along the supply chain. At the centre of these rail operational improvements is the consolidation of the route tankers and route substitution. The recommended strategy is to move to block trains/ block loads thus exiting inefficient routes and re-allocating capacity to the Durban to Gauteng corridor. These operational



improvements may lead to the quadrupling of rail capacity thus reducing the need for increased road transport for moving petroleum products.

In consultation with Spoornet and industry, it was agreed in principle that operational improvements mainly consolidating rail tank cars (RTCs) into block trains will lead to increased rail capacity and should therefore be adopted. ***The move to block train operation will improve Spoornet's turn around times from an average of 14 days to a more acceptable global best practice of 4 days for equivalent distances.***

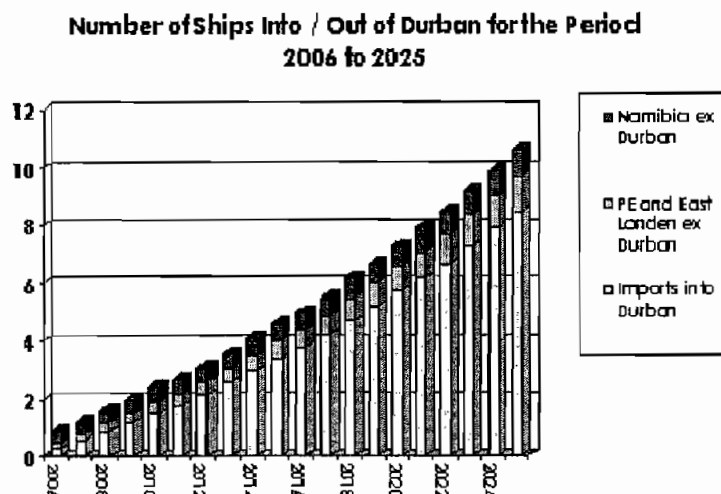
The cost of implementation will be borne by the oil industry players, who have to invest in rail sidings, loading and off-loading facilities. In some cases, the industry will have to change its operations and begin to work on weekends as well.

### **8.2.3 Ports operational improvements**

Ports operations are an integral part of the petroleum products logistical value chain. The projected demand growth for petroleum products, coupled with limited refining capacity in South Africa, as shown in recent studies, has begun to put additional pressure on the ports operations. The need for increased imports has placed strain on both the Durban and Cape Town harbours and related facilities.

The Durban port is used by a number of oil companies to ship finished petroleum products to other markets in other parts of South Africa via coastal shipping or to the inland markets via pipelines, road or rail. According to a study conducted by NPA on the Durban port there is enough capacity in the Durban port (see Figure 8).

Figure 8 - Durban port capacity profile



There were, however a number of challenges that were identified as creating constraints within the harbour for the movement of petroleum products, namely:

- *Long queuing times outside of the harbour.* the long queues for petroleum vessels were attributed to prioritisation, by NPA, of container vessels over those carrying petroleum products. It is **recommended that the oil vessels should be afforded as high a priority as the high value container vessels.**
- *Berth congestion:* Storage facilities attached to the berths are an integral part of ports operations but some oil industry participants have made inadequate investments in them and use the same tanks as part of their refining operations, thus resulting in much reduced port capacities. **The use of the “back of port” tanks for anything other than offloading and loading must be prohibited.**
- *Uncompetitive behaviour.* Some berths in Durban are for exclusive use of certain players of the industry, a situation which should be avoided as it can be misconstrued as creating a barrier to entry for new entrants. Following global best practice, **it is recommended that the back of the port be**

***operated by an independent player. It is further recommended that South African Ports Authority perform that role.***

- *Inadequate offloading and loading equipment:* Offloading and loading facilities, owned by the oil companies, have capacities well below global best practice. It is understood that some facilities operate as low as 400m<sup>3</sup>/hour when they should be operating between 1500 and 2000m<sup>3</sup>/hour. This is worsened by the limited interconnectivity within different petroleum berths. ***Oil companies must be obliged to correct the current situation and make the necessary investments or allow an independent player to effect those changes.***

To address the above challenges and allow optimum utilisation of the petroleum handling facilities at the port, it is necessary that management of the back of the port operations be consolidated and an independent operator appointed. An independently operated port handling facility will also promote access for new participants. Furthermore, the introduction of the bigger NMPP project will demand coordination for optimal operation, which is currently a risk for the NMPP.

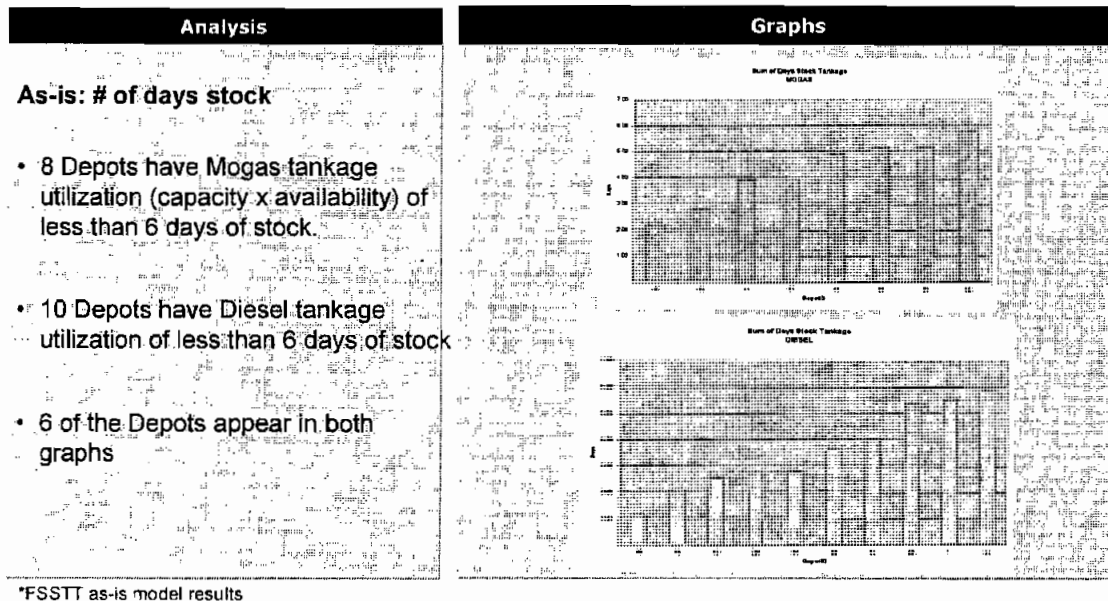
The DME can promulgate regulations under the Petroleum Pipelines Act to bring into effect the independent operation but the promotion of investments in appropriately sized handling and storage facilities is another issue, which requires further attention. NPA has to address concerns raised by industry participants in respect of the current leases held by the various oil companies or move to own the equipment itself. The DME will also be required to provide regulatory certainty, in terms of compensation for capital investment in the port side, which at the moment is compensated through the Basic Fuels Pricing mechanism.

#### **8.2.4 Storage depots improvements**

In addition, to improving the other infrastructure capacities along the petroleum supply chain, there is an urgent need for investment in adequate depot infrastructure serving pipelines, rail and road. These investments will alleviate some of the constraints identified by the FSSTT study, which include the inability of most

of the depots to receive the large pipeline shipments. An increase in the pipeline, as expected in 2010 will exacerbate the need.

Figure 9 - Existing depot capacity



The need for increasing depot capacity is strategic as much as it is operational. As can be seen in Figure 9, the current industry stock days are totally inadequate. As a case in point, during the December 2005 fuel shortages "actual monthly stocks over the period June 2005 to January 2006 crude stocks varied between 16 days (Sept 2005) and 20 days (Dec 2005). During this period, finished product stock levels in refineries, coastal terminals and inland depots fluctuated between 14 days in September 2005 and 10 days in November 2005"<sup>12</sup>.

In addressing this potential threat to security of supply, a strategic stocks study was commissioned. Based on this study, it is recommended that the industry be obliged to hold 28 days commercial stock, which will be paid for by consumers of petroleum products. The cost of this insurance is expected to be in the order of 4c/l, allowing for the installation of new capital equipment and building stocks to the required level. The approval of the strategic stocks policy is a subject of a separate approval process.

<sup>12</sup> Moerane Report, 2006, page 33.

This requirement will also be applicable to ACSA, which holds stock on behalf of the airline industry, and Eskom. The airline industry is currently expanding their stock holding levels to 5 days. However, the concern is that 5 days stocks would, in case of an emergency, not suffice given their current consumption levels and international benchmarks. For the operation of its OCGTs, Eskom also has to build its own commercial stocks which will not be less than 28 days. To ensure that all consumers pay for the insurance accorded to them, including unregulated commercial customers, and to correct past inequities, the petroleum products pricing framework is under review.

### **8.2.5 Integration issues – short term**

The recent introduction of Open Cycle Gas Turbines (OCGTs) is set to exert more pressure on the supply of liquid fuels if their operations are not integrated to that of liquid fuels production plants. The biggest challenge is planning for fuel that would be demanded by these plants, largely because their operation is driven by electricity demand and other generation plants' availability. As can be seen in Figure 10, depending on the OCGTs' utilisation rates, the fuel demand from their use can range from 296 million litres of diesel per annum at 5% load factor to 1.78 billion litres per annum if all the OCGTs run at 30% load factor.

*Figure 10: Eskom's OCGTs fuel demand variation with increasing load factors*

Per annum	5% M litres	10%	15%	20%	25%	30%
Ankerlig	85	170	354	338	423	510
A Gas 1	106	212	318	424	530	636
Gourikwa	63	126	190	254	315	378
M Gas 1	42	84	126	168	210	252

An additional area of integration in the short-term concerns the use of LPG as a source of energy for household cooking and space-heating. While this source of energy is more suitable for the aforementioned applications, its pricing, availability through local or import sources, as well as distribution to end-users are areas that require attention. This becomes even more important if the use of LPG is to be more wide-spread than it is currently.

### 8.3 Medium- to long-term strategic options

#### 8.3.1 NMPP

As discussed under section 8.2.1, rapid inland demand growth indicates that the current Petronet Durban to Johannesburg pipeline (DJP) has reached its full capacity and is reaching the end of its useful economic life and requires replacement. The plans associated to this large project are therefore to replace the existing DJP and expand capacity with a NMPP from Durban to the inland market. The NMPP Project also addresses the capacity constraints in the Petronet Inland Pipeline Network (IN) resulting from the future increased demand requirements placed on the IN. This is perhaps the single most important investment in the

petroleum industry in the next 5 years. The timing for the investment is as critical as the size of the pipeline.

As was noted in Figure 6, any unplanned outage in any of the inland refineries results in liquid fuels supply shortages for the country. It is for this reason that a new pipeline supplying the inland region must have adequate capacity at any point to be able to handle additional demand for product from the coast. It is for this reason that a recommendation is made for a new pipeline that would have sufficient capacity to transport at least 350,000 m<sup>3</sup> per week by 2015. ***The timing, the size and the routing of this pipeline are critical. It is therefore critical that the Petronet NMPP project be immediately approved to allow the project to commence in earnest.***

The project however requires a further supporting decision to make it work: *Security of supply levy*: Pipeline tariffs are a function of pipeline size (and its associated equipment like pumps) and utilisation. A pipeline, which has been sized for security of supply purposes, will invariably operate at less than optimum level, especially at the early stages of its operation. This additional capacity could be funded through higher tariffs or a dedicated levy. The higher tariff approach comes with major unintended consequences like higher profits for one of the players and even a possibility of making the pipeline use more expensive than other modes of transport, further reducing use of the pipeline, resulting in an even higher tariff. ***The preferred mode of funding required, is a security of supply levy that will be levied on all petroleum products.*** It is envisaged that such a levy will not be more than 1 c/l.

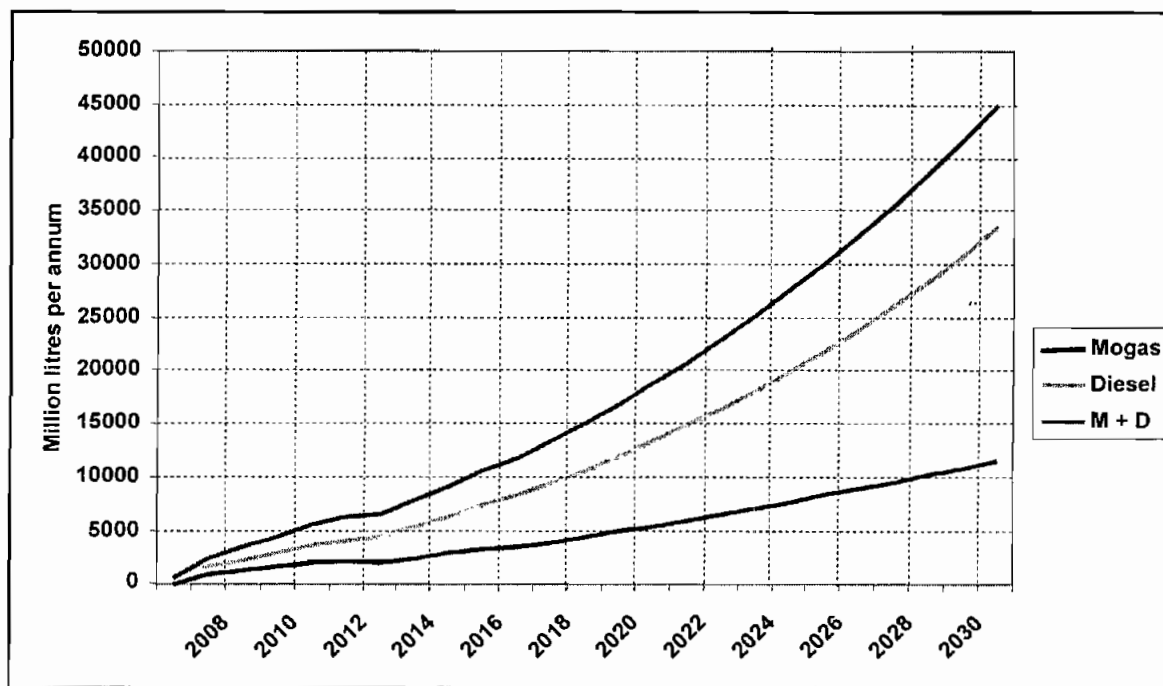
The introduction of the NMPP provides an opportunity to limit the risk associated with ORTIA's jet fuel supply. Currently almost all of ORTIA's jet fuel comes from Natref. In the event that Natref was to be off line for an extended period of time, the ORTIA operations are put at serious risk. Some jet fuel is currently supplied from the coast through rail but it cannot replace the need for a pipeline to move jet fuel from the coast to ORTIA. The building of a new Durban – Gauteng multi-product pipeline presents ORTIA with an opportunity to address this issue.

### 8.3.2 New refining capacity

Without additional refining capacity, South Africa will increasingly be dependent on imported refined fuels. It is also increasingly more technically challenging and costly to gain access to upstream oil and gas resources due to increased competition fuelled by escalating global demand for these resources.

A recent study conducted shows that the national demand for automotive fuels will exceed South Africa's production capacity in the near future, as depicted in Figure 11.

Figure 11: Forecast Liquid Fuels Supply shortfall for South Africa



It is evident from the forecast that either a new CTL (roughly 5 billion litres/annum), or crude refinery, at double the capacity, could be accommodated from 2013/14, which is the earliest date by which any one of these could be implemented. Local companies are currently working on building business cases for securing the supply of liquid fuels through CTL and Crude Oil Refining.



### 8.3.3 Integrated energy modelling and planning

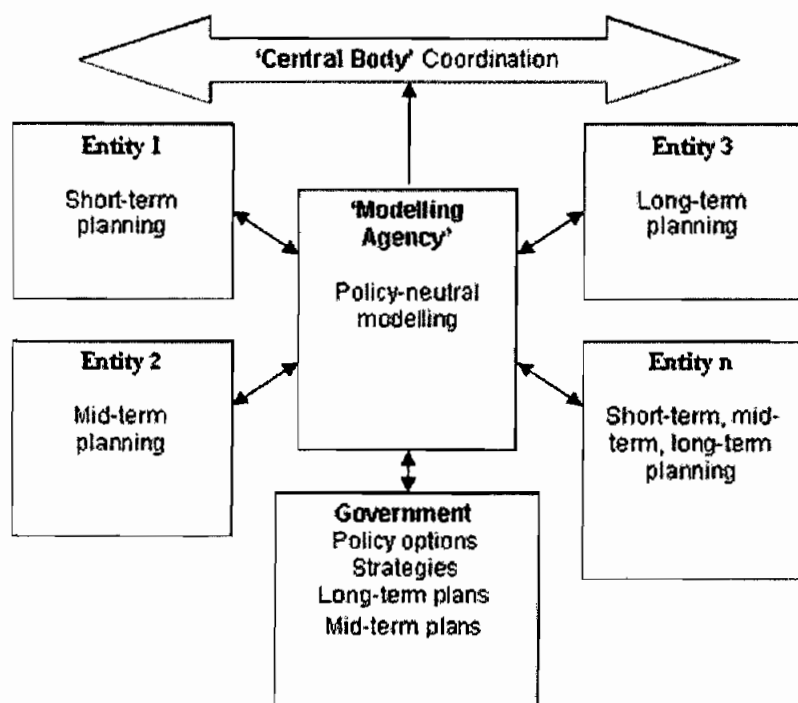
Considering the definition of energy security proposed herein, an integrated approach is required to ensure that all the constituting elements are addressed in a coordinated manner. This takes into account the potential conflicts among some of the elements, for example economic growth and environment management requirements, or affordability of service and the promotion of investments required to ensure sustainable supply.

Considering that a deliberate effort is required to ensure coordination, there is an urgent requirement to develop an integrated energy modelling capability, which would be instrumental in the development of energy plans and evaluation of options that are proposed by policy-makers. This also implies a clear definition of roles for various players, one of the important areas in this regard is the responsibility for managing data and models that are used in planning.

As an example, the incorrect estimation of GDP growth rate has been cited as one of the reasons for the low reserve margin that currently exist in the electricity supply system. However, there has not been any question regarding whether GDP is still a good predictor of energy demand in the first place or not. The question therefore arises as to the extent to which the real challenges would be addressed if there were no detailed interrogation of the underlying causes.

As illustrated in Figure 12, one key consideration in addressing this requirement is the institutional separation of modelling, planning and coordination. Based on this approach, decentralised planning by various entities (e.g. from 'entity 1' to the nth entity or 'entity n') will continue, with the coordination or integration of such planning being done centrally at the DME. This will ensure that a function is created, whose sole responsibility will be to deeply investigate key drivers that require attention in planning processes.

*Figure 12: Interactions between planning, modelling and coordination functions*



This demarcation of roles relies on the principle of policy neutrality, which means that modelling should be undertaken in such a way as to use prevailing policy, legislative arrangements, proven or almost proven technology and industry structural conditions as a basis for the development of energy plans. Further, the principle assumes that the entity that manages energy data is able to source and disseminate the information in a manner that guarantees the credibility and integrity thereof.

The key outputs from the modelling process will be the publication of an energy outlook, as well as an energy review, on an annual basis. Monthly or quarterly publication of key information could also be considered, for instance, the level of the country's strategic petroleum stock. Further, specific analytical support in respect of evaluating legislative or regulatory proposals will form part of the expected services.

One of the areas that require consideration in this respect is the provision of appropriate legislative support mechanisms in order to confer the necessary authority to the entity that manages energy information in an independent manner. This means making it compulsory to provide specified information for energy modelling purposes, with the proviso that such information would be used only for that purpose, and not for

example, in arriving at regulatory decisions<sup>13</sup>. Because of the time it would take to develop such modelling capability from scratch, ***it is recommended that the approach used by the US Department of Energy in the form of the EIA, be adopted in South Africa.***

The reasons for proposing this approach are many but the most important ones being applicability of the model to the needs of South Africa and time required to customise as opposed to the time that it would take to develop a modelling approach from scratch. The focus on integrating the modelling of the supply, conversion and demand sectors of the energy industry, as well as the rest of the economy and international energy markets is perhaps the reason why the US approach was considered in the first place.

Considering the challenges faced in the country, especially due to convergence between the liquid fuels and electricity markets, pressures on the logistics infrastructure's capacity, as well as structural changes to the economy, integrated modelling is the preferred approach. The approach will allow for integrating other strategies like the industrial and transport strategies with energy modelling. This is further supported by the requirement to address challenges associated with the availability of resources (i.e. oil, gas, coal, uranium, wind, etc). South Africa currently imports almost all its crude requirements but exports its coal and uranium resources. Energy modelling will allow for the testing of the advisability and sustainability of these approaches.

For this reason, access to the conceptual design of the US NEMS would be useful towards facilitating the process of developing a National Integrated Energy Modelling System (NIEMS) for application in South Africa. This conceptual design should primarily be in the form of the algorithms and methodologies that inform the NEMS modelling procedures, and NOT the actual programming code or structure. This distinction is important, as borne out by a number of practical considerations that

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<sup>13</sup> Although nothing would prevent the relevant regulatory authorities to base further investigations on the publicly available analysis resulting from the modelling process. The principle, however, should be that such regulators would have arrived at decisions on the basis of their own, independent investigations.

militate against attempting to develop NIEMS on the basis of modifying the actual code and architecture of NEMS.

Despite the conceptual relevance of NEMS to South Africa's requirements, some practical considerations need to be made. Some of these include the fact that a dated programming language is used (i.e. FORTRAN), the complexity of the software application (e.g. the size of its code and the potential that it may not be 'programmer-friendly') and that the modular structure may not be as highly defined in the code itself as maybe expected.

Mr John Conti, who is the Director at the EIA, provided some interesting observations about implementing NEMS in the US, as well as the experience that Canada had in customising the system for application in that country. Some of the practical considerations they have had to make in the customisation process are as follows:

- ✦ *"At an absolute minimum all of the modules had to be modified to operate at a provincial level"*: This means it would not be possible to customise only the priority modules from a South African perspective. It makes sense that this is required, considering that the underlying principle behind NEMS is that the modules are integrated.
- ✦ *"People working directly on the model needed knowledge of the design and operation of the NEMS system, the FORTRAN programming language, econometric regression, basic economics, how the industry works, and general modeling skills. In many cases this was a team effort so different people brought a different set of skills to the project"*: While skills in econometric regression, basic economics, general modelling skills and knowledge of the South African industry are not a challenge, the same cannot be said regarding FORTRAN and the detailed design of NEMS. The issue of the programming language and approach explains why from a South African perspective, the focus is only on customising the conceptual methodologies and algorithms.
- ✦ *"In order for the model to maintain relevance it should be updated on a regular basis. This is an additional cost which should be considered. Much*

*of the data that EIA uses is already being collected by other government groups with separate budgets, something of a hidden cost*": While the requirement for regular updates may be addressed by choosing carefully which aspects of the model are 'hard-coded', the extent to which that may be feasible may be limited, considering the requirement to mathematically model processes that may not necessarily be generic. Further, the availability of data has to be addressed right at the beginning, since this will determine the extent to which the system is effective in informing decision-making.

## 9 Recommended plan of action

The recommended Energy Security Master Plan can be summarised into two specific strategic areas, namely: 1) infrastructural and 2) policy and governance. The principle here is that in terms of security of supply, the interventions needed to secure supply of liquid fuels until 2010/11 does not have the luxury of 'governance' investigations beyond what have been completed to date, however with the correct management and planning tools going forward, by 2015 to 2020, South Africa will have the capacity to be more proactive than reactive in planning the investment needs of the energy sector. It is also assumed that the pressure to make urgent short term decisions on production, infrastructure and demand side investments would ease with time.

### 9.1 The infrastructural recommendations:

These recommendations are essentially focused on the short term (from 2007 to 2010), and are primarily focused on security of supply solutions to the impending liquid fuels supply crisis and include the following:

#### 9.1.1 Pipeline capacity constraints:

- Augment current pipeline capacity shortages with increased rail transport between 2007 and 2011. Also stipulate liquid fuels block trains/block loads be implemented by Spoornet, thus exiting inefficient routes and re-allocating capacity to the Durban to Gauteng corridor. The move to 'block train' operations should improve Spoornet's turn around times from an average of 14 days to a more acceptable global best practice of 4 days for equivalent distances.
- Enable increased imports via the Durban port to meet local production shortfalls. It is also recommended that the oil/refined petroleum product vessels should be afforded as high a priority as the high value container vessels.
- Block train destinations be identified and the requisite depot improvements made to receive such bulk loads. Private oil companies will make the depot

improvements and it will be necessary to initiate consultations to enable these investments as soon as possible.

#### **9.1.2 Port capacity constraints:**

- The use of the “back of port” petroleum tanks for anything other than offloading, loading and bulking for pipeline ‘packing’ must be prohibited and access and tariff setting issues referred to the regulator.
- It is recommended that the back of the port (including all petroleum related tankage, pipelines and pumping infrastructure from the wharf to the Petronet inlet flange) be operated by an independent party and that a process to identify a suitable candidate is started by end of 2007. South African Ports Operations could serve as such a 3<sup>rd</sup> Party.
- Oil companies must be obliged to correct the current constrained port-off-loading and loading situation and make the necessary investments or allow an independent party to effect those changes. A concrete proposal in this regard should be on the table by September 2007.
- With regard to the above two bullets, an immediate (August 2007) study to determine the asset value from company balance sheets as to how gantries, tanks, pipelines and pumping infrastructure etc. are currently accounted for.

#### **9.1.3 The proposed Multi Product Pipeline from Durban to Gauteng**

- The timing, the size and the routing of this pipeline are critical. It is therefore critical that the Petronet NMPP project is immediately (July 2007) approved to allow the project to commence in earnest.
- The preferred mode of funding essential pipeline infrastructure such as the NMPP, should be a split tariff where the capacity that is immediately utilised is paid for via a direct usage tariff levied on all users of the pipeline, and the required ‘reserve’ capacity, which is under-utilised initially, is funded by a security of supply levy, applied on all petroleum products. Levy structure to be finalised by end 2007.

## **9.2 Policy and governance recommendations**

These recommendations are essentially focused on the medium to long term outcomes (2007 to 2015), and are primarily focused on energy security and the tools required to give effect to a holistic and integrated energy security modelling and planning concept. Such an energy security outlook should provide a basis for long term infrastructure planning options that will reduce the risk of realising a liquid fuels supply crisis beyond 2020. It should be noted however that designating these as medium to long-term interventions, means there is need for immediate implementation so that by the 2010/11 deadlines concrete outputs are realised. These recommendations include the following:

### **9.2.1 The proposed energy modelling and analysis agency**

- It is recommended that the approach used by the US Department of Energy in the form of the EIA and its modelling and analytical competence, be adopted in South Africa.
- It is recommended that the energy modelling agency be set up in 2007 with the objective to deliver the first integrated energy outlook by 2009. The urgency is founded on the need to develop modelling and analytical competence in order to assess all of the other interventions that impact on energy security on an ongoing and dynamic basis.

### **9.2.2 Local refining capacity to augment energy security**

It is recommended that local liquid fuels refining be promoted as much as possible, with a particular preference placed on production of liquid fuels from local resources, where local would include resources from South Africa's neighbouring states. It is recommended that production from local sources be maintained at least at the current level of 30% local production.

### **9.2.3 Importing of petroleum products**

- It is recommended that 30% of all crude oil consumed in South Africa be procured through PetroSA and a sustainable mandate be developed to ensure



transparency and uptake by the various refineries. Such a policy would be implemented by end 2008;

- It is further recommended that South Africa, through its national oil company, procure its own VLCC.
- In support of promotion of local production of liquid fuels, it is recommended that a policy of limited imports be re-endorsed with a dynamic component responding to the fluctuating levels of capacity to produce locally and to enable imports as production capacity changes with time. The requisite import policy decision by end 2007 would provide regulatory certainty to potential local production investors.
- To ensure security of supply, it would therefore be recommended that global fuels specifications be adopted this will ensure ready access to available supply of refined product when imports are urgently required. This is ongoing in terms of the operationalisation of the Petroleum Products Act (as amended).

#### **9.2.4 Improving Energy Efficiency**

As part of the Energy Security Master Plan, it is recommended that energy efficiency and other demand side initiatives be strongly promoted in all energy demand sectors of the economy. And in this regard, the current energy efficiency and demand side policies should be reviewed to ascertain its rationale, implementation constraints and the appropriateness of its targets, both in terms of levels and targeted sectors. These reviews should start towards end 2007 or early 2008.

## 10 Conclusion

Energy security and supply security are generally used interchangeably but they are not the same thing. Security of supply is only one part, an important part, but one part of energy security. To ensure energy security, proper focus should be placed on understanding and planning for the demand. Inclusion of demand in the energy security argument should never be confused with security of demand. In ensuring energy security, a clear understanding of the interaction of energy with the economy and the environment is required, complemented by an understanding of the impact of changes in the environment on energy.

The concept of supply security in effect deals with two key issues, namely ability to produce and transport energy to where it is required. The two sides of supply security are equally important.

It is fair to think that it would be impossible to develop adequate energy plans without appropriate data acquisition and modelling tools. To prevent energy plans from being used for selfish purposes by individuals who are intent on selling their products at the expense of the economy and the people of South Africa, energy modelling should always be policy neutral.

Continued sustainable availability of affordable energy for the economy and development is fundamental for the continued survival of this economy. In the short-term, major changes are required in the operation of the liquid fuels industry. In the medium term, new investments are required in the petroleum value chain. Parallel to both these stage, a modelling and integrated planning capability will need to be built. In the long term, there is a need to make adjustment in the structure of the economy to ensure continued energy security in an environment of economic growth.

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