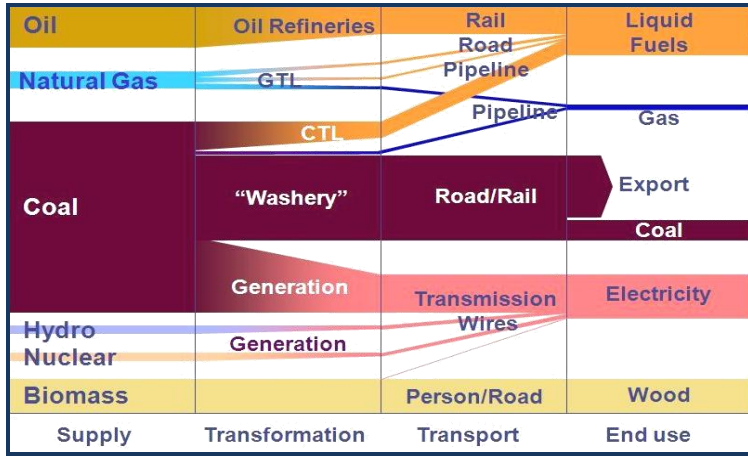
SOUTH AFRICAN ENERGY SYNOPSIS 2010



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The Department of Energy of the Republic of South Africa

Mandate

Ensure secure and sustainable provision of energy for socio-economic development.

Mission

To regulate and transform the sector for the provision of secure, sustainable and affordable energy.

Vision 2014

A transformed and sustainable energy sector with universal access to modern energy carriers for all by 2014.

Vision 2025

Improving our energy mix by having 30% of clean energy by 2025.

ACKNOWLEDGEMENTS

The South African Energy Synopsis was created by overhauling the South African Energy Profile which was last published in 2003 by the South African National Energy Association (SANEA). The Synopsis contains the most recent data collected by the Department of Energy and reflects recent changes and developments in the energy sector. Data are primarily from the Department of Energy's 2006 energy balances. Other information was sourced from the Department of Energy Strategic Plan, the South African Energy Price Report, the Reserve Bank Quarterly report, Department of Mineral Resource (DMR) reports, South African Revenue Service (SARS), annual reports for Eskom's and South African Petroleum Industry Association (SAPIA) and various directorates within the Department of Energy.

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ABBREVIATIONS

BEE	-	Black Economic Empowerment
BFP	-	Basic Fuel Price
CDM	-	Clean Development Mechanism
CO_2	-	Carbon dioxide
DME	-	Department of Minerals and Energy
DOE	-	Department of Energy
DSM	-	Demand Side Management
EDRC	-	Energy and Development Research Centre
EWP	-	Energy on White Paper
EDRIC	-	Electricity Distribution Industry Restructuring Committee
ERC	-	Energy Research Centre
ERI	-	Energy Research Institute
FBC	-	Fluidised Bed Combustion
GDFI	-	Gross Domestic Fixed Investment
GEAR	-	Growth Employment and Redistribution
GTL	-	Gas-to-Liquids

HDSA	-	Historically Disadvantaged South Africans
HFO	-	Heavy Furnace Oil
IBLC	-	In-Bond-Landed-Cost
IEP	-	Integrated Energy Planning
IRP	-	Integrated Resource Plan
IPP	-	Independent Power Producer
LPG	-	liquid Petroleum Gas
NEPAD	-	New Partnership for African Development
NER	-	National Electricity Regulator
NNR	-	National Nuclear Regulator
NO_x	-	Nitrous Oxides
NPA	-	National Ports Authority
RDP	-	Reconstruction and Development Programme
SAEE	-	The Southern African Association for Energy Efficiency
SAPIA	-	South African Petroleum Industry Association
SANEDI	-	South African National Energy Development Institute
SEMA	-	South African Energy Management Association
SO_2	-	Sulphur Dioxide

INTRODUCTION

The purpose of the South African Energy Synopsis is to provide a summary of recent and topical energy policies and the latest national energy statistics in a compact format. The Synopsis complements the South African Energy Digest and Price Report. The Digest summaries historical energy supply and demand and the Price Report provide historical prices of commonly use energy carriers.

The Synopsis begins with a description of the Department of Energy and briefly summarises key energy policy documents and energy related legislation. State owned enterprises reporting to the Department of Energy are listed and briefly described. The supply of various energy carriers used to meet demand is summarised and the demand for energy for each economic sector are presented. Figures and tables are used to highlight the main features of each topic at a quick glance. Further information is provided adjacent to each figure. The Digest of South African Energy Statistics and the Energy Price Report should be consulted for more detailed information.

OVERVIEW OF THE DEPARTMENT OF ENERGY

The Department of Energy was established in May 2009 as a result of a decision by the President to separate the Department of Minerals and Energy into two independent departments – the Department of Energy and the Department of Mineral Resources. The Minister of Energy is Ms Dipuo Peters, the Deputy Minister is Ms Barbara Thompson and the Director-General is Ms Nelisiwe Magubane. This restructuring was informed by the increasing recognition of the importance of achieving energy security in a world dominated by varying and different interests.

Mandate and Strategic Objectives

The mandate of the Department of Energy is to formulate and exercise oversight in the implementation of overall energy policies, to ensure access to affordable and reliable energy by all South Africans and to promote environmental friendly energy use. The Department of Energy is responsible for ensuring development, processing, utilisation and management of South Africa's energy resources. As the country's economy continues to grow, energy is increasingly becoming a key focus.

The Department's strategic plan seeks to deliver results with eight strategic objectives:

- Ensure energy security – creating and maintaining a balance between energy supply and energy demand, develop strategic partnerships, improve co-ordination in the sector and ensure reliable delivery and logistics;
- Achieve universal access and transform the energy sector – diversify energy mix, improve access and connectivity, provision of quality and affordable energy, promote safe use of energy and transform the energy sector;
- Regulate the energy sector – develop effective legislation, policies and guidelines; encourage investment in the energy sector and ensure compliance with legislation;
- Effective and efficient service delivery – understand stakeholder needs and improve turnaround times;
- Optimal utilisation of energy resources – develop enabling policies and encourage energy efficient technologies;
- Ensure sustainable development – promote clean energy alternatives, encourage economic development and promote job creation;
- Enhance DoE culture systems and people – attract, develop and retain appropriate skills, promote good organisational culture and make the Department an employer of choice; and
- Promote corporate governance – optimal utilisation of resources, manage budget effectively, implement fraud and risk management, and ensure compliance with relevant prescripts.

Structure of the Department of Energy

The department consists of four operational branches: Policy Development; Energy Operational Services; Integrated Energy Planning; and Nuclear Energy; and three support branches: Corporate Services; Financial, Information and Supply Chain Management; and Office of the Chief Operating Officer (COO). The functions of each branch are detailed below.

Operational branches of the DoE

Policy Development:

- Develop, implement and review electrification policies;
- Develop, implement and monitor policy and strategies relating to the restructuring of the supply industry;
- Develop, implement and review hydrocarbons policies; and
- Develop and review policies as required by international agreements and governance of the nuclear sector in South Africa.

Energy Operational Services:

- Regulate pricing, promote public awareness on the state of petroleum products and provide energy advisory services;
- Manage petroleum licensing activities and enforce compliance;
- Oversee the Integrated National Electrification Programme (INEP) for the department; and

- Facilitate the implementation of renewable energy technologies and regulate and promote Clean Development Mechanism (CDM) activities.

Integrated Energy Planning:

- Ensure energy security by developing, implementing and maintaining a National Integrated Energy Plan; and
- Manage and monitor economic factors that impact on the energy industry.

Nuclear Energy:

- Manage and implement all matters relating to nuclear safety and technology as required by legislation and international agreements; and
- Manage all matters related to nuclear non-proliferation and radiation security as required by legislation and international agreements.

Support branches of the DoE

Corporate Services:

- Render auxiliary support services;
- Render communication and knowledge management services;
- Render a strategic human resources service; and
- Render legal advice.

Financial, Information and Supply Chain Management Branch

- Manage all departmental expenditure and creditors;
- Manage the budgetary process and report on Departmental financial activities in terms of the PFMA;

- Render a sound supply chain management service; and
- Develop and maintain all departmental application systems and ensure a sound information technology service.

Office of the Chief Operating Officer

- Monitor the department‘s performance and evaluate the departments impact on operations within and outside the department;
- Ensure the implementation of risk management strategies and compliance with the strategic plan;
- Monitor compliance by the department’s public entities with regard to legislation, finance and administrative requirements; and
- Handle and coordinate international liaison in the field of energy.

Key Energy Policies and Legislation

The Energy White Paper is the premier policy document which guides all subsequent policies, strategies and legislation within the energy sector. Several key energy policy documents are briefly outlined below.

The White Paper on Energy Policy

Following the 1994 elections, there was a general review of policy by government. South Africa had just emerged from the apartheid era and was influenced by international pressures. As the economy opened up, energy sector decisions needed to ensure appropriate energy supply and use. Local policy developments inevitably acknowledge international trends. This led to the 1998 White Paper on Energy Policy. The Energy White Paper consists of four parts: context and objectives for energy policy; demand sectors; supply sectors and crosscutting issues.

The following five policy objectives form the foundation of the White Paper on Energy Policy:

- Increasing access to affordable energy services;
- Improving energy governance. *(Governance of the energy sector will be improved. The relative roles and functions of the various energy governance institutions will be clarified, the operation of these institutions will become more accountable and transparent, and their membership will become more representative of the*

population, particularly in terms of participation by previously disadvantaged people);

- Stimulating economic development. *(Government will encourage competition within energy markets);*
- Managing energy-related environmental and health effects. *(Government will promote access to basic energy services for poor households, in order to ameliorate the negative health impacts arising from the use of certain fuels)*; and
- Securing supply through diversity. *(Given increased opportunities for energy trade, particularly within the Southern African region, government will pursue energy security by encouraging a diversity of both supply sources and primary energy carriers).*

The White Paper on Renewable Energy

The White Paper on Energy Policy provides a national context for the White Paper on Renewable Energy by emphasising integrated resource planning. This ensures that necessary resources are provided to promote renewable energies.

The White Paper on Renewable Energy was published in November 2003. The objective of this policy is to provide an outline of government's vision, policy principles and strategic objectives for encouraging the use of renewable energies and to inform the relevant institutions of their role within the process. The midterm (10-year) aim of the Paper is to facilitate the production of 10 000 GWh of final energy consumption by 2013, representing 4% of projected electricity demand.

Climate change, the potential for renewable energy markets and South Africa's role in the international arena have created an environment for South African entities to participate in renewable energy developments. In particular, the Johannesburg Action Plan from the World Summit on Sustainable Development (WSSD) has increased the urgency for global action against climate change. The White Paper on Renewable Energy is currently undergoing a review process by the department.

Integrated Resource Plan, 2010

The Integrated Resource Plan (IRP2010) supersedes the Energy Security Master Plan for Electricity which was approved by cabinet in 2001. The IRP2010 determines the demand profile for electricity over the next 20 years and details how this demand can be most effectively met from different sources, such as nuclear energy, coal, gas and renewable energies.

The IRP is intended to:

- Improve the long term reliability of electricity supply through meeting demand criteria over and above keeping pace with economic growth and development;
- Ascertain South Africa's capacity investment needs for the medium term business planning environment;
- Consider environmental and other externality impacts and the effect of using renewable energy technologies in reducing environmental impacts; and

- Provide a framework for Ministerial determination of new generation capacity (inclusive of the required feasibility studies) as envisaged in the New Generation Capacity regulations.

National Energy Act

The National Energy Act, 34 of 2008, is a framework legislation which empowers the Minister to undertake certain measures to ensure energy security including integrated energy planning, energy research and collection of information regarding energy demand, supply and generation. It also serves to address gaps in existing legislation or those elements in the Energy White Paper which have not been implemented.

Integrated Energy Planning

- Integrated Energy Plan (IEP) involves estimating how much energy all the different consumers (e.g. industry or households) will need in the future to deliver certain services; and then identifying a mix of appropriate sources and forms of energy to meet these energy service needs in the most efficient and socially beneficial manner.

- The IEP is both a methodology and a framework for analyzing the energy system and linking policy formation to broader national goals. IEP focuses on the energy service needs of energy users. To meet users needs effectively, different fuels or a mix of fuels or possibly alternative investment in conservation or efficiency measures need to be considered. Energy systems analysis and subsequent policy

formulation has to manage effectively the balance required by the complex set of interaction between individual supply sector and wider socio-economic, policy and environmental considerations.

- In terms of Section 6(1) of the National Energy Act, Act 34 of 2008 the Minister must develop and, on an annual basis, review and publish the Integrated Energy Plan (IEP) in the Government Gazette.

National Nuclear Regulator (NNR)

Activities of the National Nuclear Regulator

- In accordance with the provisions of the NNR Act, the NNR is mandated to exercise regulatory control over nuclear installations, nuclear vessels and other actions capable of causing nuclear damage.
- The purpose of the regulatory process is to ensure the protection of persons, property and the environment from nuclear damage.
- The regulatory process entails authorisation, safety case review and assessment, and the undertaking of compliance assurance and enforcement activities as appropriate

The NNR Act makes provision for the granting of four categories of nuclear authorisation. These are:

- Nuclear installation Licences;
- Nuclear Vessel Licences;
- Certificates of Registration; and
- Certificates of Exemption (NNR, 2010).

National Nuclear Regulator Act

The aim of National Regulator Act, 47 of 1999, is to provide for the establishment of a National Nuclear Regulator in order to regulate nuclear activities; to provide for safety standards and regulatory practices for protection of persons, property and the environment against nuclear damage.

The objects of the Nuclear Regulator are to:

- Provide for the protection of persons, property and the environment against nuclear damage through the establishment of safety standards and regulatory practices;
- Exercise regulatory control related to safety.
- Exercise regulatory control over other actions through the granting of nuclear authorisations; fulfil national obligations in respect of international legal instruments concerning nuclear safety; and ensure that provision for nuclear emergency planning are in place.

Nuclear Energy Act

The aim of Nuclear Energy Act, 46 of 1999, is to:

- Provide for the establishment of the Nuclear Energy Corporation of South Africa (NECSA), a public company wholly owned by the State;
- Provide for responsibilities for the implementation and application of the Safeguards Agreement and any additional protocols entered into by the Republic and the International Atomic Energy Agency in support of the Nuclear Non-Proliferation Treaty;
- Regulate the acquisition and possession of nuclear fuel and related material and equipment as well as activities relating to the importation and exportation of nuclear fuel, material and equipment in order to comply with the international obligations (GCIS, 2010);
- Prescribe measures regarding the discarding of radioactive waste and the storage of irradiated fuel; and
- Provide for incidental matters.

Nuclear Energy Policy and Strategy

Government aims to achieve the following objectives with the Nuclear Energy Policy and Strategy:

- Promotion of nuclear energy as an important electricity supply option through the establishment of a national industrial capability for the design, manufacture and construction of nuclear energy systems;
- Establishment of the necessary governance structures for an extended nuclear energy programme;
- Creation of a framework for safe and secure utilisation of nuclear energy with minimal environmental impact;
- Contribution to the country's national programme of social and economic transformation, growth and development;
- To guide in the actions to develop, promote, support, enhance, sustain and monitor the nuclear energy sector in South Africa;
- Attainment of global leadership and self-sufficiency in the nuclear energy sector in the long term;
- Exercise control over un-processed uranium ore for export purposes for the benefit of the South African economy;
- Establishment of mechanisms to ensure the availability of land (nuclear sites) for future nuclear power generation;
- Allow for the participation of public entities in the uranium value chain;
- Promoting energy security for South Africa;
- Improvement of the quality of human life and to support the advancement of science and technology;

- Reduction of greenhouse gas emissions; and
- Skills development related to nuclear energy.

Petroleum Products Act

The aim of Petroleum Products Act, 120 of 1977, is to:

- Provide measures in the saving of petroleum products and an economy in the cost of the distribution thereof, the maintenance and control of a price, for the furnishing of certain information regarding petroleum products, and for the rendering of services of a particular standard, in connection with petroleum products;
- Provide for the licensing of persons involved in the manufacturing and sale of certain petroleum products;
- Promote transformation of the South African petroleum and liquid fuels industry;
- Provide for the promulgation of regulations relating to such licences; and
- Provide for matters incidental.

Entities Reporting to the Department of Energy

Below is a brief description of the State Owned Enterprises (SOEs) which report to the Department of Energy.

Central Energy Fund (CEF)

I terms of the CEF act, CEF gives effect to the objectives of the central Energy fund.
The objective of the Central energy fund includes; financing and marketing the acquisition (coal), exploitation (coal deposits) and manufacturing (liquid fuels) different energy sources other than any other objective which has been assigned and approved by the Minister with the concurrence of the minister of Finance. (CEF website: 10/01/2011)

The Subsidiaries of CEF includes:

- South African National Energy Institute
- National Energy Efficiency Agency
- Petroleum Agency of South Africa
- Energy Development Cooperation

Electricity Distribution Industry Holdings (EDI)

The Electricity Distribution Industry Holdings is guided by the objectives of electricity distribution industry restructuring as encapsulated in the Energy White Paper of 1998 and the Blueprint on Electricity Distribution Industry Reform of 2001. The EDI restructuring objectives are:

- To provide low cost electricity to all consumers, with equitable tariffs for each customer segment;
- To provide a reliable and high quality supply and service to all customers, in support of the Government's economic and social development goals;
- To meet the country's electrification targets in the most cost-effective manner, and so ensure that electrification is contributing to social and economic development;
- To meet the legitimate employment, economic and social interests of all employees in the sector, and ensure their safety ; and
- To operate in a financially sound and efficient manner, in order to provide a reliable and sustainable future for both consumers and employees.

National Energy Regulator of South Africa (NERSA)

Strategic Objectives of NERSA are:

- To implement relevant energy policy efficiently and effectively;
- To implement relevant energy regulations efficiently and effectively;
- To identify, develop and implement relevant energy rules efficiently and effectively;
- To establish the credibility, legitimacy and sustainability of NERSA as an independent and transparent energy regulator;
- To create an effective organisation that delivers on its mandate and purpose; and
- To evaluate the Energy Regulator's effectiveness.

Nuclear Energy Corporation of South Africa (NECSA)

The main functions of NECSA are to:

- Undertake and promote research and development in the field of nuclear energy and radiation sciences and technology and, subject to the Safeguards Agreement, to make these generally available;
- Process source material, special nuclear material and restricted material and to reprocess and enrich source material and nuclear material; and
- Cooperate with any person or institution in matters falling within these functions subject to the approval of the Minister.

South African National Energy Development Institute (SANEDI)

The South African National Energy Development Institute is established as a juristic person. The functions of the institute, as defined in the National Energy Act, are to promote energy efficiency as well as energy research and development.

ENERGY SUPPLY

The South African energy supply is dominated by coal with 65.7% of the primary energy supply followed by crude oil with 21.6%, renewable and wastes with 7.6 % and Gas with 2.8%. Nuclear, Hydro and Geothermal solar constitute the smallest portion with 0.4%, 0.1%, and 0.1% respectively, as shown for 2006 in Figure 1.

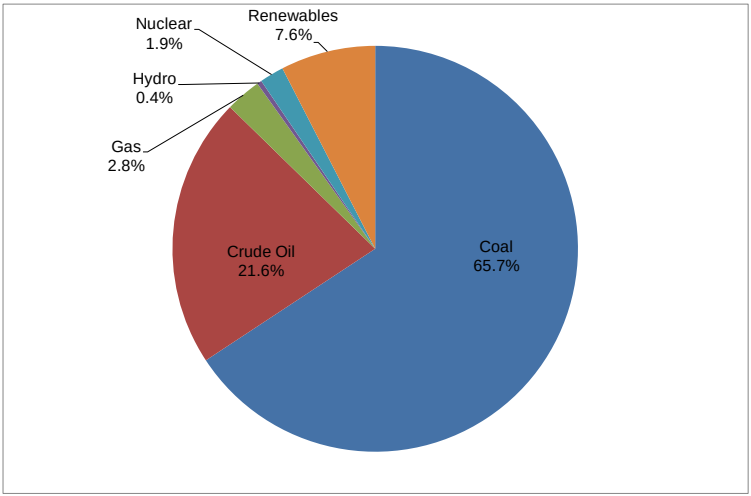

Figure 1: Primary Energy Supply for 2006, Total: 5560 PJ (DME, 2009)

Coal

This section provides a background to the South African coal industry. Resources and production are briefly summarised and key role players are listed. Coal production, imports exports and sales are discussed.

Resources and Production

Coal provides over 70% of South Africa's primary energy. South Africa's coal, which was laid down in about 55 million years between the Permian and Triassic periods, is different from northern hemisphere coals, which were laid down in 330 million years between the Devonian and the Cretaceous periods. South African coal is nearly all bituminous, with very little anthracite. It is generally of low quality with high ash content. However, sulphur levels are low at about 1%. South African coal enjoys a competitive advantage over northern coals in that it is laid down in thick, level seams at shallow depths and is relatively free of faulting.

South Africa has proven coal reserves of 48 Gt, representing 5.7% of total global reserves. The bulk of South Africa's coal reserves are situated in the central basin, which consists of the Witbank, Highveld, Ermelo, South Rand and KwaZulu-Natal coalfields.

South African coal mining began in 1870 when the first coal was used in the newly discovered Kimberley diamond mine. Production rose steadily to about 30 Mt/a in the 1950s. The increasing demand for electricity in South Africa, and the increasing international demand for coal following the oil crises led to South African coal production increasing dramatically between 1975 and 1995. Production was over 100 Mt/a in 1980.

A survey of South African coal reserves was undertaken by the DMR (2009b). In 2006, 244.8 Mt of coal was sold of which 68.7 Mt was exported (Table 1). Most of the local sales were used for electricity generation and the production of liquid fuels and chemicals. South Africa is a world leader in the use of low quality coal.

The mining, distribution and sale of coal were deregulated in 1988. The only exception is that some mines are bound to long term contracts with Eskom signed before this date. Coal prices are considerably lower than those in the countries of the Organisation for Economic Cooperation and Development (OECD) which provides South Africa with a competitive advantage for exports.

Table 1: Saleable coal production, local sales and exports (DMR, 2009b)

	Production	Local Sales	Export Sales
	Mt	Mt	Mt
1997	218.6	157.2	59.0
1998	224.9	168.5	67.0
1999	222.3	154.6	66.2
2000	224.1	154.6	69.9
2001	223.5	152.2	69.2
2002	220.2	157.6	69.2
2003	239.3	168.0	71.5
2004	242.8	178.3	67.9
2005	245.0	173.4	71.4
2006	244.8	177.0	68.7

Key players

Anglo Coal is one of the world's largest private –sector coal producers and exporters. The company has nine coal mining operations in South Africa. It also has a 50% interest in the Mafube mine, with joint venture partner Exxaro Resources holding the remaining 50%.

Eyesizwe Coal is the fourth largest coal producer in South Africa. It operates the Arnot, Glisa, Mafube, Matla, and New Clydesdale collieries.

BHP Billiton Energy Coal South Africa Ltd (BECSA) formerly known as the Ingwe Collieries, is a wholly owned subsidiary of diversified mining company BHP Billiton; It is the largest coal exporters in the world. The company currently owns four colliers, namely Douglas mine, Middelburg mine, Khutala mine and Klipspruit colliery.

Exxaro Resources is South Africa's largest black-controlled diversified mining company. The company has seven coal –mining operations which have the capacity to produce 42.7 Mt a year of thermal, metallurgical and coking coal. The company exports some 2.5 Mt of coal a year through the RBCT.

Xstrata Coal South Africa forms part of global diversified metals and mining company largest producer of export thermal coal and significant producer of coking coal. The company has more than ten operations in South Africa located within the major coalfields, Witbank and Ermelo.

In line with the objectives of the White Paper on Energy, the coal industry has been encouraging more participation through black owned companies. In 2000, Anglo and Ingwe sold assets worth $222 million to the black empowerment group NewCoal, now called Eyesizwe, thus forming South Africa's fourth largest coal mining company. In 2003, BHP-Billiton sold its Delmas Colliery to Kuyasa Mining, a black empowerment company, which now produces about 2.2 Mt coal a year. Other BEE coal companies include African Coal, Benavan Securities, Imbawula Mining, Sebenza Mining and Siyaya Services Ltd.

The Local Coal Market

In 2006, South Africa's run-of-mine coal production was 312 Mt, 245 Mt of which were of saleable quality, making South Africa the fifth-largest producer of saleable hard coal in the world after China, the USA, India and Australia.

South Africa's coal production is largely concentrated in the Mpumalanga province where, in 2006, more than 84% of the country's total coal output was mined from 50 operations. The Witbank coalfield remains the largest producer of coal, followed by the Highveld coalfield. Together, these two coalfields are the source of over 80% of the country's total coal output. It is estimated that over 70% of South Africa's coal reserves are located in the Witbank, Highveld and Waterberg coalfields. While the Witbank coalfield is nearing depletion, the Waterberg coalfield is a likely replacement, as it has the potential to contain significant virgin coal reserves (Mining Weekly, 2010)

The local coal market for electricity is secure and almost certain to expand. Eskom generates over 92% of its electricity from coal and it is probable that new coal stations will be built to meet growing demand for electricity.

Sasol is switching to natural gas as its feedstock at the Sasolburg plant which manufactures chemicals. However, the demand for liquid fuels from its coal fed Secunda plant is steady and that market is secure.

The rest of the local coal market, about 15%, is in industry and includes mining and quarrying, and household fuel. Household coal is supplied mainly by traders through informal but established networks in townships.

There is a large potential for recovering the energy in discard coal. This would also remove an environmental problem. A likely technology for doing so would be Fluidised Bed Combustion (FBC). Supply of limestone, needed in this process, is an issue that would need to be resolved.

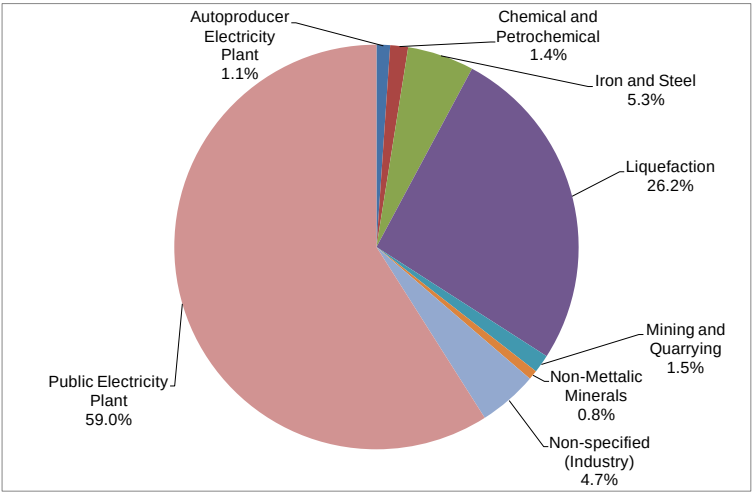

Figure 2: Coal consumption by industry sub-sector for 2006, Total: 2653 PJ (DME, 2009)

Export Market

About 60% of South Africa's coal exports go to Europe, the rest to countries along the Pacific Rim. The coal-mining industry has become a major exporter of steam coal, the second biggest in the world after Australia. Coal is South Africa's third largest export earner. South African coal has the competitive advantages of low pit head costs and low sulphur levels. The disadvantages of high ash and low heating value have, to a large extent, been overcome by washing and blending the coal to meet required specifications. A small amount of anthracite and blend coking coal is exported.

Most of the coal is exported through the Richards Bay Coal Terminal in KwaZulu Natal, the world's largest single coal export facility. Richards Bay has a deep water harbour and is connected by rail to the coalfields of Mpumalanga Province. The Richards Bay Coal terminal has a capacity of 72 Mt/y and there is a proposal to expand this to 82 Mt/y. Small amounts of coal are exported through Durban in KwaZulu Natal and Maputo in Mozambique.

There are two major uncertainties about coal exports in the short term future: the state of the world market and the rate of the South African Rand against the Dollar. There is increasing competition from countries such as Indonesia and Colombia, and world coal prices have been steady over recent years, at $51,12/ton in 2007 (DMR, 2009b). The low coal prices are almost certainly the result of the depressed world economy and so should recover when it picks up. However, the trade in thermal seaborne coal was expected to grow from 319 Mt in 2002 to 464 Mt in 2006, and so the long term prospects appear to be good. A proviso, though, is the environmental pressure on coal from climate change concerns about its high carbon dioxide emissions.

Petroleum and Gas

This section provides a background to the South African petroleum and gas industry. National reserves are discussed, key role players are listed, information about the refining industry, such as refining capacity, is provided, and liquid fuel consumption by sector is summarised.

Resources and Production

South Africa has small oil reserves and only modest gas reserves, although they could be of considerable economic importance. All of the reserves are off-shore in fields off the west and south coasts. The Oribi/Oryx Fields supply enough crude oil for about 2% of South Africa's liquid fuel requirements. The Sable field, which has recently come into production, will supply enough for a further 7% to 10%.

From the 1950s, for political, strategic and economic reasons, the South African government began a programme to reduce dependence on crude oil imports. The idea was to make liquid fuels from abundant coal resources. This was the function of Sasol. The synthetic fuel plants of Mosgas and Sasol supply about 38% of the final liquid fuel demand. The rest is refined from imported crude oil.

In 2006, South Africa produced 12 157 barrels of oil per day, 482 000 million cubic feet and had four production fields.

The South Africa gas infrastructure consists of an 865 km, 26-inch, high-pressure steel pipeline from Mozambique Temane Pande gas fields to Sasol's Secunda site where it links to the Sasol Gas network. (Industrial and commercial clients)

Sasol Gas, a wholly owned subsidiary of Sasol, has developed a 1 500 km pipeline network in South Africa. The network delivers gas to more than 600 customers. Sasol supplies Egoli Gas, a distributor supplying piped gas in the greater Johannesburg metropolitan area.

Key players

There are seven major oil companies in South Africa: BP; Chevron; Engen; PetroSA; Sasol; Shell; and Total. BP Southern Africa (BPSA) is the third largest of seven oil companies operating in South Africa. The company processes crude oil, and has a 50% stake in the South Africa Petroleum Refineries (Sapref) at Reunion, 16 kilometres south of Durban on the East Coast of South Africa.

Chevron was established the Pacific Coast Oil Co. on Sept. 10, 1879. Since then, the company's name has changed more than once. Engen Petroleum Limited is a wholly-owned subsidiary of Engen Limited, and conducts all downstream activities in South Africa. The company is an African-based energy group, focused on the refining and marketing of petroleum and petroleum-based products, and the provision of retail convenience.

PetroSA (originally Mosgas) is the state owned oil company set up for the production of gas and condensate from certain offshore fields (the Mosgas Mining Lease) and their conversion,

on-shore, to a range of refined products including petrol, diesel, and liquefied petroleum gas. The Mosgas plant was commissioned in 1992.

Sasol, originally called the South African Coal, Oil and Gas Corporation and funded by government established the Sasol 1 coal-to-liquid fuel plant in Sasolburg in 1954. Two larger plants were built at Secunda in the late 1970s. Sasol become a private company in 1979. Sasol at first received tariff protection if crude oil prices dropped below $16/barrel but this lapsed at the end of 2000.

Shell entered in South Africa in 1902 and is a global group of energy and petrochemical companies. TOTAL entered in South African petroleum market in 1954. It plays an important role in petrochemicals market with products like jet fuel and liquid petroleum gas to lubricants, greases and kerosene.

Background

During the apartheid era, liquid fuels were tightly regulated and subject to much secrecy. With the advent of democracy and the lifting of sanctions, the industry has become open and state ownership has declined.

In 2006 South Africa consumed about 24 billion litres of liquid fuels (see Table 2), imported about 22 Mt of crude oil and used about 44 Mt of coal to make liquid fuels (SARS, 2009). Consumption of liquid fuels is detailed in Table 2.

Table 2: Consumption of liquid fuels in South Africa from 1994 to 2006 (SAPIA, 2009)

			Million litres				
Year	Petrol	Diesel	Paraffin	Jet Fuel	Fuel Oil	LPG	Total
1994	9 629	5 110	875	1 193	633	485	17 925
1995	10 153	5 432	850	1 368	615	471	18 889
1996	10 566	5 759	917	1 601	704	450	19 997
1997	10 785	5 869	973	1 779	635	492	20 533
1998	10 883	5 959	1 052	1 877	574	523	20 868
1999	10 861	5 993	1 054	1 995	561	540	21 004
2000	10 396	6 254	857	2 020	555	567	20 649
2001	10 340	6 488	786	1 924	555	599	20 692
2002	10 335	6 831	745	1 967	536	586	21 000
2003	10 667	7 263	769	2 099	528	558	21 884
2004	10 985	7 678	798	2 076	569	563	22 669
2005	11 165	8 115	761	2 180	482	563	23 266
2006	11 279	8 708	738	2 269	476	605	24 075

Storage, Imports and Exports

During the years of apartheid, when there were oil sanctions, there was a large strategic stockpile of oil in disused coal mines, steel tanks and underground containers. With the advent of democracy and the demise of sanctions, the stockpile has been reduced considerably from its 1988 level of 158.5 million barrels.

The ratio of petrol to diesel production in South Africa's refineries and the demand for petrol and diesel do not match. This resulted in surplus diesel in relation to the demand in the past. The increase share in diesel vehicles and the growing demand for liquid fuels, however, has reduced this imbalance. The growth in demand has resulted in South Africa being a net importer of liquid fuels. South Africa imported approximately 3400 kt of liquid fuels in 2006. The refineries produce more LPG than is consumed locally and this is exported to Southern African Customs Union (SACU) countries and other countries in Southern Africa and on the Indian Ocean.

Table 3: South African petroleum imports in 2006 by country of origin (SARS, 2009)

Main trading partners	Quantity (kt)	Value (million Rand)
SAUDI ARABIA	7 715	22 562
IRAN, ISLAMIC REP OF	6 349	18 201
NIGERIA	2 770	9 198
SINGAPORE	728	3 239
UNITED ARAB EMIRATES	814	3 068
ANGOLA	759	2 471
LIBYAN ARAB JAMAHIRIYA	683	2 428
INDIA	393	1 595
ARGENTINA	558	1 543
TURKEY	297	1 383
OMAN	437	1 248
Others	**3 979**	**13 051**
Total	**25 481**	**79 988**

Table 4: South African fuel imports 2006 (SARS, 2009)

Product	Import Quantity (kt)	Import value (million Rand)
Crude oil	21 715	64 459
Diesel	1 709	7 299
Petrol	1 294	5 874
Jet kerosene	220	988
Petroleum coke	373	660
Paraffin wax	29	188
Aviation gasoline	30	184
Residual fuel	96	161
Lubricants	10	147
White spirits	3	16
LPG	2	11
Total	**25 481**	**79 987**

The future pattern of fuel imports and exports is uncertain. On one hand, with the rapid development of the large oil fields in Angola, it might make economic sense to import finished liquid fuels from there. On the other, with Sasol's new technology for making very clean liquid fuels from natural gas, South Africa could become a large exporter of this fuel.

The Mthombo Project is a PetroSA initiative to build a world-class crude oil refinery in the Coega Industrial Development Zone in the Eastern Cape. This will be the biggest (400 000 bbl/d) in Africa and provide a national security of supply for South Africa's future fuel requirements. This project is expected begin in 2012 and completed by 2025.

Table 5: South African fuel exports 2006 (SARS, 2009)

Product	Export quantity (kt)	Export value (million Rand)
Crude oil	488	3 118
Residual fuel	1 021	1 874
Petrol	441	1 767
Diesel	324	1 197
Paraffin wax	105	646
Lubricants	71	544
Jet kerosene	114	387
LPG	11	39
Aviation gasoline	5	30
Bitumen	9	21
Other kerosene	**4**	**21**
White spirits	3	18
Total	**2 598**	**9 662**

The Crude Oil Refining Industry

Imported and synthetically produced crude oil provides about 17% of South Africa's primary energy needs. South Africa has four conventional oil refineries, three at the coast and one inland. The coastal refineries are Calref in Cape Town, owned by Chevron, Enref in Durban, owned by Engen, and Sapref, also in Durban, owned jointly by BP and Shell. The inland refinery is Natref in Sasolburg, owned by Sasol and Total. The Natref refinery is set up to produce very little heavy fuel oil, which at the coast would be sold as marine bunkers. This makes its products slightly more expensive. Crude oil is pumped in a pipeline from Durban to Sasolburg.

Table 6: South African oil refineries and their capacities (SAPIA, 2009)

Refinery	Location	Owners	Capacity (1 000 barrels per day)		
			1992	2002	2007
Sapref	Durban	BP & Shell	120	180	180
Enref	Durban	Engen	70	125	125
CalRef	Cape Town	Chevron	50	100	100
Natref	Sasolburg	Sasol & Total	78	103	108
Secunda*	Secunda	Sasol	150	150	150
PetroSA*	Mossel Bay	State-Owned	45	45	45
		Total	**513**	**703**	**708**

**Crude equivalent*

Source:South African Petroleum Industry Association

The Synthetic fuel Production Industry

South Africa has the world's largest production of liquid fuels from coal and natural gas. The coal and gas is broken down into "syngas", a combination of hydrogen and carbon monoxide, and then built up using the Fischer-Tropsch process into hydrocarbons such as methane, petrol, diesel, paraffin and polymers.

Sasol commissioned its first international joint-venture Gas-To-liquid (GTL) plant in Qatar in 2006 and a second GTL plant is under construction in Nigeria and intended to be completed in 2009.

These GTL ventures incorporate the proprietary Sasol Slurry Phase Distillate™ process. The Sasol processes produce two useful gases as by-products, the "hydrogen rich gas", from the Sasolburg plant, and the "methane rich gas" from the Secunda plants. These are sent to industrial and residential customers via a pipeline system that links Sasolburg, Secunda, Gauteng (the Johannesburg area), Durban and Richards Bay.

In 1987 the South African Government approved the Mosgas project for the production of liquid fuels from natural gas in the off shore field just south of Mossel Bay. Part of the reason for building it was strategic, to develop South Africa's own fuel production in the face of oil sanctions in the previous era.

The synfuel production plant at Mossel Bay is owned by PetroSA. It is fed by the F-A offshore gas field and produces about 45 000 barrels/day (crude oil equivalent) of liquid fuels, about 8% of South Africa's requirements.

Liquid Fuels Marketing

Under the threat from international oil sanctions in the past, the liquid fuel industry was tightly regulated and subject to much secrecy. The 1998 White Paper on Energy proposed minimum governmental intervention and regulation in the liquid fuel industry. It aimed to deregulate crude oil procurement and refining, and to remove price control and import and export control. In 1991 the refining industry was deregulated and the Marketing of Petroleum Activities Return (MPAR) system was introduced for marketing income only.

The In Bond Landed Cost (IBLC) was first introduced in the 1950's with the establishment of the first refinery in South Africa and was previously revised in 1995 when a market spot price component was introduced. The Basic Fuel Price (BFP) formula has replaced the IBLC formula, with effect from 2 April 2003. An investigation by the DME and the oil industry decided that the old formula was outdated because of changes in global markets, and that it was more appropriate to use "spot" prices rather than refinery "posted" prices. Like the IBLC, the BFP is essentially an import parity pricing formula, intended to match the cost of importing substantial volumes of finished fuels.

The basic prices of petrol and LPG are now based on 50% of the prices in the Mediterranean area and 50% in Singapore. The basic prices of diesel and illuminating paraffin are based on 50% of prices in the Arabian Gulf and 50% in the Mediterranean. Other elements in the BFP

are freight costs from the refining centres to South African ports, demurrage, insurance, and allowance for evaporation, wharfage, coastal storage and stock financing.

The BFP sets the price of fuel at the refinery gate. For petrol, the price is regulated to the retail level (the price at the pump). The petrol price is made up of the BFP, government taxes and levies, the wholesale margin, the service differential, zone differentials (between the coast and inland), the wholesale price, the dealer margin and pump rounding factors.

The price of diesel is only controlled to the wholesale level. Paraffin is controlled to formal retail level only. LPG is also controlled from the refinery gate price and the retail price.

Renewable Energy

South Africa is well endowed with renewable energy resources with the potential to produce energy from biomass, wind, solar, small-scale hydro and waste; these resources remain largely untapped. The main use for the renewable energy would be power generation and non-electric technologies such as solar water heating and bio fuels.

The coastal regions of South Africa have the highest potential for power generation from wind. Other areas such as the Eastern highveld, Bushmanland and the Drakensberg foothills show moderate potential for wind generation. Total onshore wind generation has an estimated potential to provide 1% of the required electricity in South Africa. Applications of wind energy also include water pumping, wind farms for hydroelectric systems, solar-hydro hybrid systems and distributed power generation.

Biomass wood fuel is a major energy resource in rural areas for domestic cooking. Present wood consumption is unsustainable because it is being consumed faster than it is replenished. Bagasse from sugarcane production and waste from the pulp and paper industry are used to provide energy within these industries but can be used to a greater extent to provide energy for nearby consumers. There is a large potential for bio fuels from energy crops such as sugarcane and maize. Manure and litter from livestock via fermentation can also provide usable energy.

Hydropower is limited by its environmental impacts due to the flooding of large areas and the displacement of people for the development of dams. The Inga hydropower scheme on the Congo River is viewed as having great potential for providing electricity in Africa via the Southern African Power Pool (SAPP).

South Africa has a large potential for solar power. The main applications for solar power are space heating, water heating, solar cookers, crop drying and photovoltaic for electricity generation and heat pumps for pumping water.

Energy from waste is also of considerable interest in urban areas due to the large amount of waste and the increasing costs of landfill sites in higher population density areas.

Wave energy and ocean currents will also be considered for power generation in the longer term.

The Department of Energy has the Renewable Energy White Paper Policy that was approved by the Cabinet in November 2003. The White Paper sets a target of 10 000 GigaWatt hour

(GWh) by 2013 to be produced from renewable energy source. This target can only be achieved through the implementation of renewable energy projects

The Renewable Energy Directorate is implementing the Renewable Energy White Paper thereby monitoring and evaluating the renewable energy power production for the achievement of the 10 year target and development of policies, regulations and strategies to create an enabling environment for the development and uptake of renewable energy.

The directorate assists the project developers in a number and variety of ways to successfully implement renewable energy projects. These include financial support and information provision.

The directorate performs the following functions, amongst others, Develop, implement and monitor the Renewable Energy White Paper Policy.

Create an enabling environment for the renewable energy technologies through:

- Regulations;
- Promotion (funding);
- Technology development (standards, R&D); and
- Education, awareness and capacity building.

Eskom has become the biggest generator and distributor of electrical power in Africa. This status was won by the efforts of generations of Eskom people striving to do better, more efficiently and more effectively.

Biomass

Biomass is estimated to contribute about 10% of South Africa's primary energy. Biomass can be divided into wood and bagasse.

Wood

Wood as a source of energy in South Africa has two quite different uses, industrial and domestic. The industrial use is by South Africa's modern pulp and paper industry, which has a production of about 4.5 Mt a year. In the chemical pulp mills, the fibre is separated out in chemical digesters and the residue, known as "black liquor" and containing useful energy, is burned in recovery boilers to raise steam for process heat and electricity generation. Bark and sawdust from the wood is also burned in boilers.

The domestic use is by poor households, mainly in the remote un-electrified rural areas. Wood is a very important residential fuel in South Africa, as it is throughout the continent. It is used for domestic purposes including cooking, heating water, space heating and others. The exact amount of residential wood fuel used is unknown but estimates put it at 86 PJ/y, roughly equivalent to 7 Mt of wood per year.

Bagasse

Bagasse, the waste fibre from sugar cane, is the most important energy source for South Africa's sugar refining industry. The total sugar cane crop is over 20 Mt a year, which yields

about 7 Mt of bagasse with a heating value of 6.7 MJ/kg, most of which is used as energy in raising steam for process heat and electricity generation. The installed generation capacity of the industry is about 245 MWe. Some bagasse is used for making paper.

Municipal Waste

South Africa disposes of almost all of its refuse in landfill sites. It has been estimated that the total domestic and industrial refuse has an energy content of about 11 000 GWh per annum. This could be directly incinerated or converted into biogas and methane to produce electricity. There have been proposals for such schemes but none have been implemented so far.

Solar Energy

Solar energy comprised of different categories, the well known are namely: solar Photovoltaic (PV), Concentrated Solar Power (CSP) and Solar Water Heating (SWH)

South Africa has some of the world's best conditions for solar power. Almost the whole of the interior of the country has an average insolation in excess of 5 000 Wh/m^2/day. Parts of the Northern Cape have average insolation of over 6 000 Wh/m^2/day. The annual 24 hour solar radiation average for South Africa is 220 W/m^2, compared with 150 W/m2 for parts of the USA and about 100 W/m^2 for Europe. There is a large potential for solar power to contribute to South Africa's energy needs. So far, however, solar power does not generate any electricity for the national grid.

The best applications of solar power are the heating of water for households and the provision of photovoltaic electricity for remote rural communities in houses, schools and clinics. The Department of Energy, through Integrated National Electrification Programme (INEP) has embarked on schools, clinics and residential electrification. The programme is funded through the DoRA allocation while implementation is undertaken by Eskom for schools and clinics, and by non grid service providers for residential electrification.

In 1998 Eskom initiated the South African Bulk Renewable Energy Generation (SABRE) programme to investigate the use of large scale wind and solar power. In 2002, they installed a 25kW Solar Dish/Stirling Engine at the Development Bank of Southern Africa premises in Midrand. Eskom is studying the feasibility of a 100 MWe demonstration solar thermal power station, which would probably be built in the Northern Cape.

Solar water-heating programme

The Department of Energy and CEF have embarked on a solar water-heating project, which promotes the use of solar geysers. The programme targets households, group houses (such as military bases and mine residences) and commercial and industrial applications. Government has set a target of one million solar water geysers to be installed in households and commercial buildings by 2014. Eskom's Solar Water-Heating Programme is an initiative that could lead to a reduction in demand of about 530 MW on the national grid and a favourable contribution to reducing carbon emissions.

Solar Park

The South African government is considering the best way to mobilise industrial development around an ambitious solar-park concept, which it hopes to deploy in the sun-drenched Northern Cape Province over the coming years, primarily due to the intense solar radiation in this province. The project could produce 5 000 MW of renewable energy. The proposed solar park is expected to provide as much power as one coal-fired power station.

Wind

South Africa has quite good conditions for wind energy, mainly in the coastal regions. The accompanying wind map illustrates this. Wind is used widely for pumping water on remote farms and it is estimated that about 300 000 such windmills have been erected over a long

period. There are also about 500 wind turbines on farms used to generate Direct Current (DC) electricity, usually at 36V.

Darling Windfarm was commissioned in 2009; it is a 5.2 MW capacity and estimated to generate 13 GWh per annum. The off-taker is City of Cape Town.

The Department of Energy has established South African Wind Energy Programme (SAWEP). SAWEP is a Global Environment Facility (GEF) funded programme and aims to provide dedicated support for wind energy development in South Africa and to update South Africa's wind atlas which will be publicly available to prospective wind energy developers. A strong focus on capacity building is targeted at research and development institutions

Table 7: Renewable energy projects that were commissioned in 2008, 2009 and 2010 (DoE, 2009d)

Project Name	Capacity (MW)	Province	Technology
Clanwilliam	1.5	Western Cape	Hydro
Methcap	4.2	Western Cape	Biogas
Bethlehem	7.0	Free State	Hydro
Darling	5.2	Western Cape	Wind
Durban landfill gas	6.0	KZN	Landfill

Electricity

In 2003, the Republic of South Africa Cabinet decided that future power generation capacity would be divided between Eskom (70 percent) and independent power producers (30 percent). In line with that decision, on 5 September 2007 Cabinet designated Eskom as the single buyer of power from IPPs in South Africa. In light of that decision and the need to ensure that 30% of all new power generation is derived from independent power producers.

In the past, there were large differences between the performance and revenue of the distributors. The segments of apartheid meant that some authorities included commercial and industrial areas and showed surpluses on their electricity account, while black local authorities controlled areas that included only poor residential sectors with little electrification and were usually not economically viable. The Electricity Distribution Industry (EDI) has been in the process of restructured.

Key players

The National Energy Regulator (NERSA) is a regulatory authority established as a juristic person in terms of Section 3 of the National Energy Regulator Act, 2004 (Act No. 40 of 2004).

Eskom

Eskom, the national electricity utility, supplies over 94% of the electricity in South Africa. South Africa's remaining electricity is supplied by municipal power stations and auto generation from industry. In 2006, Eskom had a peak demand of 34 807 MWe. Over 91.7% of the electricity is generated from coal. About 66% of electricity is used by industry, 17.4% by resident as shown in Figure 5. The total electricity sales by Eskom in 2006 grew by 4.9% to 218 120 GigaWatt hour (GWh).

Eskom is a large consumer of freshwater in South Africa, accounting for approximately 1.5% of the country's total water consumption annually. Eskom power stations run constantly, supplying in excess of 94% of South Africa's electrical energy and more than half of the electricity used on the African continent. Without water, this output would not be possible.

Eskom uses raw water, which is put through extensive purification and treatment before entering the production processes. The salinity of the raw water dictates the volume of effluents that are produced during the treatment process. During 2005 (April 2005 to March 2006) Eskom used approximately 292 million cubic metres of water for, mainly at its coal-fired power stations (Eskom, 2010).

Electricity Generation

South Africa has coal, nuclear, hydro, gas and pumped storage power stations. Coal is dominant. Coal is the main source of electricity generation (91.7%), followed by nuclear being (4.2%) and the lowest electricity generator is pumped storage (1.7%) for the year 2006,

as is shown in Figure 4. Eskom supply about 95% of electricity and 5% is supplied by both Independent Power Producers (IPP) and the municipalities. In 2005, Eskom has about 26 operating electricity generating power station, there are 19 municipalities that supply and about 12 private companies (Nersa, 2005).

The number of operational stations for each energy source are:

- Coal: 20;
- Nuclear: 1;
- Bagasse: 4;
- Hydro: 10;
- Pumped storage: 3;
- Gas turbines: 11; and
- There are 3 mothballed coal stations.

In terms of actual electricity generated rather than generation capacity, the dominance of coal is even greater and nuclear has a slightly larger share. This is because of the low availability of the hydro, gas turbine and pumped storage stations which are used primarily as peak stations.

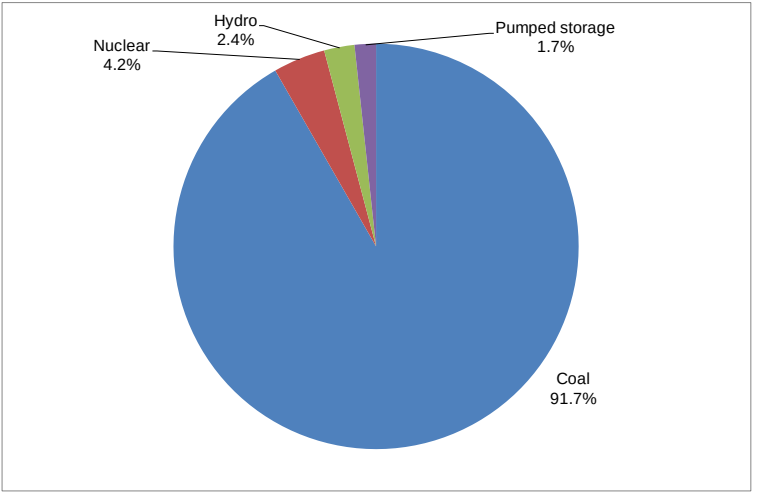

Figure 3: Electricity generation capacity by energy source for 2006 (DME, 2009:45)

Coal Power Stations

From the 1970s onwards, South Africa embarked on a programme of building large, standardised "six-pack" coal stations each with capacity of 3 600 MWe or larger. Each Power station is built next to a coal field and has coal supplied from the mine by conveyer belts. They do not have flue gas desulphurisation. They have delivered to South Africa the cheapest electricity in the world.

Because of South Africa's limited water resources, two of the coal stations, Kendal and Matimba, each with a capacity of about 4 000 MWe, have dry cooling. They are the world's largest dry cooled power stations.

Nuclear Power Stations

South Africa has one nuclear power station, Koeberg, about 30 km north of Cape Town. Koeberg has a nominal capacity of 1 840 MWe and consists of two 920 MWe pressurised water reactors (PWRs) built by Framatome, a French company. The first unit was commissioned in 1984. Koeberg's electricity costs are now comparable to those of the coal powered stations, although its capital costs were higher as is to be expected for nuclear power plants.

Other Eskom Power Stations

Eskom has two hydro-electric power stations with a combined capacity of 600 MWe, and two pumped storage stations with a combined capacity of 1400 MWe. Each of the pumped storage stations has an upper dam and a lower dam. In off-peak times, water is pumped to the upper dam. In peak times, water runs to the lower dam through a turbine, generating electricity.

Eskom has two gas power stations, each of 171 MWe capacity. These are open cycle gas turbines used only for peaking and stand-by power.

Municipal Generators and Auto-generators

Municipalities in South Africa own a total generation capacity of 2 432 MWe. 1 932 MWe of this is in coal stations, 320 MWe in open cycle gas turbines, 4 MWe in hydro stations and 180 MWe in a pumped storage station. Most of the coal stations are old and have low load factors.

A new entrant in the electricity supply market is City Power Ltd, which is owned by the City of Johannesburg. Kelvin Power Station, with a capacity of 600 MWe, was sold in November 2001 to AES Corporation, a USA company, who later sold it to CDC Globeleq Limited, a British company. City Power signed a 20 year Power Purchase Agreement with CDC in November 2001. City Power distributes over half of the power used in Johannesburg. 25% of its power comes from Kelvin Power Station, which is an Independent Power Producer (IPP),

and the rest from Eskom. City Power also has an installed capacity of 180 MW of diesel-fired generation capacity.

Some large industries, including synfuels, pulp and paper, and sugar refining, produce their own electricity from fuels which are a natural part of their processes. Sasol has a generation capacity of about 728 MWe (using coal), the pulp and paper industry a capacity of about 170 MWe (using black liquor, coal, HFO and bark), and sugar refining about 245 MWe (using mainly bagasse).

With the expected restructuring of electricity generation, it is likely that some of Eskom's power stations will be sold and that independent power producers (IPPs) will be able to enter the South African generation market. In the short term electricity prices will have to increase, although in the long term improving technology should bring them down again. Proper regulation of the generation market will be crucial to make new capacity investment attractive, yet to keep prices low enough to foster economic growth and development.

Future power stations are likely to obtain their energy from four sources: coal, nuclear, gas and imported hydro-power. Coal is abundant and South Africa has an excellent record of running coal power stations. However, the coal fields are all inland in the north east of the country, which means transmitting power over distances of up to 1 500 km to supply some coastal regions. Moreover, there are environmental concerns over coal, particularly about greenhouse gas emissions.

Generation Capacity and Demand

In the 1960s, faced with high economic growth and an imminent shortage of electricity, Eskom embarked on a determined programme of building large, standardised coal driven power stations. Economic growth dropped in the late 1980s but because of the long lead times construction continued. The result was that in 1990 South Africa had a large surplus of generation capacity. However, few new stations have been ordered since 1983 and, with the advent of democracy, economic growth and electricity demand has been growing (see Figure 4).

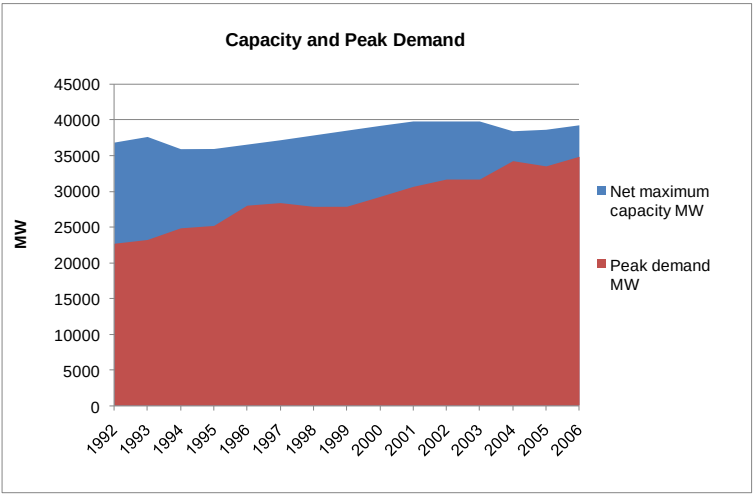

Figure 4: Electricity generation capacity versus peak electrical demand (DoE, 2009b:44)

Transmission

South Africa is a large country with an area of 1.2 million square kilometres, more than twice the size of France. The national electricity transmission grid covers every corner of the country, from Cape Town to the Zimbabwe border, a distance of over 2 000 kilometres. It has to cope with some severe conditions, including high altitudes and some of the world's worst lightning conditions in the north eastern region.

Distribution

By 2006, Eskom had connected 185 833 new households to electricity in South Africa. Electricity is at present distributed by Eskom, municipalities and town councils. In 1997, the South African Government proposed a restructuring of the Electricity Distribution Industry (EDI).

Electrification Programme

The electrification programme was started by Eskom during the late 1980's. It was further refined by the National Electrification Forum (NEF) during the early 1990's and the electricity access was 30%.During this period the electrification programme was funded by the National Electricity Regulator (now called NERSA). After 1994 and through the government's initiative of RDP (Reconstruction and Development Programme), electrification programme was endorsed through Energy White Paper 1998.

During 2001 the government took responsibility for funding electrification programme. The funds are made available from the fiscal (National Treasury).

Access to electrification is to date standing at 74.9% (See table below) of Households grid & over 50 000 Households connected to Solar Home System (SHS). The backlog in the below mentioned table includes both formal and informal settlements. The province with the highest access to electricity/energy is Western Cape Province with 85.1% and lowest is Eastern Cape Province with 61.5%.

Table 8: Electrification Statistics for March 2010 (DoE, 2010)

PROVINCE	Total number of households	Backlog	Households not electrified (Percentage)	Number of electrified households	Electrified households (Percentage)
EASTERN CAPE	1 683 420	647 593	38.5	1 035 827	61.5
FREE STATE	834 337	199 625	23.9	634 712	76.1
GAUTENG	3 185 858	779 754	24.5	2 406 104	75.5
KWAZULU NATAL	2 439 751	816 354	33.5	1 623 397	66.5
MPUMALANGA	889 958	227 479	25.6	662 479	74.4
NORTHERN CAPE	276 265	49 794	18.0	226 471	82.0
LIMPOPO	1 264 792	322 172	25.5	942 620	74.5
NORTH WEST	923 954	195 802	21.2	728 152	78.8
WESTERN CAPE	1 355 952	202 125	14.9	1 153 827	85.1
TOTAL	**12 860 165**	**3 440 699**	**25.1**	**9 419 466**	**74.9**

Electricity Sales and Prices

Eskom electricity sales and prices for 2009/10 are given in Table 8. Electricity is sold by Eskom to redistributors and who in turn sell to residential, commercial and industrial customers. Low prices help to keep electricity affordable for poor households. As a matter of policy, encouraged by the government, Eskom has tried to keep the rise in the price of electricity below inflation.

Table 9: Eskom electricity sales and unit prices per category of customer 2009/10 (Eskom, 2010)

Category	Number of Customers	Sales GWh	Revenue Rm	Price c/kWh
Local	**4 463 291**	**205 364**	**66 970**	**290.26**
Redistributors	773	90 712	27973	30.84
Residential	4 325 550	10 350	6622	63.98
Commercial	47 984	8 889	3642	40.97
Industrial	2925	55 816	15089	27.03
Mining	1134	31 733	9599	30.25
Agricultural	84415	5 010	2954	58.96
Traction	510	2 854	1091	38.23
International	**10**	**13 227**	**2 972**	**53.46**
Utilities	7	4 109	1561	37.99
End users across the border	3	9 118	1411	15.47

Electricity consumption by sector is shown in Figure 5. The consumption is dominated by the industrial sector which consumes 60% of all electricity, followed by residential consumption with 20.4% and commerce and public services with 14.8%. The remaining 4.8% is consumed by agriculture and transport. Demand side interventions to reduce electricity demand are likely to be most effective in the industrial sector because of its large share of consumption.

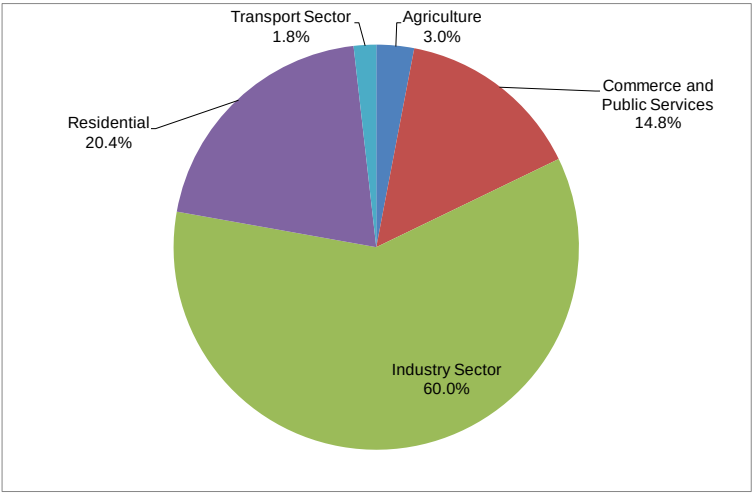

Figure 5: Electricity consumption by economic sector for 2006, Total: 700 PJ (DME, 2009)

South Africa requires investment in new power stations but in order to give an acceptable return on investment, electricity prices for the new station will have to be much higher than the current prices. Therefore, for the short to medium term at least, it is highly likely that electricity prices will rise in real terms

Southern African Power Pool (SAPP)

The SAPP was established in 1995 through an Inter Governmental Memorandum of Understanding (IGMOU), as a regional SADC body with the objective of optimizing the use of available energy resources in the region and supporting one another during emergencies. Thereafter, the SADC Utilities signed an Inter Utility Memorandum of Understanding (IUMOU) in order to facilitate and develop power pooling and trade in the region. The SAPP comprises of 12 SADC Member States Utilities in exclusion of the utilities of the two SADC island states of Madagascar and Mauritius. It is funded by subscriptions paid by the member utilities. The SAPP Co-ordination Centre is based in Harare, Zimbabwe and SAPP operations are run through sub-committees. The SAPP facilitates optional utilization of regional hydro and thermal energy resources and reduces capital and operating costs through coordination.

ENERGY DEMAND

The South African economy can be divided into five economic sectors: industry (including mining); commerce and public services; transport; agriculture; and residential. The commerce and public services sector includes government, offices, shops, hospitals, education, entertainment and museums.

The share of total energy consumed by each sector is shown in Figure 6. A small quantity of energy is converted into other products such as chemicals and paper (these are referred to as “Non energy” in the figure). The term “Other” refers to unaccounted energy (energy that has not been classified into a specific sector).

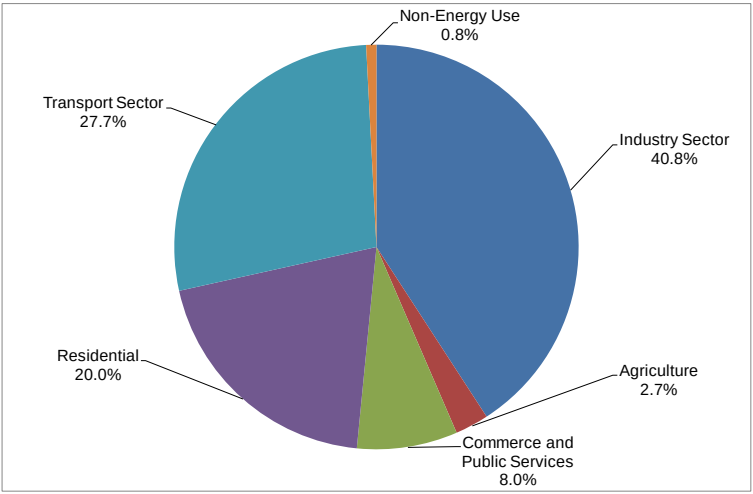

Figure 6: Energy demand by economic sector for 2006, Total: 2627 PJ (DME, 2009)

Industry

The Industrial sector consumes 40.8% of the final energy supplied in the country. The sector may be divided into mining, iron and steel, chemicals, non-ferrous metals, non-metallic minerals, pulp and paper, food and tobacco, and other. The largest subsector is iron and steel which consumes 27.4% of the total energy used by the industry sector. The share of final energy demand by sub-sectors of the industrial sector is presented in Figure 7.

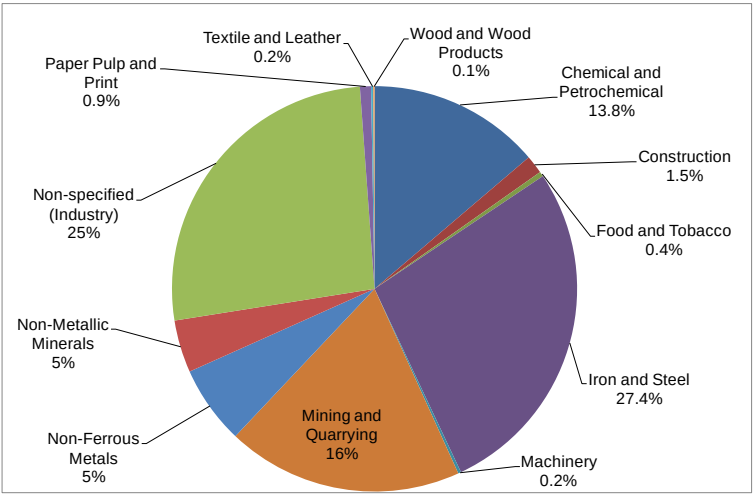

Figure 7: Energy demand by industrial sub-sectors for 2006, Total: 1072 PJ (DME, 2009)

Mining

South Africa has the world's largest reserves of chrome, gold, manganese, platinum group metals and vanadium, and huge reserves of other minerals. The industrialisation of South Africa began with the discovery of diamonds and gold in the 1870s.

Mining in South Africa is divided into gold and metals. Gold production has declined from 1 000 tons in 1970 to 253 tons in 2007 (DMR, 2009b). This is caused by declining ore grades. The energy required to extract gold has increased fourfold during this period. This is because the mines are going deeper and having to process more ore for each ton of gold. There was a 7.2 % decline in the production of gold between 2006 and 2007. Electricity makes up over 90% of energy use on gold mines, which are the single greatest users of electricity in South Africa.

Energy use for all mining constituted 202 PJ in 2006. Electricity makes up 56.1% of the energy used, other direct energy uses are coal, petroleum products and gas with 26.4%, 16.0% and 1.4% respectively as presented in Figure 8.

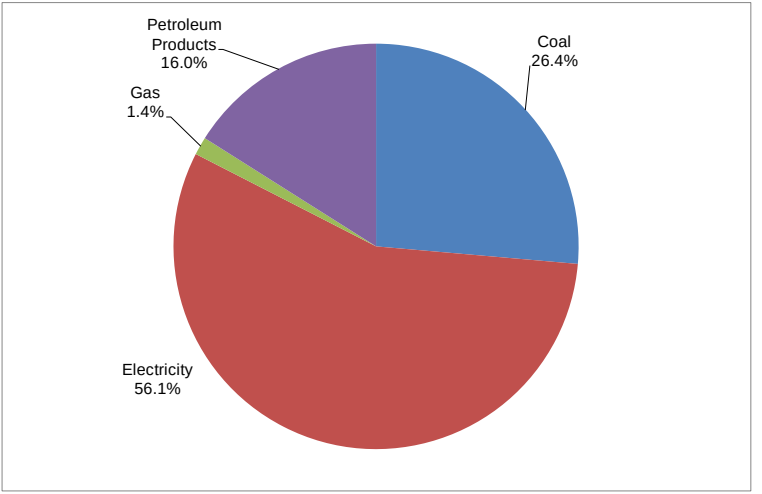

Figure 8: Energy in mining for 2006, Total: 202 PJ (DME, 2009)

Iron and steel

South Africa has all the resources required for steel-making except for coking coal. In 1996 6.5 Mt of steel was produced. Since then the industry has modernised towards specialist mills and mills using new technologies that do not require coke. An example is Saldanha Steel which uses the Corex and Midrex processes to make hot-rolled steel. There has also been considerable investment in stainless steel capacity. The main energy source for iron and steel production is coal providing 66.3 % of the energy, followed by electricity contributing 26.2 % and gas contributing 7.5 % as presented in Figure 9.

Chemicals

South Africa's chemical and petrochemical industry is well developed. It produces plastics, fertilizers, explosives, agrochemicals and pharmaceuticals. South Africa's special expertise and experience in making chemicals from coal gives it a unique advantage in this field. Coal has been the main feedstock in the past but natural gas has replaced some of this.

Non-ferrous metals

The big energy users in this segment are aluminium and titanium smelting. South Africa is the world's second largest producer of titanium minerals and made over 914 thousand tons of aluminium in 2007 (DMR, 2009b). Over 95% of the energy used is electricity. This has been affected by the recent economic downturn.

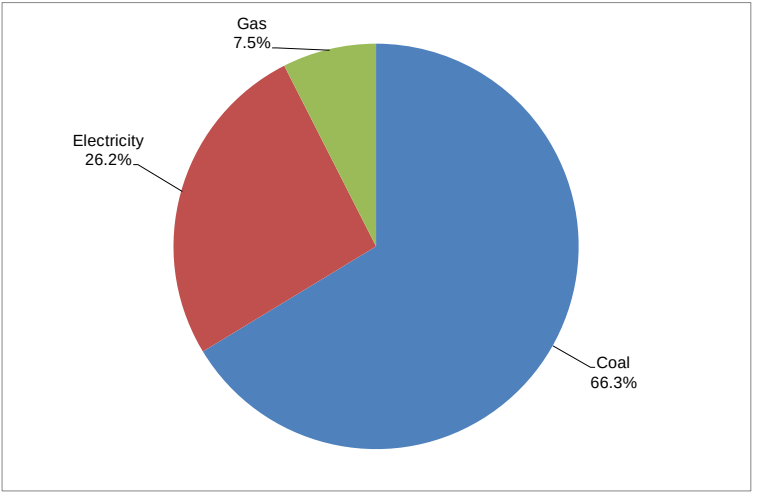

Figure 9: Energy in iron and steel for 2006. Total: 293 PJ (DME, 2009)

Non-metallic minerals

This segment makes cement, bricks and glass. South African cement is made with efficient "dry" kilns but some brick-making still uses inefficient “clamp” kilns. South Africa is self-sufficient in all of these products.

Pulp and Paper

Just above 1% of South Africa is forested, but these forests provide good conditions for commercial softwood and hardwood species. Modern pulp mills use black liquor to produce most of their energy requirements, the remainder coming from coal, gas, HFO and imported electricity, which are also used by straight paper mills that do not make their own pulp. Mondi, the largest paper and pulp company in South Africa, produced 510 000 tonnes of paper and 720 000 tonnes of pulp in 2006. In 2006 pulp and paper consumed 66.9% of electricity and 33.1 % of gas, as shown in Figure 10.

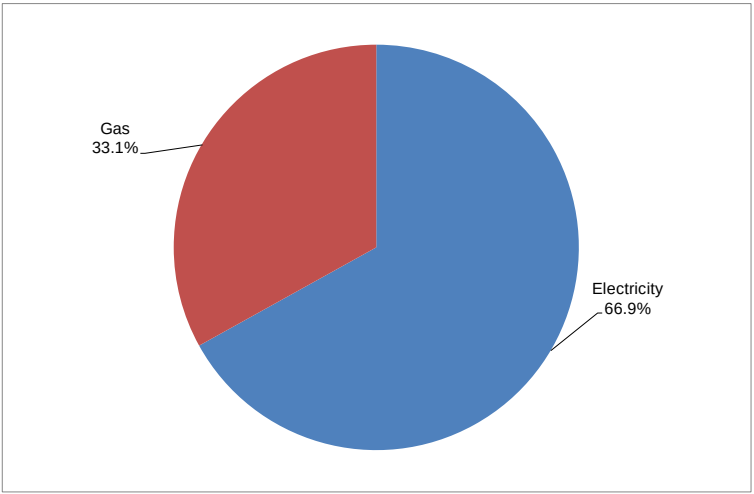

Figure 10: Energy in pulp and paper for 2006, Total: 9 PJ (DME, 2009)

Food, tobacco and beverages

The single biggest energy user in this segment is the sugar refining industry, which gets much of its energy requirements from bagasse. It consumed 66.2% of electricity and 33.8 % of gas in 2006, as shown in Figure 11.

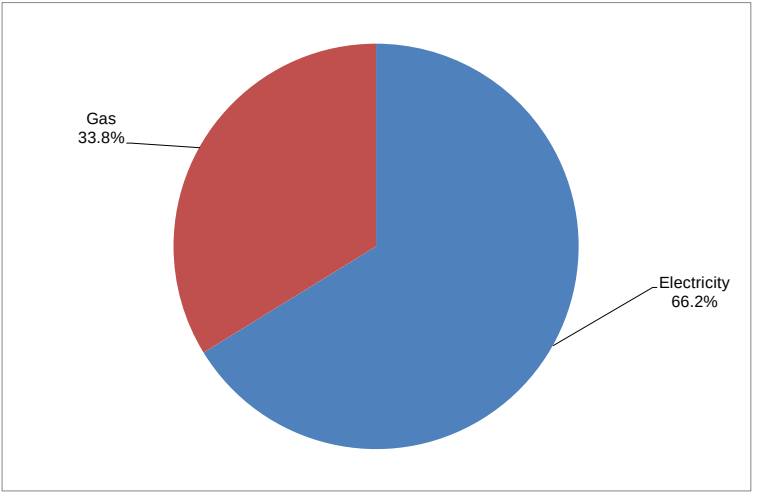

Figure 11: Energy in food, tobacco and beverages for 2006, Total: 4 PJ (DME, 2009)

Other

This segment includes manufacturing, construction, textiles, wood products and various other activities in industrial processing and fabrication. It includes large and small industries. This segment contains high value economic activity and it is expected to grow faster than most other segments. The energy demand by energy carrier for this segment is shown in Figure 12.

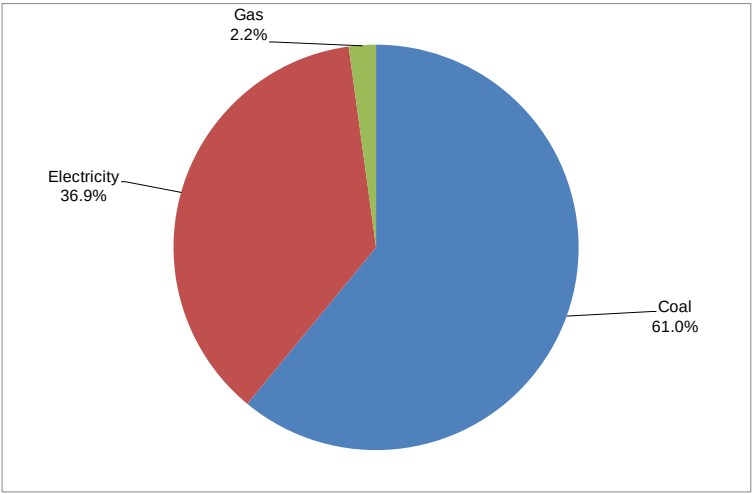

Figure 12: Energy in non-specified industry for 2006, Total: 283 PJ (DME, 2009)

Commerce and Public Services

As economies develop the commercial and public services sector usually grow quicker than other sectors. This is true of South Africa. The sector includes financial services, information technology, retail, tourism and government. There are large opportunities for improved energy efficiency in buildings which contain the activities of this sector. Commerce and public services consume 14.8% of the total final energy demand. The breakdown of the energy demand by carrier is presented in Figure 13.

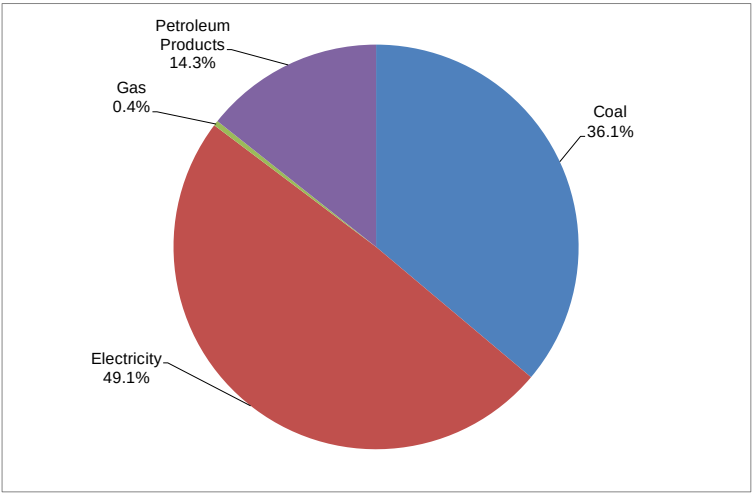

Figure 13: Energy in commercial sector for 2006, Total: 211 PJ (DME, 2009)

Agriculture

The South African agricultural sector includes large modern commercial farms and small traditional subsistence farms. With South Africa's re-admittance into world trade, locally produced high quality fruit, wine and other foodstuffs are making inroads into international markets. If there were a relaxation of food subsidies and protection in Europe and the USA, this trend would increase. Commercialisation should cause merging and consolidation of South African farms. On the other hand, land reform might see the emergence of a large number of small scale black farmers. Most energy for agriculture comes from diesel, for modern farming, but a substantial amount also comes from vegetable wastes, for subsistence farming. It is likely that in future electricity's share will grow. The shares of demand by energy carrier are shown in Figure 14.

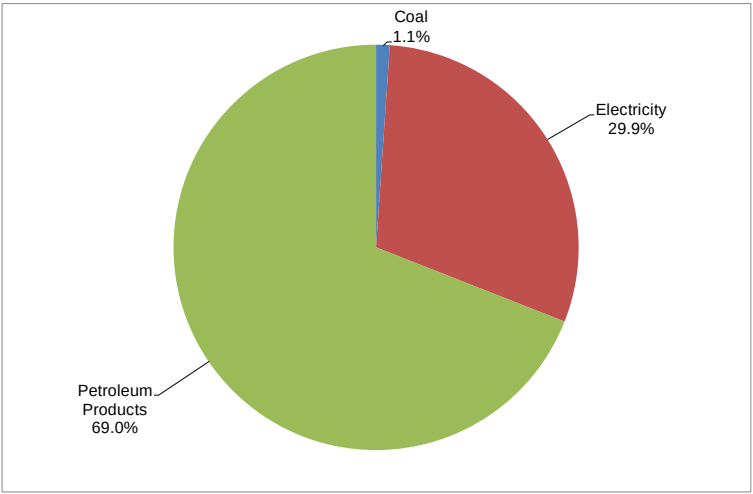

Figure 14: Energy in agriculture for 2006, Total: 70 PJ (DME, 2009)

Transport

South Africa is a large country with an extensive network of road, rail, air and sea transport. Land passenger transport is the biggest user of energy followed by land freight and then air transport.

Transport energy consists overwhelmingly of liquid fuels. The dominant fuel is petrol with 53.3%, followed by diesel with 34% and then jet fuel with 10.9% and the lowest is electricity with 1.8% as is depicted in Figure 15. (Here marine bunkers are not considered as they are used mostly for ships travelling to and from South Africa rather than within it.) However, in recent years, the share of diesel has increased.

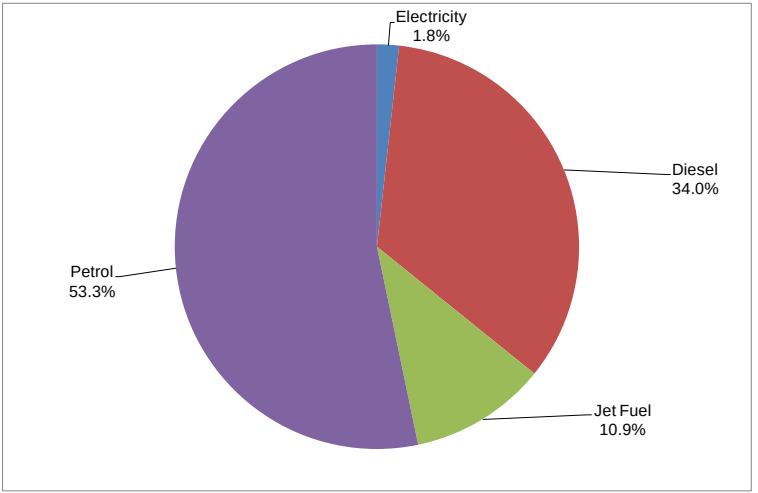

Figure 15: Energy demand by carrier in the transport sector for 2006, Total: 713 PJ (DME, 2009)

Residential

South African households consume about 20% of South Africa's final energy. This energy is provided by various energy carriers including wood, dung and other vegetable matter, coal, paraffin, LPG, candles, electricity and gas. The main form of energy used is based on availability, accessibility, cost of the energy carrier and costs of energy devices. In 2006 72.8% of energy consumed by South African households was in the form of electricity, 29.1% from coal, and 7.4% from petroleum products (mostly illuminating paraffin but also a small amount from liquid petroleum gas) (Figure 16).

By 2009, 75% of all households in South Africa were electrified, totalling 9 245 357 households. The highest percentage (86%) of electrified households is found in Western Cape, while the lowest percentage (60%) is found in the Eastern Cape (DoE, 2009).

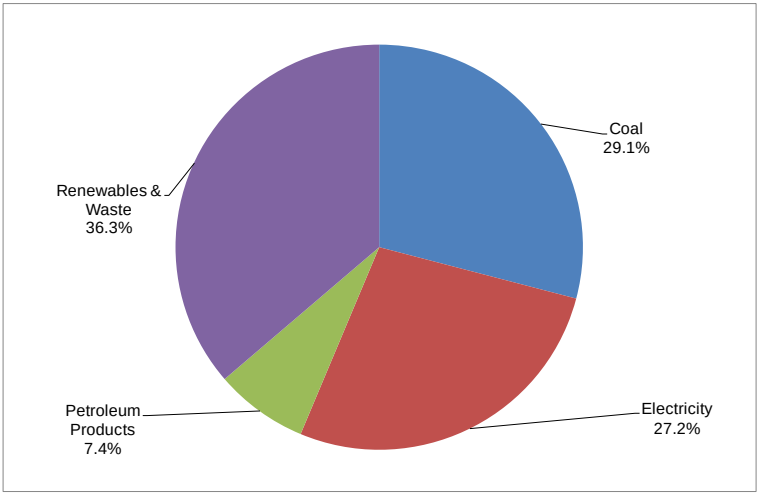

Figure 16: Energy for residential sector for 2006, Total: 525 PJ (DME, 2009)

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Useful Addresses and Websites

State Owned Enterprises

NERSA – www.nersa.org.za
ESKOM – www.eskom.co.za
NECSA – www.necsa.co.za
CEF/EDC – www.cef.org.za
PASA – www.petroleumagency.co.za
NNR – www.nnr.co.za
PetroSA - www.petrosa.co.za
SANERI - www.saneri.org.za

Research Institutions

ERC – www.erc.uct.ac.za
SANERI – www.saneri.org.za
CSIR - www.csir.co.za

Industry Associations

SANEA – www.sanea.org.za
SAPIA – www.sapia.co.za
FRA - www.fuelretailers.co.za
PRASA - www.prasa.com

Common Energy Units

tcf	-	trillion cubic feet (1 tcf natural gas has an energy value of about 1130 PJ)
kW	-	kilowatt (1x10e3 watts)
MW	-	megawatt (1x10e6 watts)
kWh	-	kilowatt-hour (1x10e3 watt-hours)
GWh	-	gigawatt-hour (1x10e9 watt-hours)
GJ	-	gigajoule (1x10e9 joules)
TJ	-	terajoule (1x 0e12 joules)
PJ	-	petajoule (1x10e15 joules)
mcf	-	million cubic feet
MJ	-	megajoule (1x10e6 joules)
Mt	-	million tons
Mt/a	-	million tons per annum
MWe	-	megawatt of electrical power
MWh	-	megawatt-hour (1x10e6 watt-hours)
Rm	-	Million Rand

Common Conversion Factors

From \ To	J	kWh	toe	Btu
1 J	1	0.278×10^{-6}	0.2388×10^{-6}	0.948×10^{-3}
1 kWh	3.6×10^{6}	1	0.86×10^{-6}	3.412×10^{3}
1 toe	42×10^{9}	11630	1	39.68×10^{6}
1 Btu	1.055×10^{3}	0.293×10^{-3}	0.252×10^{-9}	1

Note: toe = ton oil equivalent

ENERGY SAVING TIPS

- Switch off your geyser between 11:00 and 18:00 and between 21:00 and 5:00 (alternatively a time switch can be used).
- When using a kettle only boil as much water as you need.
- Consider using other energy carriers for cooking and heating as an alternative to electricity.
- Take a short shower or a shallow bath – use low flow shower heads.
- Switch off lights when they are not needed.
- Use daylight instead of electric light as far as possible.
- Open windows rather than using an air conditioner.
- Buy energy-efficient appliances or gas appliances.
- Physically turn off appliance switches or at the wall (e.g. a TV or Hi-Fi), instead of leaving them on standby.
- Make one-pot meals and keep lids on pots while cooking.

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