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HYDROCARBONS INDUSTRY IN SOUTH AFRICA, 2013

DIRECTORATE: MINERAL ECONOMICS

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2013

DIRECTORATE: MINERAL ECONOMICS

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ABBREVIATIONS AND SYMBOLS

bbl	barrel
bbl/d	barrels per day
Bcf	billion cubic feet
Bcm	billion cubic metres
Btu	British Thermal units
CTL	coal-to-liquid
EIA	Energy Information Administration
EU	European Union
FSU	Former Soviet Union
IDC	Industrial Development Corporation
kt/a	kiloton per annum
M^3	cubic metre
Mbbl	million barrels
Mbbl/d	million barrels per day
Mt	million tons
Mt/a	million tons per annum
OECD	Organization for the Economic Co-operation and Development
OPEC	Organization of the Petroleum Exporting Countries
pa	per annum
R	rand (South African currency)
RBCT	Richards Bay Coal Terminal
SA	South Africa
SAPIA	South African Petroleum Industry Association
TFR	Transnet Freight Rail
t	metric ton
t/a	tons per annum
Tbbl	thousand barrels
Tbbl/d	thousand barrels per day
TCF	trillion cubic feet
Tcm	trillion cubic metres
UAE	United Arab Emirates
UK	United Kingdom
US	United States
US$	United States dollar
l/d	litres per day

1. INTRODUCTION

South Africa has fairly limited liquid fuels as a result of inadequate or small oil and natural gas deposits. However, downstream liquid activities are quite substantial. Owing to the lack of these reserves, the country imports about 95 percent of its crude oil from the Middle East and some African countries to meet its requirements. Refined petroleum products such as petrol, diesel, residual fuel oil, paraffin, jet fuel, aviation gasoline, and liquid petroleum gas (LPG) are refined in the country and are produced by:

- refining crude oil
- converting coal to liquid fuels (CTL)
- turning natural gas into liquid fuels (GTL)

This industry is dominated by seven companies which are affiliated to the South African Petroleum Industry Association (SAPIA) and regulated by the National Energy Regulator of South Africa (Nersa). The country has two synfuels production facilities that produce liquid fuels from coal and gas, which are owned by PetroSA and Sasol.

World crude oil reserves were estimated at 1 652.6 billion barrels with 72 percent of these accounted for by Organization of the Petroleum Exporting Countries (OPEC) countries. World oil production, which is dominated by OPEC (40%), has been stagnant over the past decade. The transportation sector is the major driver of petroleum demand.

World proven natural gas reserves amounted to 208.4 trillion cubic metres (Tcm) in 2011. Russia had the largest natural gas reserves. Production amounted to 3 276 billion cubic metres (Bcm) in 2012 with the US dominating both production and consumption for natural gas.

Global demand for liquids fuels is expected to exceed 103 Mbbl/d by 2030, while natural gas is expected to maintain its growth of over 2 percent per annum. The diminishing reserves of crude oil and natural gas are going to continue to impact negatively on growth of that sector, increasing the country's reliance on imports unless the strategies that are being devised yields positive results.

The aim of this report is to give an overview of the hydrocarbon industry globally and locally, and will cover the liquid fuel and gas industries (natural and shale gas).

2. STRUCTURE OF THE INDUSTRY

2.1. Private Sector

This industry is comprised of seven companies that are active in the production of liquid fuels in South Africa; these companies are members of the South African Petroleum Industry Association (SAPIA). The companies include:

- BP Southern Africa (Pty) Limited
- Chevron South Africa (Pty) Limited
- Engen Petroleum Limited
- Sasol Limited
- Shell South Africa Marketing (Pty) Limited
- The Petroleum Oil and Gas Corporation of South Africa (Pty) Limited ('PetroSA')
- Total South Africa (Pty) Limited.

SAPIA represents the common interests of the petroleum industry and promote an understanding of the industry's contribution to economic and social progress in South Africa. Companies associated to SAPIA supply more than 90 percent of South Africa's petroleum products. According to SAPIA, these companies recorded a combined operating profit of R11.29 billion and a turnover of R217 billion in 2010.

2.2. Government

The hydrocarbons industry is exposed to different governmental regulations and legislation given its strategic nature. Its issues range from environmental, health and safety, through to economic regulation and other aspects of the industry. Regulatory standards and guidance are necessary to protect the interests of consumers and to allow for the required investment in the refining industry, in the best interest of the country.

2.2.1. Policy and Regulatory Framework

South Africa's hydrocarbons industry is regulated by the following legislation:

The National Energy Act of 2008 is the enabling legislation that empowers the Minister of Energy to ensure that diverse energy resources are available in sustainable quantities and at affordable prices in the South African economy to support economic growth and poverty alleviation, while also taking into account environmental considerations. In addition, the Act also provides for:

- energy planning,
- the increased generation and consumption of renewable energy,
- contingency energy supply, the holding of strategic energy feedstock and carriers,
- adequate investment in the appropriate upkeep and access to energy infrastructure,

- measures for the furnishing of certain data and information regarding energy demand, supply and generation,
- establish an institution to be responsible for the promotion of efficient generation and consumption of energy and
- energy research and all matters connected therewith

The Petroleum Products Act of 1977, as amended, provides for measures in the saving of petroleum products and the economy in the:

- cost of distribution,
- the maintenance and control prices,
- the furnishing of certain information regarding petroleum products,
- the rendering of service of a particular kind or standard in connection with petroleum products,
- licensing of persons involved in the manufacturing, wholesaling and retailing of prescribed petroleum products,
- promote the transformation of the South African petroleum and liquid fuels industry,
- the promulgation of regulations relating to such licenses and matters incidental.

The National Energy Regulator Act, 2004, provides for the establishment of a single regulator to regulate the electricity, piped-gas and petroleum. This led to the establishment National Energy Regulator of South Africa (NERSA), which is mandated to:

- Regulate South Africa's electricity, piped gas and petroleum industries and
- Collect levies from people holding title to gas and petroleum.

The idea behind a single regulator for the three industries was to improve efficiency and cut costs. It is also expected to boost private sector participation in the energy sector.

The National Environmental Management Act, 1999, has a direct impact on legislative and other measures to reduce carbon emissions, energy efficiency and mitigation of the impact of the generation/refinement and use of energy on the environment.

Consequently, during the Copenhagen climate change negotiation in 2009, South Africa committed to reducing its Greenhouse Gas (GHG) emissions by 34 percent by 2020 and 42 percent by 2025 provided there is sufficient availability of financial and technological support.

The Mineral and Petroleum Resources Development Act, 2002, makes provision for ownership, access to and sustainable development of mineral and petroleum resources. This act recognises the state as the custodian over the country's mineral resources. It also regulates the prospecting for, optimal exploitation, processing and utilisation of minerals.

3. PRODUCTION AND PROCESSING

3.1. CRUDE PETROLEUM EXTRACTION

The extraction process of petroleum includes the removal of crude oil from the earth. Seismic surveys are used to search for geological structures that may form oil reservoirs. The standard method includes the creation of an underground explosion in close proximity and observing the seismic response that provides information about the geological structures under the ground.

The extraction of crude oil usually starts with drilling wells into the underground reservoir. When an oil well has been tapped, a geologist will note its presence. Often many wells (called multilateral wells) are drilled into the same reservoir, to ensure that the extraction rate will be economically viable. Also, some wells (secondary wells) may be used to pump water, steam, acids or various gas mixtures into the reservoir to raise or maintain the reservoir pressure, and so maintain an economic extraction rate.

The oil well is created by drilling a hole into the earth with an oil rig. A steel pipe (casing) is placed in the hole, to provide structural integrity to the newly drilled borehole. Holes are then made in the base of the well to enable oil to pass into the bore. Finally a collection of valves called a “Christmas Tree” is fitted to the top; the valves regulate pressures and control flows.

The amount of oil that is recoverable is determined by a number of factors including the permeability of the rocks, the strength of natural drives (the gas present, pressure from adjacent water or gravity), and the viscosity of the oil. When the reservoir rocks are shale, oil generally cannot flow through but when they are permeable such as in sandstone, oil flows freely. The flow of oil is often helped by natural pressures surrounding the reservoir rocks including natural gas that may be dissolved in the oil, natural gas present above the oil, water below the oil and the strength of gravity. Oil tends to cover a large range of viscosity from liquids as light as gasoline to heavy as tar. The lightest forms tend to result in higher extraction rates.

PetroSA’s Oribi and Oryx currently produce approximately 1,800 barrels of crude daily. They are located approximately 120km south-west of Mossel Bay, Orca. Their floating production, storage and offloading (FPSO) facility, has been active in the Oribi field since 1996. With a sulphur level of 1.14 percent, Oribi crude is classified as sweet crude. This reduces sulphur dioxide emissions at the refinery. Additionally, Oribi crude has low contaminant levels, making it easier to produce lighter, value-added products.

3.2. COAL-TO LIQUIDS (CTL)

The Coal to Liquid (CTL) method is a South African patented technology used by Sasol to produce synthetic gas from low-grade coal using the Fischer-Tropsch (equation below) conversion processes (Fig.1). The process starts in the gasification plant, where coal, under high pressure and temperature in the presence of steam and oxygen is converted into crude gas. After cooling, the gasification condensates produce co-products such as tars, oils and pitches.

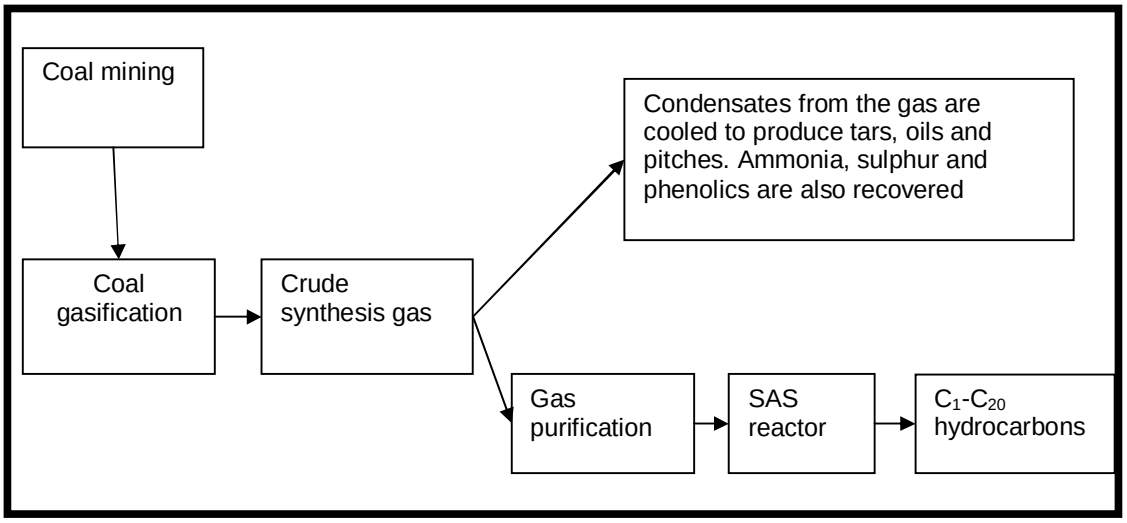
Fischer-Tropsch

$$nCO + 2nH_2 \rightarrow CnH_2n + nH_2O$$

• NB the ratio CO: H2 must be ~2

Other co-products, such as nitrogenous compounds, sulphur and phenolics are recovered as ammonia, sulphur, cresols and phenols respectively, with the pitch being converted into coke. The purified synthesis feed gas is then available for conversion to automotive fuels and oils, as well as a range of petrochemical compounds.

FIGURE 1: GASIFICATION OF COAL TO PRODUCE LIQUID FUELS



Sources: Everything Science

3.3. GAS-TO-LIQUIDS (GTL)

The basic process is exactly the same as CTL, except that the gasifier is replaced by a reformer. In reforming, natural gas (methane) is reacted with steam at high temperatures as indicated by the equation below.

$$-CH_4 + H2O \rightarrow CO + 3H_2$$

After the above mentioned reaction the syngas has too much hydrogen, so some of it is reacted with CO2:

$$-H2 + CO_2 \rightarrow CO + H_2O$$

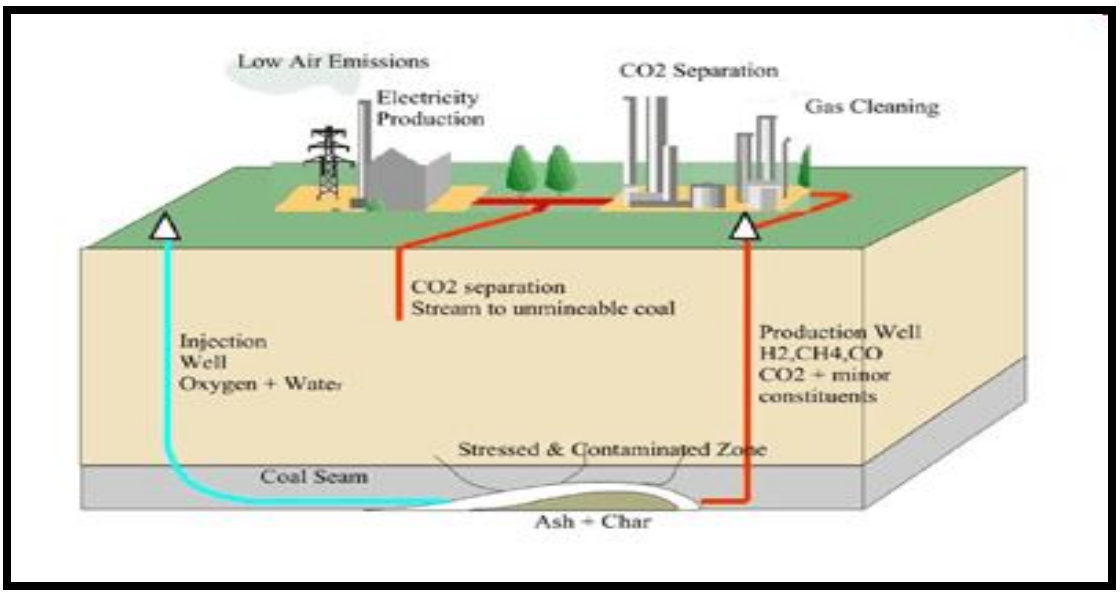
The carbon efficiency in gas is much higher than that of coal because some of the CO_2 is used to get the syngas back to the ideal 1:2 CO: H_2 ratio. Once the syngas is ready for synthesis, it follows the same process as CTL. The syngas is then chemically reacted over an iron or cobalt catalyst to produce liquid hydrocarbons and other byproducts. This is a method used in South Africa by PetroSA to convert gas into liquid fuel (GTL).

3.4. UNDERGROUND COAL GASIFICATION

Underground Coal Gasification (UCG) is a method of converting uneconomic coal seams into a combustible gas which can be used for industrial heating, power generation or the manufacture of hydrogen, synthetic natural gas or diesel fuel. UCG technology allows countries that are well endowed with coal resources to fully utilize them from unrecoverable coal deposits in an economically viable and environmentally safe way. UCG turns this resource into high value products such as; clean power, liquid fuels, syngas, fertilizers and other chemical feedstocks.

In South Africa, Eskom has been running UCG trials, using the same gasification reactions at Majuba, in Mpumalanga. One hole injects oxygen into a burning coal seam; there is sufficient water underground that none needs to be added. Another hole removes syngas with some CO_2 and coal volatiles (Fig.2). Eskom has demonstrated controlled burning and a consistent gas quality. Eskom has started a small production demonstration which will feed an 110MW turbine generator, if successful; the company plans a 1200MW production system.

FIGURE 2: UNDERGROUND COAL GASIFICATION



Source: http://www.iea-coal.org.uk

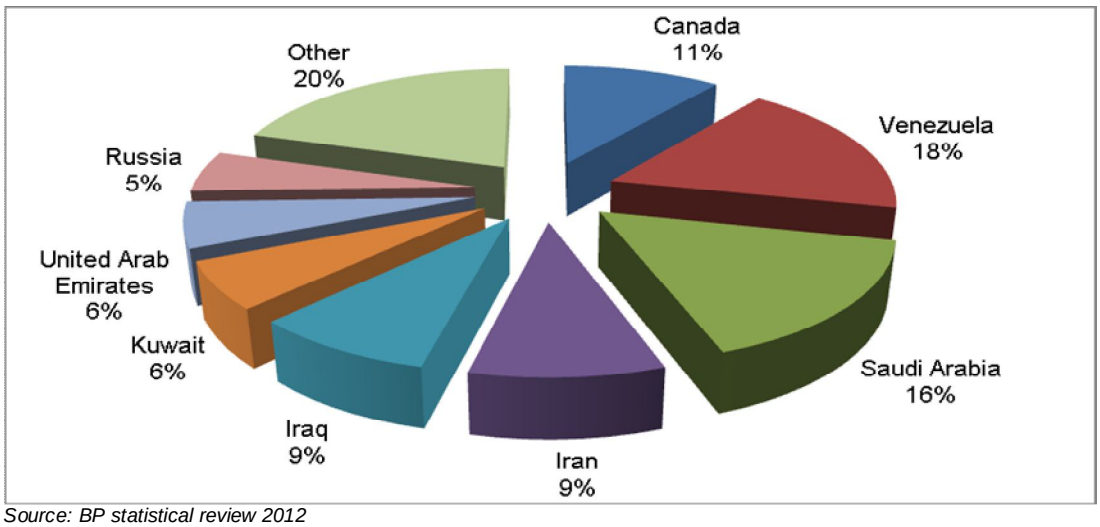
4. SUPPLY AND DEMAND TRENDS

4.1. Oil

4.1.1. Supply / Production

In 2011, proven world oil reserves were estimated at 1 652.6 billion barrels. Approximately 48 percent of the proved oil reserves are located in the Middle East (Fig.1). The Organization of the Petroleum Exporting Countries (OPEC), which includes: Algeria, Indonesia, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, UAE and Venezuela, accounted for 72.4 percent of the world's total reserves, while Non-OPEC accounted for 19.9 percent and the Former Soviet Union accounted for 7.7 percent.

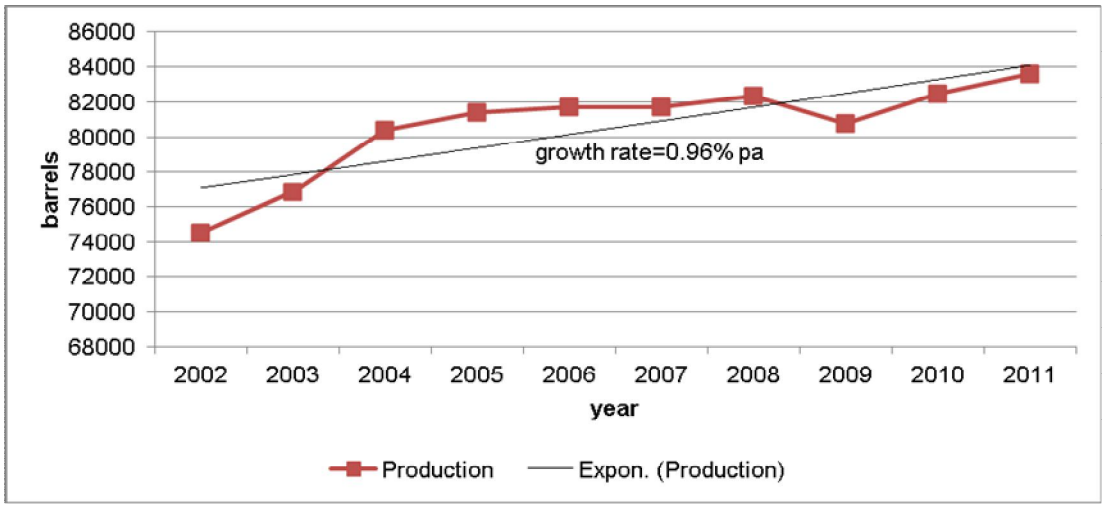
FIGURE 3: WORLD OIL RESERVES, 2011



Source: BP statistical review 2012

Global oil production has been increasing at approximately 0.96 percent for the past decade, as a result of rising world demand for oil (Fig.4). In 2009, production declined as a result of the global financial crisis which started in the last quarter of 2008. However, in 2011 production rose by 1.3 percent to 88.6 b/d compared with the previous year due to the increases in OPEC production (Table 1).

FIGURE 4: WORLD PRODUCTION OF OIL, 2002-2011



Source: BP statistical review 2012

The political unrest in Libya resulted in output losses, but these losses were offset by increased output in Saudi Arabia, the UAE and Qatar. The US had the largest increases among non-OPEC producers, driven by continued strong growth in onshore production of oil shale.

TABLE 1 – WORLD PRODUCTION OF OIL, 2011

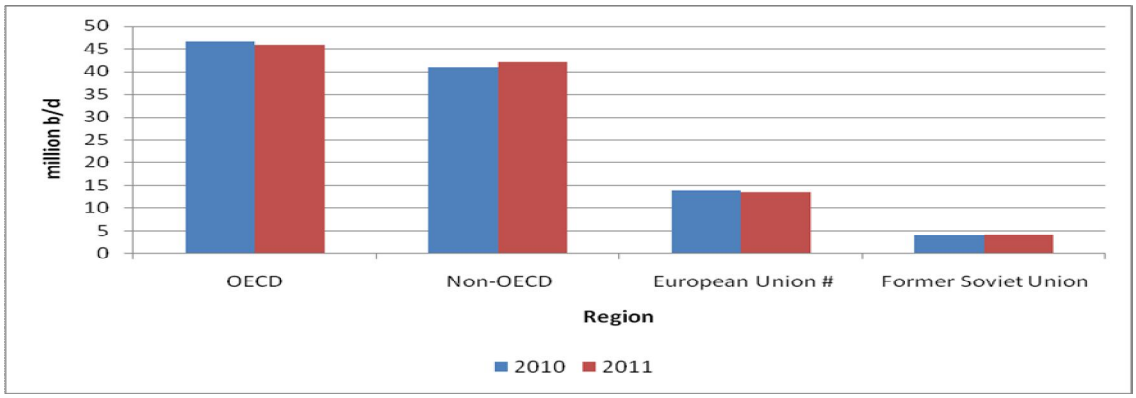
PRODUCTION			
	OIL		2011 Share of Total
	(1000 bbl/d)		percent
OPEC COUNTRIES	2 010	2 011	
Algeria	1 762	1 729	2.1
Indonesia	1 003	942	1.1
Iran	4 338	4 321	5.2
Iraq	2 480	2 798	3.3
Kuwait	2 518	2 865	3.4
Libya	1 659	479	0.6
Nigeria	2 453	2 457	2.9
Qatar	1 569	1 723	2.1
Saudi Arabia	9 955	11 161	13.4
UAE	2 867	3 322	4.0
Venezuela	2 775	2 720	3.3
Subtotal	**33 379**	**34 516**	**41.3**
OTHER SELECTED COUNTRIES			
Argentina	652	607	0.7
Australia	561	484	0.6
Brazil	2 137	2 193	2.6
Brunei	172	166	0.2
Canada	3 367	3 522	4.2
China	4 077	4 090	4.9
Ecuador	495	509	0.6
Europe and Eurasia (EE)	17 629	17 314	20.7
India	827	858	1.0
Malaysia	642	573	0.7
Mexico	2 958	2 938	3.5
Oman	865	891	1.1
USA	7 555	7 841	9.4
Other	7 164	7 074	8.5
Subtotal	**41 937**	**49 059**	**58.7**
TOTAL	**82 480**	**83 576**	**100**

Source: BP statistical review 2012

4.1.2. Demand/ Consumption

Major demand markets for oil are the transport sector which accounts for approximately 52 percent of the total demand, followed by the industrial sector at 33 percent, electricity generation and residential sectors at 6 percent each.

FIGURE 5: GLOBAL OIL CONSUMPTION BY REGION, 2010-2011



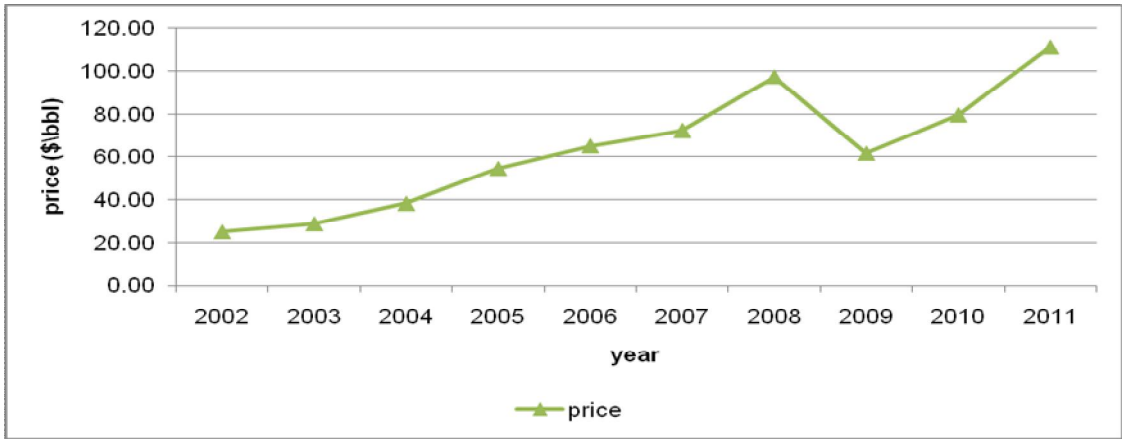
Source: BP statistical review 2012

Global oil consumption increased by 0.7 percent to 88 million b/d, owing to a 2.8 percent growth in non-OECD countries, which offset the 1.2 percent decline in non-OECD (Fig.5). Oil consumption growth was modest in major producing regions of the Middle East and Africa due to political unrest. The US, at 20.5 percent, is still the largest consumer of oil in the world, followed by China and Japan at 11.4 and 5 percent respectively.

4.1.3. Prices

The Brent crude oil price has been increasing at an average of 15 percent per annum since 2002, due to increasing demand. The price steadily increased until 2008, where it started dropping due to slow demand resulting from the global recession. However, the price of oil has improved significantly since then. In 2011, the oil price averaged at $111.26/bbl, a 39.95 percent increase compared to $79.50\bbl in 2010. The loss of the Libyan supply early in the year, combined with smaller disruptions in a number of other countries pushed prices higher despite a large increase in production among other OPEC countries and the release of strategic stocks from international energy agency member countries.

FIGURE 6: BRENT CRUDE PRICES, 2002-2011



Source: BP statistical review

4.1.4. Oil Refineries

Global oil refining capacity has increased by 1.5 percent to 93 million b/d in 2011, compared to 91.6 million b/d in 2010. The US has the largest refining capacity in the world at 19.1 percent, followed by China's 11.6 percent and Russia's 6.1 percent (Table 2).

TABLE 2: REGIONAL OIL REFINERY THROUGHPUTS

Refinery throughputs **Thousand barrels daily***	**2010**	**2011**	**2011 share of total %**
US	17 594	17 730	19.1%
Canada	1 951	2 046	2.2%
Mexico	1 463	1 606	1.7%
S. & Cent. America	6 653	6 590	7.1%
Europe & Eurasia	24 435	24 570	26.4%
Middle East	7 923	8 011	8.6%
Africa	3 192	3 317	3.6%
China	10 302	10 834	11.6%
Japan	4 291	4 274	4.6%
Other Asia Pacific	1 638	1 667	1.8%
Other	12 174	12 359	13.3%
TOTAL WORLD	**91 616**	**93 004**	**100.0%**

Source: BP Statistical Review of World Energy, 2012

4.2 NATURAL GAS

4.2.1. Supply / Production

World proven natural gas reserves amounted to 208.4 Tcm in 2011, a 5.9 percent increase from 196.1 Tcm in 2010. Russia, at 44.4 percent has the world's largest reserves followed by Iran's 33.1 percent and Qatar's 25 percent, (Table 3). Gas production rose by 3.1 percent to 3 276.2 Bcm in 2011. The US was the largest producer at 20 percent, followed by Russia's 18.5 percent and Canada's 4.9 percent. Libya's production declined by more than 75 percent due to political instability. However; production increases in a number of countries such as Iraq, Qatar and Brazil made up for the shortfall.

TABLE 3: WORLD GAS RESERVES AND PRODUCTION, 2010-2011

Country	Natural Gas Reserves / trillion m^3			Natural Gas Production / billion m^3		
	2010	2011	2011 Share of Total Percent	2010	2011	2007 Share of Total Percent
Saudi Arabia	8.0	8.2	3.9%	87.7	99.2	3.0%
Canada	1.8	2.0	1.0%	159.9	160.5	4.9%
Iran	33.1	33.1	15.9%	146.2	151.8	4.6%
Iraq	3.2	3.6	1.7%	1.3	1.9	0.1%
Kuwait	1.8	1.8	0.9%	11.7	13.0	0.4%
United Arab Emirates	6.1	6.1	2.9%	51.3	51.7	1.6%
Venezuela	5.5	5.5	2.7%	30.2	31.2	0.9%
Russia	44.4	44.6	21.4%	588.9	607.0	18.5%
Libya	1.5	1.5	0.7%	16.8	4.1	0.1%
Nigeria	5.1	5.1	2.5%	36.6	39.9	1.2%
Kazakhstan	1.9	1.9	0.9%	17.6	19.3	0.6%
United States	8.2	8.5	4.1%	604.1	651.3	20.0%
China	2.9	3.1	1.5%	94.8	102.5	3.1%
Qatar	25.0	25.0	12.0%	116.7	146.8	4.5%
Algeria	4.5	4.5	2.2%	80.4	78.0	2.4%
Brazil	0.4	0.5	0.2%	14.4	16.7	0.5%
Mexico	0.3	0.4	0.2%	55.1	52.5	1.6%
Azerbaijan	1.3	1.3	0.6%	15.1	14.8	0.5%
Norway	2.0	2.1	1.0%	106.4	101.4	3.1%
Others	39.2	49.9	23.9%	943.2	932.7	0.3
World Total	**196.1**	**208.4**	**100.0%**	**3178.22**	**3276.216**	**100.0%**

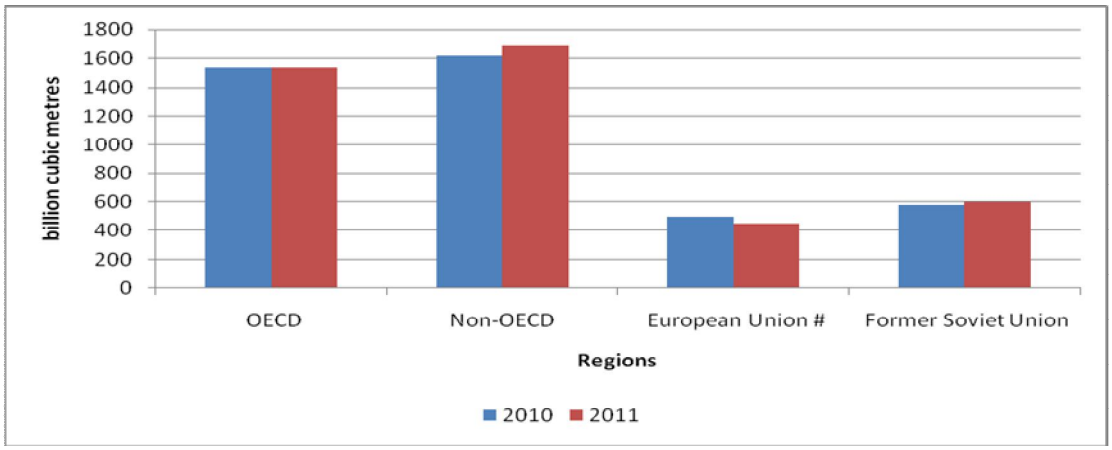
Source: BP Statistical Review of World Energy, 2012

4.2.2. Demand/ Consumption

Natural gas consumption rose by 2.2 percent to 311.8 Bcf in 2011, compared with 305.1 Bcf in 2010. Consumption growth was negative in most regions except for non-OECD and the Former Soviet Union (Fig.7).

The US was the largest consumer of natural gas at 21.5 percent, followed by Russia at 13.2 percent and Iran at 4.7 percent. The largest growth in consumption was recorded in China (21.5 percent), Saudi Arabia (13. 2 percent) and Japan (11.6 percent). These increases offset the largest decline on record in EU gas consumption (-9.9 percent) driven by a weak economy, high gas prices, warm weather and continued growth in renewable power generation.

FIGURE 7: REGIONAL NATURAL GAS CONSUMPTION, 2010 – 2011



Source: BP Statistical Review of World Energy, 2012

4.2.3. Prices

Natural gas consumption has been increasing since 2002 pushing the Henry Hub natural gas spot price upwards to high levels reaching, $8.79 per million Btu in 2005 and $8.85 per million Btu in 2008. However, prices started declining at the end of 2008 from $8.85 per million Btu to $4.01 per million Btu in 2011 (Fig.8) as a result of the surging natural-gas production and weak demand for gas-fired heating due to the mild winters in major consuming countries.

FIGURE 8: HENRY HUB NATURAL GAS SPOT PRICE, 2002-2011

Source: BP Statistical Review of World Energy, 2012

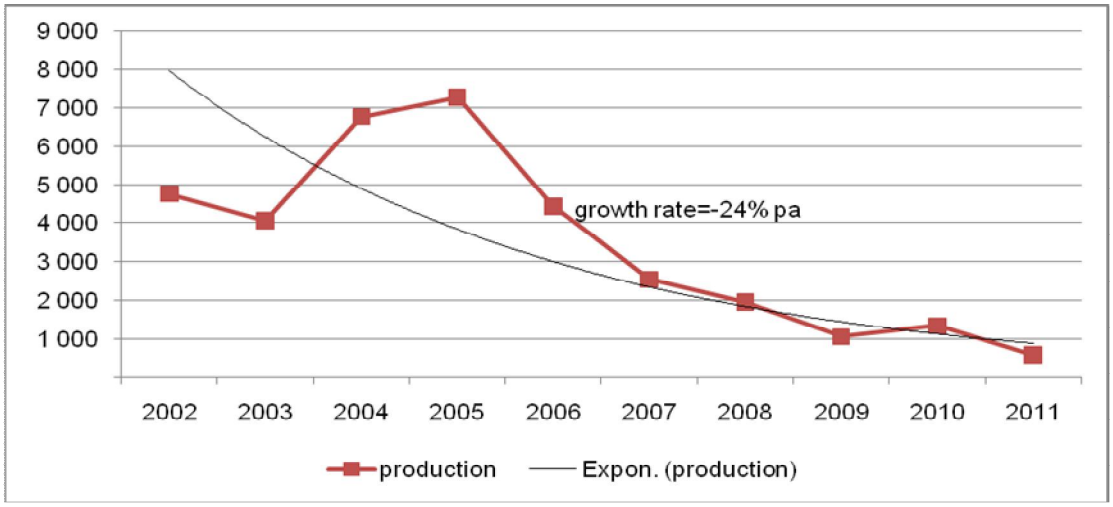
5. SOUTH AFRICA'S FUEL INDUSTRY

South Africa is one of the leading economies in Africa and a key player in the African oil industry. Liquid fuels are an important component of the South African energy sector. The hydrocarbon fuel industry is dominated by fossil fuels, an abundance of coal reserves that have led to the establishment of a well-developed synthetic fuels industry. The country produces approximately 5 percent of its fuel requirements from gas (GTL), 35 percent from coal (CTL), 50 percent from crude oil and the balance is imported.

5.1. Oil

South Africa had 15 million barrels proven oil reserves in 2011; which are located offshore in the Bredasdorp basin and off the west coast of the country near the border with Namibia. The country's production of crude oil has been declining at an average of 24 percent annually for the past decade, due to the depleting reserves at PetroSA's Oribi and Oryx oilfields. In 2011, production continued to shrink amounting to 591 bbl, a 130 percent decline compared to 1 358 bbl in 2010 (Fig.9). This was as a result of production halts at PetroSA's Oribi Oilfield.

FIGURE 9: SOUTH AFRICA'S PRODUCTION OF CRUDE OIL, 2002-2011



Source: DMR, Directorate Mineral Economics

The country's consumption of oil decreased to 528 000 bbl/d in 2008 due to slow demand resulting from the global recession that started at the end of 2008. However, consumption increased in 2010 to 547 000, mainly due to remedial activities (Table 4).

TABLE 4: SOUTH AFRICA'S CRUDE OIL CONSUMPTION, 2007-2011

Year	Consumption (bbl/d)	Change (%)
2007	549 000	
2008	528 000	-3.8 %
2009	517 000	-2.08 %
2010	547 000	5.8 %
2011	547 000	0%

Source: BP Statistical Review of World Energy, 2012

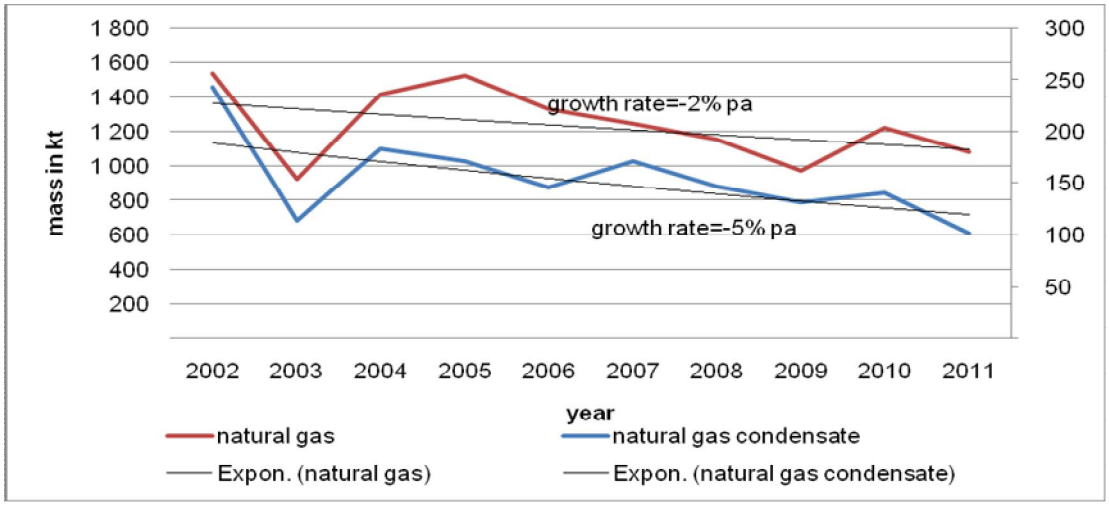
In 2011, the country imported 17.83 billion tons of crude oil. The majority of oil imports are from OPEC countries, mainly the Middle East, Nigeria and Angola.

5.2. Natural Gas

South Africa has an estimated 318 billion cubic feet of proven natural gas reserves. However, to compensate for the lack of large natural gas reserves, South Africa has entered into a natural gas supply agreements with neighbouring countries such as Mozambique and Namibia. Production of natural gas and natural gas condensate has been declining by 2 and 5 percent respectively, since 2002 due to diminishing gas reserves (Fig.10).

In 2011, domestic production further diminished to 1.08 Mt of natural gas and 102 kt of the associate condensate as a result of PetroSA reducing its throughput of its plant to about 60 percent of its capacity until 2013 when additional feedstock from the F-O gasfield is expected to be available. The company is also pursuing plans to import Liquefied Natural Gas (LNG) and is undertaking exploration activities to secure additional gas sources.

FIGURE 10: SOUTH AFRICA'S PRODUCTION OF NATURAL GAS, 2002-2011



Source: DMR, Directorate Mineral economics

The consumption of natural gas in South Africa started falling by 11.76 percent in 2009 to 3.0 Mt, compared to 3.4 Mt in 2008, due to shutdowns, commissioning delays and start-up instabilities. However, consumption recovered to 3.5 Mt in 2010 owing to the lack of interruptions. In 2011, it increased by a further 8.57 percent to 3.8 Mt (Table 5).

TABLE 5: SOUTH AFRICA'S CONSUMPTION OF NATURAL GAS, 2007-2011

Year	Consumption (Mt)	% change
2007	3.1	
2008	3.4	9.68 %
2009	3.0	-11.76 %
2010	3.5	16.67 %
2011*	3.8	8.57 %

Source: BP Statistical Review of World Energy, 2012 (estimated)*

5.3. DOWNSTREAM VALUE ADDITION

South Africa has the second largest refining capacity in Africa at 703.000 bbl/d, exceeded only by Egypt at 726.250 bbl/d. The country has four oil refineries, which have a combined capacity of producing 508.000 bbl/d of liquid fuel. They are Sapref and Enref in Durban, Chevref in Cape Town, and Natref at Sasolburg. Including two synfuel's facilities (Sasol and PetroSA) that have a combined capacity of 195.000 bbl/d of liquid fuels from coal and gas (Table 6). The final products include petrol, kerosene (paraffin), diesel, propane, liquid oxygen and nitrogen, distillates, eco-fuels, process oils and alcohols

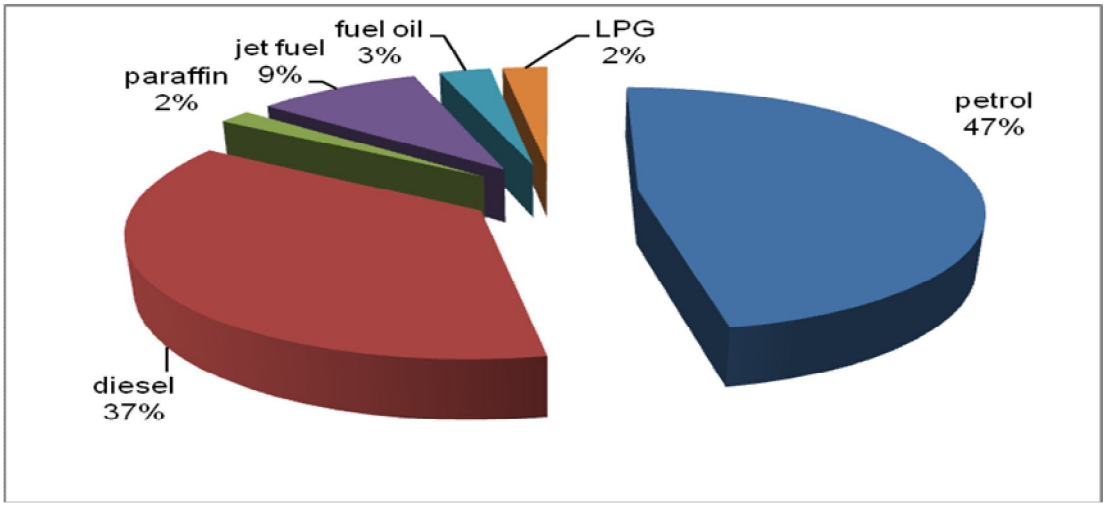
TABLE 6: SOUTH AFRICA'S REFINING CAPACITY (BBL/D)

Refineries	2009	2010	2011
Sapref	180 000	180 000	180 000
Enref	125 000	120 000	120 000
Chevref	100 000	100 000	100 000
Natref	108 000	108 000	108 000
Sasol	150 000	150 000	150 000
PetroSA	45 000	45 000	45 000
Total	**708 000**	**703 000**	**703 000**

Sapia, annual report 2011

Petrol at 47 percent is the most consumed petroleum product followed by diesel and jet fuel at 37 and 9 percent, respectively (Fig.11). The bulk of South Africa's fuel demand comes from inland, particularly in Gauteng.

FIGURE 11: SOUTH AFRICA'S CONSUMPTION OF PETROLEUM PRODUCTS



Source: Sapia annual report, 2011

5.3. SHALE GAS IN THE KAROO

South Africa could have extensive shale gas resources, which could be converted into liquid fuels as well as be used as a fuel for electricity generation. The United States Energy Information Administration (EIA) has estimated a recoverable resource of 485 trillion cubic feet (Tcf) of gas in the Karoo Basin. This assessment was evaluated by the Petroleum Agency of South Africa, which concluded that, owing to the limited amount of available data in the area, it is impossible to quantify the resource accurately. However, it is essential that additional, modern subsurface information be obtained through drilling or a geophysical survey to substantiate these estimates. However, exploration plans were put on hold, owing to environmental concerns that led to a moratorium on licensing and exploration by the government in 2011. The moratorium was lifted by Cabinet in September 2012, to allow for the recommendations made by the Fracking Task Team.

The Task Team recommended that:

- Normal exploration will be allowed, such as geological field mapping and other data gathering activities, geological field mapping and other data gathering activities to proceed under the existing regulatory framework.
- Constitute a monitoring committee to ensure comprehensive and co-ordinated augmentation of the regulatory framework and supervision of operations.
- Augment the current regulatory framework. The establishment of the appropriate regulations, controls and co-ordination systems is expected to take 6–12 months.
- Departments of Science & Technology and Mineral Resources to collaborate in developing mechanisms for the co-existence of the Astronomy Research Projects and development of shale gas in the Karoo.
- Once all the preceding actions have been completed, authorise hydraulic fracturing under strict supervision of the monitoring committee. In the event of any unacceptable outcomes, the process may be halted.
- Ongoing research to be conducted and facilitated by relevant institutions to develop and enhance scientific knowledge in respect of the development of Karoo shale gas. This includes, although not limited to, geo-hydrology of prospective areas, methodologies for hydraulic fracturing in RSA and environmental impacts.
- The actions required to give effect to the proposed conditional approval must be properly resourced, incorporated into the programmes of the relevant departments and agencies and capacity developed.

According to the Real Economy Year Book 2012, if 10 percent of the technically recoverable reserves were to be economically viable, this would provide feedstock for gas-to-liquids (GTL) fuel production equivalent to nearly 50 years of current petroleum consumption. Fracking could add between R80 billion and R200 billion to the country's GDP and create more than 300 000 jobs if a small portion of the shale resource base were exploited.

5.4. BIOFUELS

Biofuels are produced from organic crops such as sugar cane and sunflower. They produce less carbon dioxide and other emissions in the combustion process compared to liquid fuels made from mineral oil. It is estimated that greenhouse-gas emission reductions range between 35 percent and 65 percent.

The erstwhile Department of Minerals and Energy, published a Biofuels Industrial Strategy in 2007, which targeted a 2 percent penetration for biofuels in liquid fuels within five years. Crops proposed by the strategy for biofuels production include sugar cane and sugar beet for bio-ethanol and sunflower, canola and soya beans for biodiesel. The Department of Energy published Regulations Regarding the Mandatory Blending of Biofuels with Petrol and Diesel in August 2012. The regulation or discussion document determines an appropriate financial mechanism that enables this strategy.

The benefits of developing a biofuels industry in South Africa could be significant. In addition to reducing the country's dependence on imported crude oil, small scale agriculture could receive a significant boost from the biofuels industry, with government expected to require that no less than 25 percent of biofuel feedstock is sourced from small-scale farmers. This industry has the potential to create 34 000 jobs. South Africa's targets of biofuels can be achieved without jeopardising food security. The strategy does not include essential crops like maize for example.

The Industrial Development Corporation (IDC) is proceeding with a bioethanol project in Craddock. This project is expected to produce 300 000 l/d of fuel from grain sorghum and is expected to start production in 2014. The IDC ultimately intends to bring three biofuel projects into production. These ventures could produce a combined output of 300-million litres of fuel a year.

Another possible biofuel project is a sugar beet and grain sorghum project implemented by Sugar Beet RSA in collaboration with the Department of Agriculture, Forestry and Fisheries. Construction of the plant is expected to start in 2012 and it could initially produce about 90-million litres of fuel a year, with the potential to increase output to 200-million litres a year.

In the beginning of 2012, three of the world's biggest commercial aircraft manufacturers – Airbus; Boeing; and Embraer announced the signing of a memorandum of understanding regarding the joint development of easily applicable and affordable aviation biofuels. As a result, in mid-2012, it was reported that an initial strategy for meeting South Africa's aviation biofuel requirements was to be released before the end of the year. The Department of Public Enterprises has convened a technical working group, which involves State-owned companies and relevant government departments and agencies, to develop an effective supply-chain strategy. This was prompted in part by the indication given by South African Airways that it would require biofuels to comprise half of its fuel supply by 2020 to avoid future penalties. This will create a pressing demand for an extremely large quantity of biofuels, which can form a base load against which a fully vertically integrated biofuels industry can develop in South Africa and the region.

5.5. RECENT DEVELOPMENTS

The South African oil company, PetroSA, has proposed the development of a new refinery at Coega in the Eastern Cape known as Project Mthombo. The facility is expected to come on stream in 2020 and will have a capacity to produce between 200 000 bbl/d and 360 000bbl/d of liquid fuels products by refining crude oil and the project is expected to cost $11 billion. The company is continuing with the preparations for the refinery, despite not having received government's permission yet. The project has gained momentum as a result of the recent signing of a joint study agreement with a Chinese petrochemical corporation (Sinopec). The agreement will result in the commissioning of studies in two phases over a period of 18 months, phase 1 will include market studies, as well as the review and selection of a business case, while phase 2 will result in the development of a business case that is expected to prepare Project Mthombo for the front- end engineering design stage.

In an effort to curtail the impact of the liquid fuels on the environment, new liquid fuel specifications from the Energy Department will come into effect in South Africa in July 2017. These specifications, which will result in the industry migrating from the current Clean Fuel 1(CF1) standard to an improved Clean Fuel 2(CF2) standard that is equivalent to Euro V specifications, will require that existing refining facilities be upgraded. It is estimated that the required upgrades could cost about R40-billion. Sapref will be carrying out modifications to several existing units and build two new process units. At Natref, certain infrastructure changes would further reduce the level of sulphur in petrol and diesel, and to reduce levels of benzene in petrol. Therefore, a R5 billion investment will be made at the facility for that purpose.

The competition commission is investigating six major fuel companies that have allegedly been fixing the price of diesel and dividing the market which is in contravention of the Competition Commission Act. The commission's action extends to SAPIA, which represents the collective interests of its members who are Chevron, Engen, Shell, Total and BP. The commission indicated that the referral to the competition tribunal was as a result of a wide range of investigations by the commission into possible collusive conduct in liquid fuels. The investigation started in 2009 and it revealed evidence of collusive conduct through extensive exchanges of commercially sensitive information by the respondent oil companies. These exchanges started in the 1980's, but with effect from 2005, this was largely achieved through SAPIA. The commission indicated that, while the diesel price was not regulated there was a maximum wholesale list selling price (WLSP) published by the Department of Energy. The companies used the WLSP as their benchmark price and prevented competitive discounting. These companies could face administrative penalties of up to 10 percent of their annual turnover. The alleged conduct is affecting farmers, the road freight industry, fishing and the mining industries.

The National Planning Commission (NPC) has identified five potential strategies for increasing South Africa's liquid fuels supply:

- Building a new oil-to-liquid refinery;
- Building a new CTL refinery;
- Upgrading the country's existing refineries to allow for significant capacity expansion;
- Importing increased quantities of refined fuel, and
- Partnering in the building of a new refinery elsewhere, such as Angola or Nigeria, and buying a share of the product of that refinery.

The Department of Energy is undertaking an audit of South Africa's refineries to determine the most suitable option. That audit will inform a 20-year liquid fuel infrastructure roadmap that is expected to be completed before the end of the first half of 2013.

6. OPPORTUNITIES AND CHALLENGES FACED BY THE INDUSTRY

6.1. OPPORTUNITIES

- **Improved Technology**

An explosion in new technology: significantly better computer-aided geological modelling and major advances in drilling, particularly through the initiation of horizontal drilling during the past ten years has changed the landscape of this industry. Companies are developing ever-deeper resources, thanks to the evolution of advanced drilling and production technologies.

- **The West Coast, as a Hub for Regional Oil and Gas Activities**

South Africa's West Coast could become a major oil and gas hub for the entire sub-Saharan Africa region. The offshore area from Saldanha up to the Orange River Basin is an important area for oil and gas exploration and showed great potential for development. Great opportunities for the West Coast, is the provision of support, services and equipment to the oil and gas exploration and production activities in the sub-Saharan Africa region. Unlike oil and gas operations, the supply industries serving these projects could be very labour intensive; the ship and rig-repair business in particular had great potential to expand and create many jobs. Saldanha Bay, because of its available land, deep water port and established engineering community, has the potential to develop significantly as a hub for regional oil and gas activity.

- **Oil shale in the Karoo**

The extraction of oil in the Karoo will provide a lot of opportunities in this country, in terms of infrastructure development and job creation which will benefit the growth of the economy, particularly in the Northern Cape. These resources could also secure energy supply for another 400 years at the current rate of consumption.

6.2. CHALLENGES

Environmental concerns and the country's aging refineries have been the subject of debates for continual upgrading and modernisation, particularly to upgrade to produce Euro 5 fuels as required by the government. However, the refineries are reluctant to commit the required investment because of slim refining margins. The implementation of the proposed carbon tax is likely to have a significant negative impact on the margins of SASOL, the second largest Greenhouse Gas (GHG) emitter. It is likely to impact on product viability and prices.

7. OUTLOOK

Global liquids demand is expected to rise by 16 Mb/d, exceeding 103 Mbbl/d by 2030. Growth will mainly come from the rapidly-growing non-OECD economies. Increasing supply to meet expected demand growth will come primarily from OPEC, where output is projected to rise by nearly 12 Mb/d. Crude oil output from Iraq and Saudi Arabia is expected to increase to 6 Mb\d and 3 Mb\d respectively. Supply from the Americas will also expand by 8 Mb/d, as advances in drilling technologies unlock additional resources in the Canadian oil sands (+2.2 Mb/d), Brazilian deepwater (+2 Mb/d), and US shale oil (+2.2Mb/d). Overall, non-OPEC output is projected to rise by over 5 Mb/d as these growth areas more than offset declining conventional output elsewhere.

Natural gas is projected to be the fastest growing fossil fuel globally (2.1 percent p.a.). The non OECD accounts for 80 percent of global gas demand growth, which is expected to increase by 2.9 percent per annum by 2030. Demand grows fastest in non-OECD Asia (4.6 percent p.a.) and the Middle East (3.7 percent p.a.). Growth in gas demand is supported by fuel substitution, especially in the OECD, triggered by regulatory changes and lower relative prices. On the supply side the main regional contributors to growth are the Middle East (26 percent of global growth) and Former Soviet Union (FSU) (19 percent), while significant additional capacity is also expected from Australia, China, and the US.

In South Africa, crude oil and natural gas production is expected to continue declining due to diminishing reserves. However, if the exploration activities currently taking place could yield positive results, supply will be secured in the long term. Otherwise, until such time, South Africa will continue to rely on imports. Consumption of natural gas is expected to increase by 4.4 percent, reaching 4.6 Mt by 2016.

South Africa's oil consumption is anticipated to increase by 0.2 percent reaching 552 470 bbl/d, due to increasing demand of liquid fuels. The country's demand for crude oil is expected to reach 600 000 bbl/d by 2021. Demand for liquid fuel products is currently exceeding the country's ability to manufacture such products. Despite the fact that the shortfall is met through imports of refined fuel, the country has experienced localised incidents of liquid fuel shortages. In recent times, these shortages have increased in frequency and severity, and fears exist about the country's future

security of liquid fuels supply. A decision has to be taken on which of the NPC's five potential strategies will be able to assist in increasing the country's liquid fuels supply.

The South African government has recognised that the emission of greenhouse gases (GHG) from the use of hydrocarbons has led to an increasing concern about global climate change. Hence, its plan to introduce alternatives such as biofuels and use cleaner technologies such as UCG. The current regulatory framework will ensure that government meets its commitment to reducing GHG emissions and the successful exploitation of cleaner energy sources, is likely to also encourage investment in the country. The conversion to cleaner technologies will initially be capital intensive. However, positive results and benefits could far outweigh these costs.

Shale gas and biofuels could reduce the country's dependence on imports as well as generate significant investment in new infrastructure, help meet South Africa's carbon reduction goals and create numerous new jobs in line with governments' priorities.

8. REFERENCES

1. *BP Statistical Review of World Energy, June 2008*
2. *Business day, 25 October 2012. Oil firms' price-fixing case referred to tribunal*
3. *Business report, 25 October 2012. Fuel companies set to appear before tribunal*
4. *Energy Information Administration (www.eia.doe.gov)*
5. *Engineering News, 01 August 2008 (http://www.engineeringnews.co.za)*
6. *http//www.mbendi.com (World: Oil and Gas Overview)*
7. *http://energyimages.com*
8. *http://everythingscience.co.za/grade-12/05-the-chemical-industry/05-the-chemical-industry-02.cnxmlplus*
9. *http://www.cef.org.za*
10. *http://www.iea-coal.org.uk/site/2010/conferences/ucg?*
11. *http://www.offshore-technology.com/projects*
12. *http://www.opec.org*
13. *http://www.scandoil.com*
14. *International Coal Market & Policy Developments in 2007/08, Coal Industry Advisory Board, January 2009*
15. *International Energy Outlook 2008*
16. *Mining weekly, 24 October 2008*
17. *Petroleum Extraction: http://superioroilandgas.com*
18. *SAPIA, Annual Report 2006*
19. *South Africa's Mineral Industry 2006/2007*
20. *World Oil Outlook 2008*
21. *www.dailytenders.co.za/Global/News*
22. *www.howwemadeitinafrica.com/category/sectors/**oil**-**gas**/*