South African Energy Policy Discussion Document

Volume II

Overview of the South African energy sector

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Preface

In November 1994 the Department of Mineral and Energy Affairs embarked on a process to develop a new energy policy for South Africa. The new policy was required because of changes in overall South African social and economic policy associated with the change in South African government following the elections during April 1994.

The apartheid era had exerted particularly strong influences on the South African energy sector and by the end of this era in 1994 many parts of the sector could be seen to be structured around apartheid and sanctions induced needs. One of the most profound of these effects was the stifling of public debate on the energy sector as exemplified in the Petroleum Products Act (No 120 of 1977) which prohibited the "publication, releasing, announcement, disclosure or conveyance to any person of information or the making of comment regarding the source, manufacture, transportation, destination, storage, consumption, quantity or stock-level of any petroleum product acquired or manufactured or being acquired or manufactured for or in the Republic." Similar secrecy surrounded developments in the nuclear industry.

The energy sector had been developed with huge state funding and intervention. The R12 billion Mossgas project, the R21 billion state funding of the nuclear industry and the state built Sasol complex, which is now an important and integral part of South Africa's liquid fuels and petrochemical industry, are examples. The electricity industry is also in public hands, and despite the fact that Eskom is the fifth largest electricity utility in the world in terms of electricity sold, and industry in South Africa is supplied with amongst the cheapest electricity in the world, at the end of the apartheid era less than 40 percent of South Africans had access to electricity.

Whilst exceptional managerial and technological prowess had been exhibited in developing SA's energy sector, the allocation of state funds and the objectives of state support and intervention has been questioned in the light of new econonomic and social policies. In particular, the debate has been opened up for much wider participation. This has led to the requirement for information on the energy sector to be developed for making this wider participation more effective.

The debate on policy options has been enhanced in processes such as the Energy and Development Research Centre's Energy Policy Research and Training Project (EPRET), the National Electricity Forum (NELF), the Liquid Fuels Industry Task Force, the Arthur Andersen report on Sasol, the Monitoring Committee overseeing developments at Mossgas and most recently by the White Paper process of which this document is a part. The repeal of secrecy legislation and these public processes have brought to light a large amount of information on the energy sector.

Vol. I, the *South African Energy Policy Discussion Document*, published in August 1995 attempted, for the first time since public debate has been possible, to provide a comprehensive overview of the most important *policy issues and options* facing the sector. In developing Vol. I, a useful set of information was gathered whilst undertaking the systematic evaluation of the energy sector that was required to compile the policy issues and options. Whilst Vol. I reported in detail on some policy issues it provided very little empirical information on the energy sector. The lack of a coherent compilation of such information was noted in the production of Vol.I.

Vol. II, *Overview of the South African Energy Sector*, is an attempt, with the emergence of information on the sector which has been kept secret for years, to provide a picture of the energy sector as a whole and to provide details on the main energy sub-sectors. Whilst Vol. II attempts to provide as complete a picture as possible, it became apparent in compiling Vol. II that information available on the energy sector in South Africa is inadequate to meet the requirements of policy processes that are currently underway. Thus Vol II serves to both indicate the information that is available but also, as importantly, to indicate gaps in information which need to be filled before informed public debate can be possible.

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Chapter one

Introduction

1.1 Background to production of this document

Following South Africa's first democratic elections in May 1994, the Department of Mineral and Energy Affairs (DMEA) identified an urgent need to develop a new energy policy. In terms of the energy sector, the previous era had been characterised by oil sanctions and the establishment of a large state subsidised coal-to-synfuels industry, the development of a South African nuclear industry including nuclear weapons production, gross inequity in provision of local government services such as electricity and the development of non-sustainable "homelands" where poverty had led to denudation of woodlands leading to widespread rural energy poverty.

Popular and widespread resistance was associated with the development of the society in which the energy sector previously exisited. This is important because in terms of policy development one of the previous government's strategies to counter resistance was to stifle public debate. Whilst this clampdown on open debate was more apparent around issues such as freedom of movement (the pass laws) and racial discrimination in general, overall government policy expressed itself in all sectors. As far as debate and policy development in the energy sector were concerned the past government's intentions are exemplified clearly in the Petroleum Products Act (No 120 of 1977) which prohibited the "publication, releasing, announcement, disclosure or conveyance to any person of information or the making of comment regarding the source, manufacture, transportation, destination, storage, consumption, quantity or stock-level of any petroleum product acquired or manufactured or being acquired or manufactured for or in the Republic".

This Act is just an example of the many laws and regulations which prevented South Africans from discussing public policy. Parallel to the process of stifling public debate, the government developed large and powerful organisations such as the Central Energy Fund (CEF) and the Atomic Energy Corporation (AEC) that were required by law to work in secret. These organisations built vast asset bases and institutional structures and cultures to support the government of the day. This included data, information and expertise on the South African energy sector.

Thus, the situation which faced the DMEA after the 1994 elections was a legacy in which no capacity had been built in the government energy policy development sector for open, democratic public policy development. The above brief history is relevant to this document on the energy sector because one of the main features of the stifling of the energy policy debate had been the suppression of information development orientated towards facilitating open debate.

Leading up to and following the 1994 elections, laws prohibiting freedom of access to information and expression were repealed. However, in the energy sector, the effects of decades of secrecy and information suppression could not be cured overnight. The legacy of the previous era was that there was very little information on the energy sector formulated for development of policy in the new open public format. However, to meet the pressing requirements to develop energy sector policy in the line with the new government policies the DMEA needed to initiate an appropriate process.

A two step process was decided on. The first step was the production of an energy policy discussion document titled the *South African Energy Policy Discussion Document* (EPDD). Work on this commenced in November 1994 and the document was completed and published by mid-1995. The DMEA commissioned a team of twenty five energy policy workers to produce this document. Each of these team members produced a set of policy issues and options in their area of specialty and these were edited into the EPDD.

However, the EPDD was almost entirely focused on energy policy, very little descriptive information on the energy sector was included. The team members drew on their own knowledge and information and therefore, at the completion of production of the EPDD, there was still a serious lack of a compilation of basic information covering the whole energy sector. The idea for an appendix to the EPDD was born out of this need.

The initial plan to produce the appendix was that it would be a short add-on to the EPDD project in which the EPDD Project Manager would produce a compilation of relevant information in a

1950-1993. It is the long-awaited successor to South African Energy Statistics No 1 which provided data from 1950 - 1989 which significantly had no data related to liquid fuels.

- The second is the production of a 360-page highly detailed publication titled "Energy Policies of South Africa (First Draft)" by the International Energy Agency in December 1995. The IEA publication follows an in depth study tour of South Africa by the IEA in 1995 at the invitation of the DMEA to assist the DMEA in its task of formulating a new energy policy. The report became available too late for any of it to be incorporated in the current work. In many respects, with 360 pages of highly detailed information, it is more comprehensive than this Vol. II of the EPDD. However, Vol. II has a different perspective to the IEA work and the two works can be seen to complement each other. In particular, areas such as energy and the environment which have not been covered in Vol. II have detailed extensive coverage in the IEA work as this is an area of great concern to them and one in which they have extensive expertise. (After completion of work on Vol II the IEA published the final report: *Energy policies of South Africa - 1996 survey (IEA 1996).*

Chapter two

Overview of the energy sector

This chapter summarises chapters 3, 4 and 5 which deal with energy demand and the energy supply system. The purpose of the chapter is to orientate the reader within the overall energy sector and to provide key summarised data. It also attempts to contextualise the various elements of the sector in the sector, and in the economy as a whole.

2.1 Energy in the economy and energy demand in South Africa

(Summarised from chapter 3)

Energy intensity and energy consumption

By world standards South Africa's economy is highly energy intensive. In other words, more energy is used to produce a unit of economic output than in most other countries in the world. This is due to:

- South Africa's economic structure, in which energy intensive primary minerals extraction and beneficiation play a large role;
- large accessible coal resources;
- a synthetic liquid fuels industry based on coal and natural gas, which is much less efficient than refining crude oil;
- pricing of energy - energy prices are amongst the lowest in the world, and;
- the country's relatively low level of efficiency in the use of energy.

Energy consumption has grown rapidly over the past forty years. By 1990, four times as much energy was consumed in South Africa as in 1950. Demand for energy has risen in line with GDP (see figure 2.1.1 below), but at a lower rate. This is characteristic of developing economies. Developed economies on the other hand have shown a decrease in energy intensity following efficiency measures introduced after the first oil price shock in 1973. After the 1994 democratic elections, the South African government has signaled that it intends to alter South Africa's economic growth path away from energy intensive basic industries towards downstream industries with higher employment and value-added components. If this policy is successfully implemented, energy intensity should decrease. However, local demand for coal, electricity, liquid fuels and gas are all expected to continue to increase significantly in the medium term.

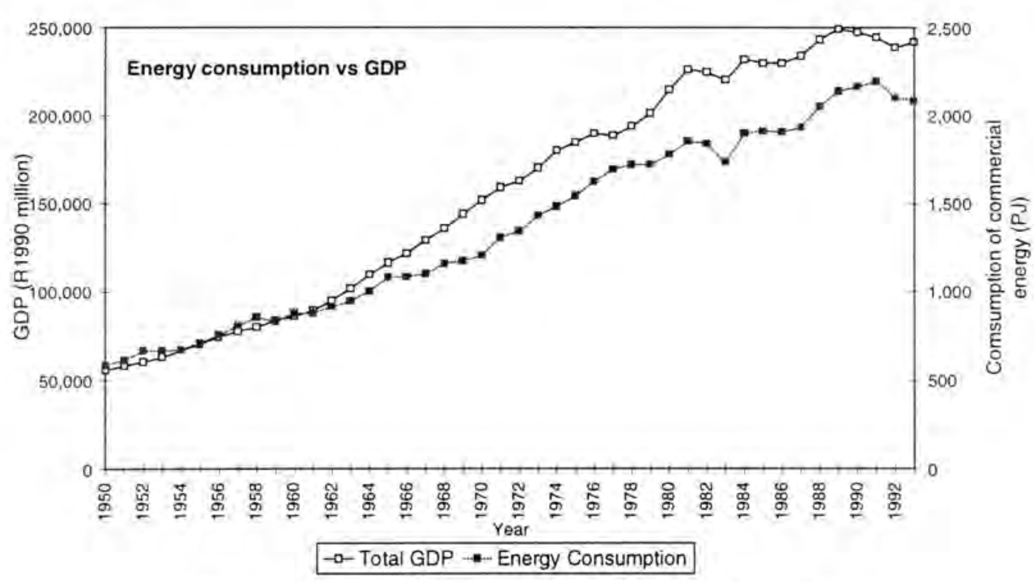


Figure 2.1.1 Historic nett energy consumption vs GDP (DMEA 1995)

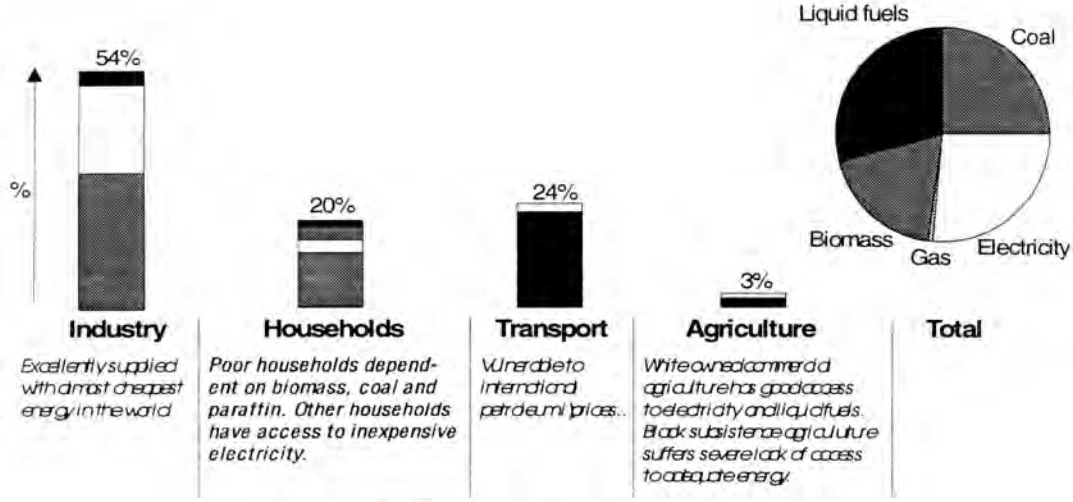


Figure 2.1.2 Nett energy consumption patterns

Nett energy consumption[1]

In 1993 nett energy consumption was approximately 2100 PJ represented by approximately 18Mt of coal, 18 billion litres of liquid fuels, 160 GWh of electricity, 12 Mt of firewood and 1 bcm of coal-gas.

In terms of quantity of energy consumed, industry accounts for more than half, with coal being the largest but electricity also playing a major role. In general, industry is well supplied with cheap energy. Transport accounts for 25% of total energy consumed - almost all of this being petrol and diesel. Households use 20% of total consumption with a large disparity between different household types. Fifty percent of households, including most rural households and many urban households, do not have access to electricity. These rely largely on woodfuel, paraffin, coal and candles. A significant proportion of households experience energy poverty. Often natural fuelwood has become scarce and cash incomes are hard pressed to provide sufficient paraffin. In low-income electrified households multiple fuel use is the norm, whilst in non-poor households almost all energy is supplied by electricity.

[1] Nett energy is fuel used in its final form and excludes fuels used to produce other fuels. For example coal used to produce electricity and liquid fuels is not included.

Primary energy and energy resources[2]

Primary energy

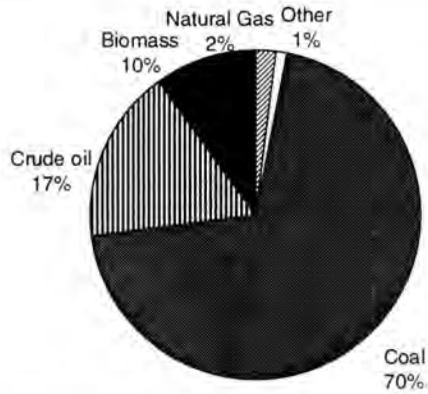


Figure 2.1.3. Primary energy consumption

Primary energy consumption in 1993 (including fuel used for production of other fuels) was approximately 4 200 PJ. Locally mined coal provides 70% of primary energy and is used largely to produce electricity, synthetic fuels and by industry. All crude oil is imported although a small (20 000 b.p.d.) oil field is under development.

Energy resources

South Africa has the 7th largest economically recoverable reserves of coal in the world (55 billion tonnes) and whilst being a large producer (243 Mt in 1994) should have sufficient coal for the next 100 years at least. However, apart from the vast potential offered by excellent solar energy, reserves of other fuels such as gas (currently 20 bcm) and oil are very small. Regional hydro-power offers realistic potential for large scale primary energy in the medium term.

Investment, revenues and employment in the energy sector

The energy sector is important in terms of both investment and expenditure in the South African economy. The energy component of the gross domestic product is more than R60 billion, or 15% (DMEA 1996a).

Electricity

An example of the importance of electricity in investment is that the largest single investment project in South Africa at present is the construction of the R9.1 billion Matimba power station. Another example is that Eskom, the national power utility, accounted for 15% of gross domestic fixed investment in 1985, at the peak of its power station investment programme. Currently, Eskom has total assets (re-valued) of about R82 billion (Eskom 1994a) and, although accurate figures are not available, other electricity distributors could be estimated to have at least a further R10 billion in assets. Electricity is also important in terms of being an input to the economy and in consumption expenditure. In 1994 electricity sales by distributors other than Eskom (receiving most of their bulk supply from Eskom) were R9.8 billion (NER 1995) and Eskom sales were an additional R8.8 billion making total electricity sales in South Africa R18.6 billion. Total employment in the electricity supply industry is about 75 000.

Petroleum fuels

There are also large investments in the liquid fuels production industry including amounts of R6.5 billion (book value - Sapia 1996) in crude refineries and R4.3 billion in Sasol Synfuels (capital employed - Arthur Anderson, 1995) and R10.9 billion (fixed assets book value) in the

[2] Primary energy includes fuels used to produce other fuels but does not include the fuels produced. For example primary energy includes coal used to make electricity but does not include the electricity produced from the coal.

Mossgas gas and synfuels production facility. However, these figures are merely indicative and do not accurately reflect the amounts invested or the current values of these investments. For example, Mossgas's value is only listed at R1.3 billion by holding company CEF (CEF 1995) and although Sasol synfuels capital employed is estimated at R4.3 billion above it is estimated that the Sasol 2 and 3 plants cost R34.9 billion (1994 Rands) to build (Sapia 1995). Also, whilst the book-value of crude refineries is R6.5 billion, construction of equivalent capacity greenfields refineries would cost about R9.1 billion (Sapia 1996). Additional investments in liquid fuels include distribution, wholesaling and bulk depot assets valued at R8.2 billion and retailing assets of R3.8 billion (Sapia 1996). Total sales of liquid fuels in South Africa were about R36 billion in 1994 (Sapia 1995) which was made up mostly of petrol (60%) and diesel (25%). Employment in the refining, synfuels production and marketing industries is in excess of 85 000.

Coal

Coal mines also represent a considerable investment but the value of the investment is difficult to estimate. Sales of coal in the local economy amounted to R5.5 billion in 1994 and exports brought in a further R4.9 billion in foreign exchange. Approximately 60 000 people are employed in the industry.

Nuclear energy

Although nuclear power supplies less than 1% of South Africa's primary energy, because of the large amounts invested in the industry (R40 billion), and the large public funding of the industry, it remains important in the economy.

2.2 The energy supply system

(Summarised from chapter 4)

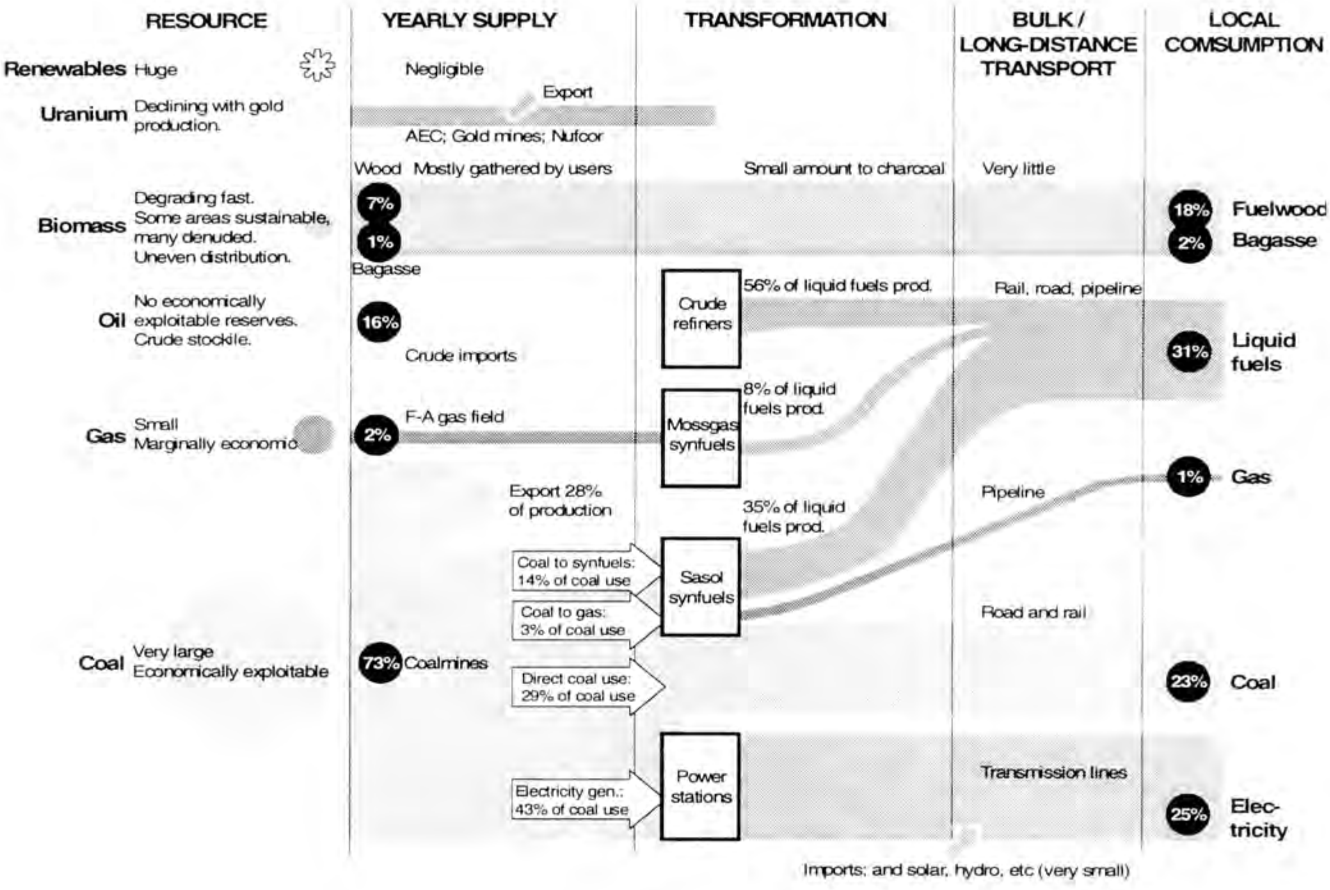


Figure 2.2.1 The South African energy supply chain

Figure 2.2.1 above depicts flows of energy from the source (either natural resources or imports) through to distribution and sales. The importance of coal both as a final energy product and as an input to the electricity and synfuels production industries is evident from the diagram.

Figure 2.2.2 below shows the geographic location of the energy resources and main supply system elements. The Gauteng area, centered on Johannesburg, combined with the industrial corridor stretching to the east of Gauteng, and the KwaZulu - Natal area to the South, account for 65% of energy consumption (Cooper 1993). This area houses most of the large power-stations and synfuel plants and associated coal mines. Nearly 80% of liquid fuels production capacity is also located in this area and the large energy intensive industries are also located here, as is more than 50% of South Africa's population.

The country is relatively well covered by the national electricity transmission grid, given the low population densities. However, only 50% of the population has access to local-level electricity distribution, and reticulation needs considerable development; this is currently underway as part of a national electrification programme. Distribution networks of liquid fuels down to retail store and service station level is good but supply arrangements of paraffin and LPG to the poorest households could be improved as excessive mark-ups are common. Coal supplies are good in the areas near to the coal fields. Coal rail transport tariffs are not regulated and have been noted as being relatively high.

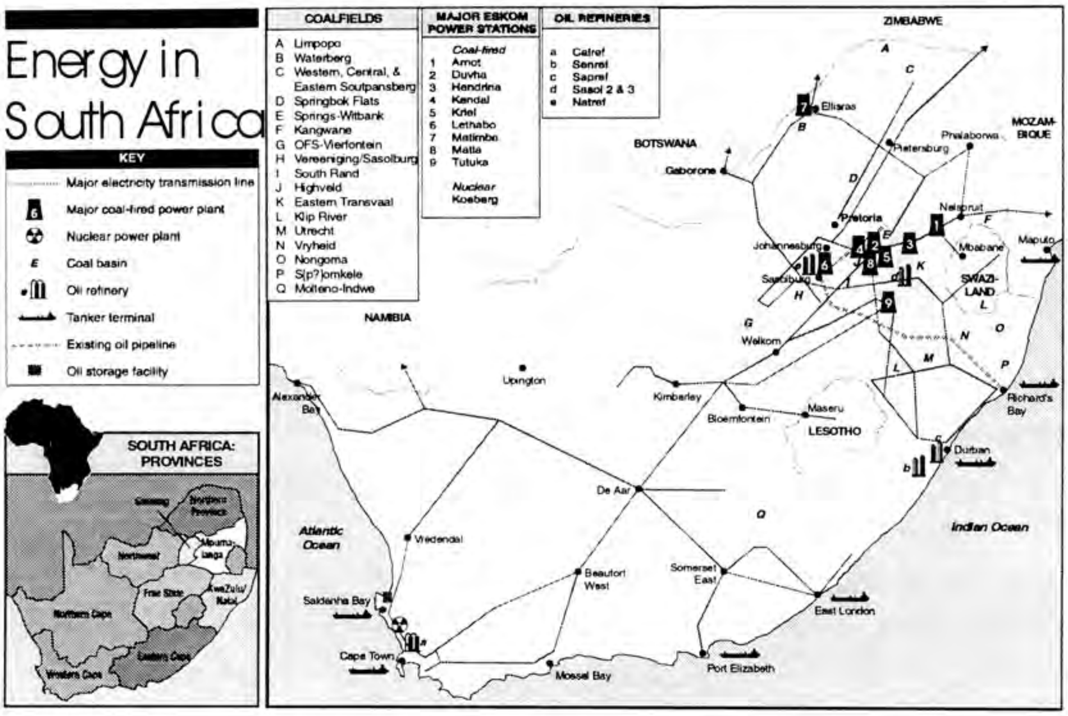


Figure 2.2.2 Map of main features of South African energy supply system

2.2.1 Coal

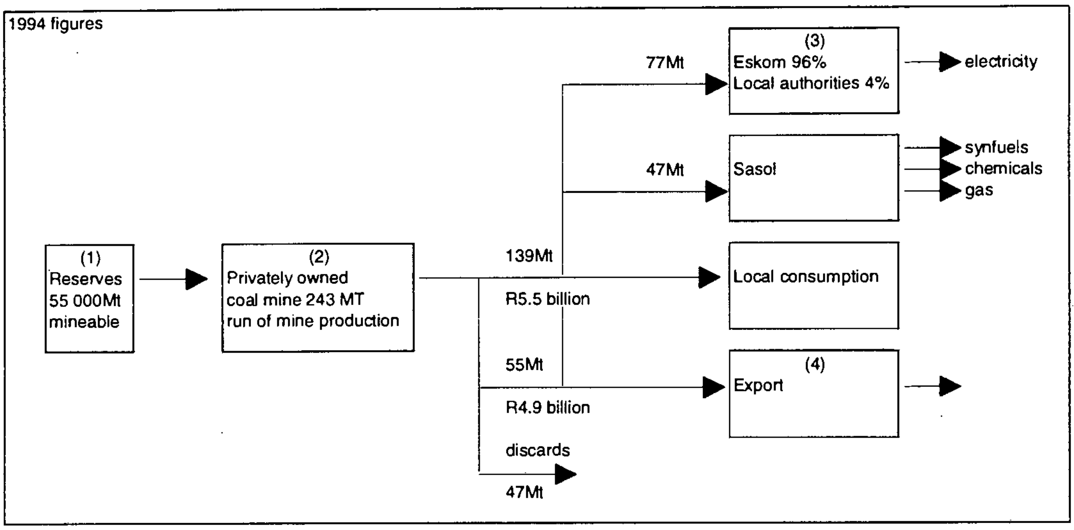


Figure 2.2.3 The coal supply chain

(1) South Africa has economically recoverable coal reserves of about 55 billion tonnes (7th largest in the world) and produced 243Mt in 1994. Most of the coal is high in ash but has a low sulphur content - less than 1%. Only small amounts of metallurgical coal (about 950Mt) and anthracite (about 1 100Mt) are present in the reserves.

(2) The coal mining industry is privately owned and controlled. However, state owned entities or entities strongly influenced by government regulation consume the the majority of production: most output goes to the Eskom parastatal (56%) which negotiates long-term contracts with private suppliers, and to Sasol (34%) which has its synfuel output strongly influenced by state regulation. Three companies, Ingwe (28%), Amcoal (23%) and Sasol (23%), account for 74% of production. Ingwe is the largest steam coal exporting company in the world.

(3) Low-grade coal with an average energy content of about 20MJ/kg and a very low price of R30/tonne is used for electricity generation.

(4) 87% of exports are steam coal. South Africa provided 23% of the world market in 1994, making it the second largest exporter in the world. Nearly all exports are handled by the Richards Bay Coal terminal which is operating at full capacity.

2.2.2 Liquid fuels and gas

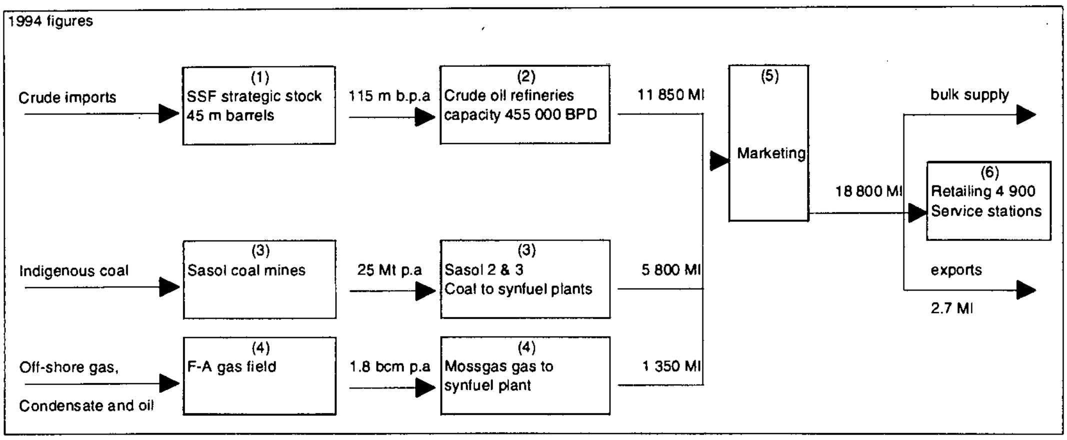


Figure 2.2.4 The liquid fuels supply chain

Refinery	Location	Capacity [TBSD**]	Ownership
Sapref	Durban	165	BP 50%, Shell 50%
Genref	Durban	105	Engen
Calref	Cape Town	100	Caltex
Natref	Sasolburg	85	Sasol 64%, Total 36%
Sasol 2+3	Secunda	150	Sasol
Mossgas	Mossel Bay	45	Central Energy Fund
Total		650	

** TBSD - thousand barrels per stream day (Crude equivalent for Sasol/Mossgas)

Table 2.2.1 South African liquid fuels production facilities

(1) South Africa's oil stocks have been drawn down from a peak of 158.5m barrels in 1988 to 45m barrels and a level of 35m barrels is aimed for. The 45m barrel storage facility at the port of Saldanha is being promoted for use of third parties.

(2) South Africa has four crude oil refineries: two at the port of Durban, one in Cape Town and one in Sasolburg (see map in figure 2.2.2).

(3) The Sasol 2 and 3 coal-to-synfuel plants were established in 1980 and 1982. The scale of these plants is unique in world terms They have received subsidies totalling at least R10 billion although the subsidy will be phased out by 1999.

(4) South Africa has 20 bcm of proven natural gas reserves, 134 bcm (recoverable) of coal bed methane, and is developing a 20 000 barrel per day oilfield. Currently 1.8 bcm p.a. of the gas reserve is fed directly into the Mossgas gas-to-synfuel plant.

(5) Petrol and diesel are marketed under eight brand names by eight oil companies. Most liquid fuel outlets are supplied by refineries in their vicinity, regardless of brand name and the oil companies share transport and depot facilities and operate product exchange agreements. Under complicated agreements made during the establishment of the synfuels industries by the state, oil companies other than Sasol and Mossgas are obliged to market nearly all synfuel production.

(6). Most petrol (92%) is sold by service stations (of which there are 4 900) while most diesel (85%) is sold in bulk. Paraffin and LPG are sold by a wide variety of enterprises ranging from oil companies to small informal dealers.

Gas

There is one coal gas distributor in South Africa, namely Sasol Heating Fuels (22 PJ p.a) which supplies about 1% of net energy consumption. However, regional gas fields, Pande and Kudu in Mozambique and Namibia respectively, are believed to show increasing potential to provide piped natural gas supplies an order of magnitude larger than current as consumption within the medium term.

2.2.3 Electricity

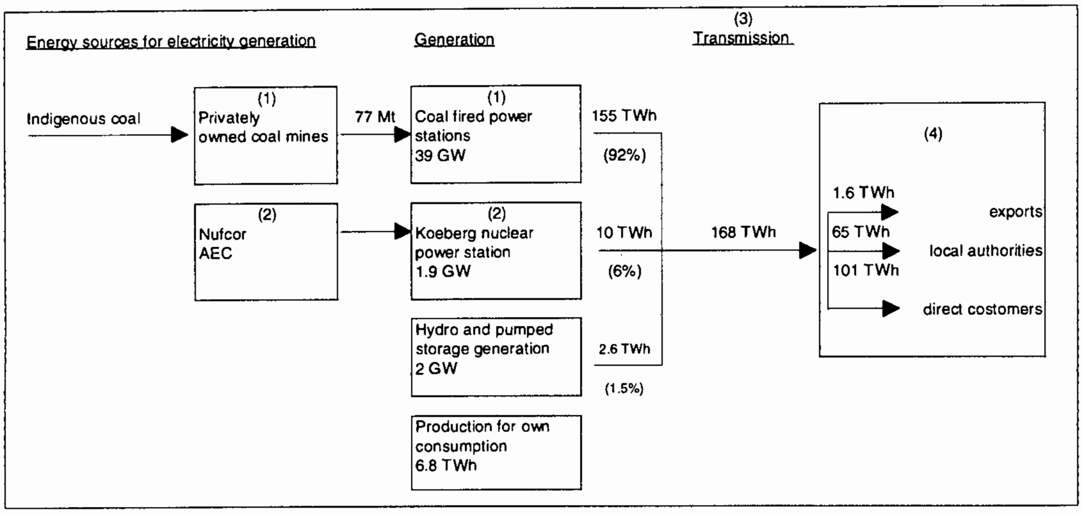


Figure 2.2.5 The electricity production chain

Notes:

(1) 92% of South African electricity is produced from coal. Eskom produces 96% of all electricity for distribution in South Africa and five local authorities also operate power stations. Privately owned coal mines supply coal within long-term contracts in which the mines are often guaranteed a return on their investments. Most of the coal used is low grade: with a high ash content up 40% and low calorific value (average 20MJ/kg). The average Eskom selling price of 10.32 c/kWh is among the lowest in the world. Eskom sales of 160 293 GWh of electricity in 1994 makes it the fifth-largest utility in the world by sales.

(2) The nuclear fuel supply chain was built up with large state subsidies but, because of changes in policy, is under transition. Whilst South Africa used to operate a full chain from mining of uranium through to fuel fabrication, the enrichment facility was closed in 1995 because it was un-economic.

(3) Eskom owns and operates the national electricity grid. The main transmission system, operating from 132 kV to 765 kV, consists of 25 181 km of transmission lines. The primary distribution system operating from 33 kV to 165 kV, consists of 38 122 km of lines, and additional reticulation lines add a further 176 154 km to give a total of 239 457 km for the Eskom national grid. Peak demand on the system in 1994 was 24 798 MW. Local authority networks represent significant further assets in terms of distribution and reticulation lines. While five local authorities have significant generating capacity, none is independent of the Eskom grid. In addition to power supplied by Eskom local authorities produce 7 TWh of power using their own facilities.

(4) Eskom provides direct supplies to its own customers, bulk supplies to local authorities (who re-sell via their own distribution networks) and direct supplies to comercial farms mainly in previously defined white areas. Local authorities make an annual surplus of some R1.7 billion on electricity sales. The household electrification programme aims to add a total of 6.3 million additional household connections compared with a total of 2.9 million existing connections in 1992.

2.2.4 Biomass[3]

Fuelwood

Biomass is very important in South Africa because rural areas house half of South Africa's population and most of 3.2 million rural households comprised of 0.9 million farmworker households and 2.3 million rural households in previously defined homeland areas depend on woodfuel as a basic energy source for cooking and heating.

Natural woodlands provide most of the supply and have deteriorated in many areas to the point where households experience difficulty in obtaining sufficient fuelwood. A project called the *Biomass Initiative* has been running for a few years with the aims of investigating the fuelwood supply problem and methods to solve it. The scale of the project is still at the pilot level.

Conventional economic supply/demand models have been shown to have limited usefulness in addressing fuelwood supply problems. The following figures are provided for reference purposes. Gandar (1994) estimated national fuel wood use at 11 million tonnes per year, of which 6.6 million tonnes is used by rural households in former homelands, 3.5 million tonnes by farmworker households and 0.7 million tonnes in urban areas. Aaron *et al* (1991) estimated the total sustainable supply of *wood* from natural woodlands for all the former homelands to be 11.6 million tonnes per year. Williams (1996) estimates that no more than half of the 11.6 million tonnes can be regarded as *fuel wood*. Williams concludes that these figures indicate a significant shortfall in wood fuel production.

Bagasse

Bagasse is a waste product of sugar refining and all consumption is by the sugar-refining industry. The DMEA (DMEA & Eskom 1995) reports that bagasse use accounted for 47 PJ in South Africa in 1993. This is significant as it represents more than five per cent of total industrial energy consumption. At 7 MJ/kg, 47 PJ is equivalent to 6.7 million tonnes of bagasse.

2.2.5 Renewables[4]

Solar and wind energy

South Africa has huge potential sources of renewable energy mainly in the form of solar radiation and wind. Daily solar radiation levels in the range between 4.5 and 6.5 kWh/m^2 are experienced and along the coast mean annual wind speeds are greater than 4 m/s and in localised areas the value of 6 m/s is exceeded.

A total of 5.1MWp of photovoltaic electricity generation is in operation and 483 600 m^2 of solar water heating panels. About 400 kW of small wind turbines for power generation have been installed. Windpumps for water supply in rural areas are very common in South Africa and about 300 000 such machines are in operation.

Hydro power

South Africa has a dry cimate and is classified as a *water stressed* country with low rainfall and few large rivers. Estimated hydro potential is 8 360 MW. South Africa has a total of 2 222MW of hydro power plants greater than 10 MW in operation, including pumped storage schemes, and 65 MW of plants smaller than 10 MW.

2.3 Conclusion

Chapter 2 has summarised key facts and figures from chapter 3 and 4 which contain a far more detailed description of the energy sector in the context of the economy and the energy supply system in South Africa.

[3] All data on biomass supplied by Anthony Williams of the Energy and Development Research Centre at the University of Cape Town.

[4] All data on renewables supplied by Anthony Williams of the Energy and Development Research Centre at the University of Cape Town.

Chapter three

Energy in the economy and energy demand

Recent work on energy policy development has indicated the importance of energy policy being sensitive to the needs of energy users, within the goals and constraints of economic, social and environmental policy. So whilst the energy supply industry is an important part of the economy, is a large employer, and needs to be viable, its raison d'être is the effective provision of energy services. In this vein, contemporary energy policy studies begin with an understanding of needs for energy services and the economic context of the energy sector. This includes suppressed demand, i.e. those energy services for which there is a need which is not met, an example of this would be non-electrified households' need for electricity. Following this rationale we now firstly consider energy in the South African economy and energy use in South Africa in chapter 3 before moving on to the energy supply system in chapter 4.

3.1 The economic context and energy-economy linkages

GDP structure, growth and energy demand

The linkage between overall output of the economy and associated energy consumption is a measure of the *energy intensity* of the economy. What is of particular interest is the degree to which growth in the overall economy (GDP growth) results in growth in energy demand and conversely how meeting demand for energy by various sectors facilitates growth in those sectors. For this we need to understand the energy intensities of energy demand subsectors.

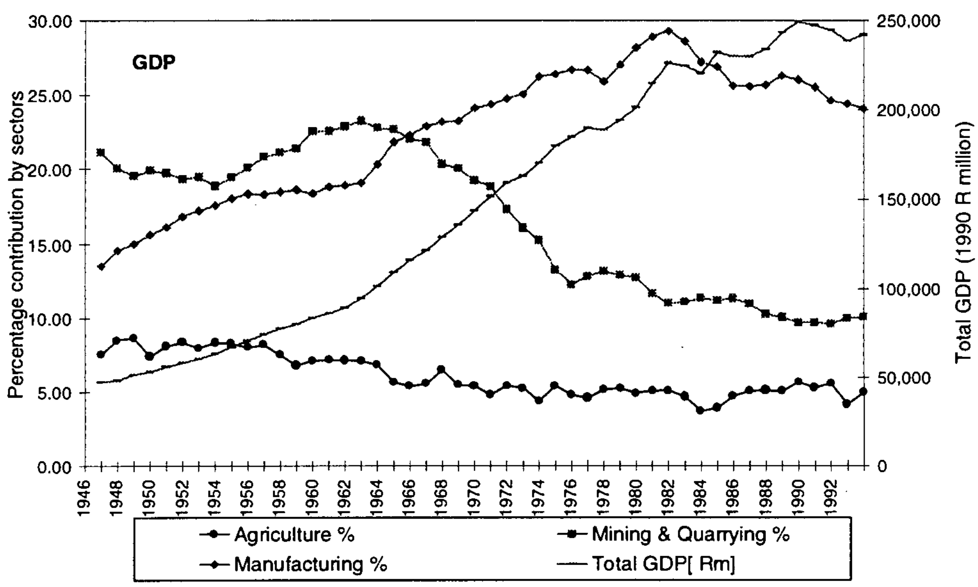


Figure 3.1.1: Sectoral contribution to GDP 1971 - 1993 (South African Central Statistical Services)

South African GDP grew steadily and rapidly from the 1950s until the beginning of the 1980s and then stagnated until the democratic elections. Since then growth has been of the order of 3% p.a and, although economic analysts differ on exact figures, even better growth rates have been forecast for the next few years at least. For instance the South African Chamber of Business forecasts a rate of between 3.5% and 4% for 1996 (Business Day, 7 December 1995).

In terms of the structure of GDP there has been a systematic decline in the relative contribution of the primary sector while the share of the secondary sector, especially manufacturing, has increased substantially and has overtaken the mining sector by a considerable margin over this period.

Energy intensity

Energy intensity refers to the amount of energy consumed in order to produce economic output. Although countries with higher GDPs tend to use more energy, this does not imply that increased energy use leads inevitably to increased economic activity: at best it could be argued that energy is a necessary but not sufficient condition for economic development. South Africa's GDP is 26th highest in the world, but its primary energy consumption ranks 16th. Its energy intensity is above average, i.e. more energy is used per unit of economic output than in many other countries. Only 10 countries have commercial primary energy intensities higher than South Africa.

South Africa's high energy intensity is largely a result of the structure of the economy with large-scale energy intensive primary minerals benefication industries and its reliance on coal for production of most electricity and a significant proportion of liquid fuels. Both of these energy transformation processes are relatively inefficient in their conversion of energy. South Africa also does not generally employ the latest developments in energy efficient technology. Energy costs are relatively low and government energy policy has favoured supply side actions rather than encouraging the efficient use of energy.

Most developed economies have shown a steady decline in energy intensity as the structure of their economies has shifted away from heavy resource based industry. Since the oil price increases of the 1970s there have been significant further improvements in energy efficiency and conservation, and the trend in industrialised countries has been a sharp decline in energy intensity; i.e. the growth in energy consumption has been slower than the growth in economic output; significantly less energy is used per unit of economic output. The same trend is not yet apparent in developing countries or in South Africa.

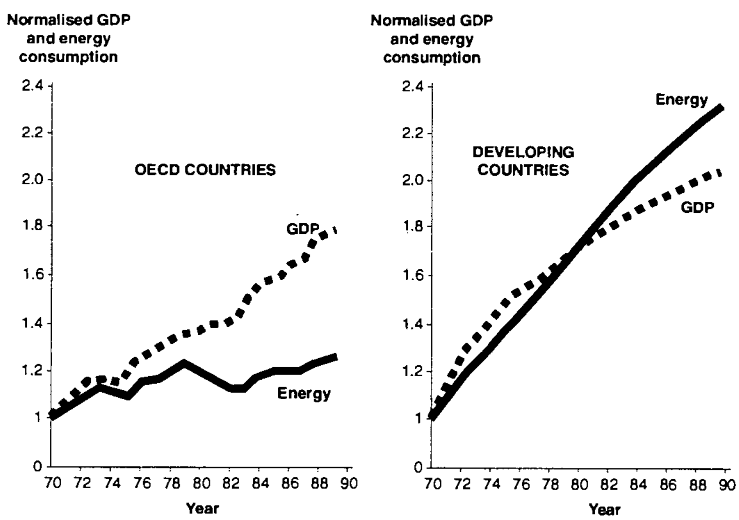


Figure 3.1.2: Trends in nett commercial energy consumption and GDP growth for OECD and developing countries (Munasinghe 1991)

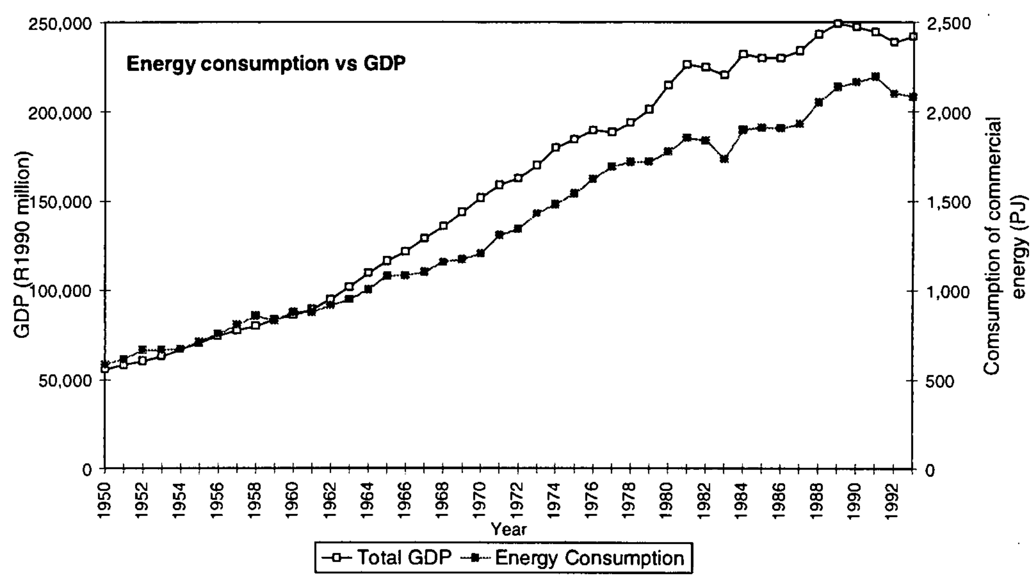


Figure 3.1.3 Trends in nett commercial energy consumption and GDP growth in South Africa (DMEA 1995)

The historical trends for the industrialised countries suggest that, as the structure of economies change from one of domination by primary industries to larger commercial and service sectors, the energy/GDP ratio tends to reach a peak and then decreases so that many industrialised countries currently experience constant energy usage with increasing economic output. With growing environmental awareness, constraints may be imposed on increased energy consumption by developing countries which have not yet reached this "hump". This is an important national and international policy issue.

Sector	Nett energy intensity (MJ/Rand output)	Electricity intensity (kWh/Rand output)
Mining	5	1.4
Commercial	1	0.2
Food and beverage	10	0.7
Clothing and footwear	9	0.7
Wood, paper, printing	7	0.7
Chemicals, plastics	9	0,8
Ceramics, glass, cement	25	1.3
Base metals	32	2.2
Manufacturing other	0.5	0.5
Total industry	12	0.9
Total economy	8	0.9

Table 3.1.1: Sectoral energy intensity (NEC 1990)

The energy intensity for individual subsectors as shown in table 3.1.1 indicates that base metals, an important component of South African exports, have the highest energy intensity both for total energy use and for electricity use. Thus, while mineral processing remains important in South Africa the relatively high energy intensity of the economy can be expected to continue. The second highest intensity for electricity is recorded for the mining industry. This is largely owing to the deep level gold mining industry which is in decline. Ceramics, glass and cement are by their nature energy intensive and this sector will most likely continue to experience growth.

3.2 Changes in South African economic policy

Macro-economic indicators

In order to form a view on what possible future growth paths can be envisaged for the energy sector in South Africa it is necessary to have a view of what direction the overall economy might take. The following is an edited extract from the South African Department of Trade and Industry's (DTI's) 1994 Annual Report. The extract gives an indication in which directions the South African economy may be expected to move in the years ahead.

> The year 1994 marked a turning point in South Africa's history. Fundamental political and social transformation was accompanied by important shifts in the economic policies of the Government of National Unity. The Department of Trade and Industry has noted the new guiding objectives for trade, industrial and investment policy as outlined in the Reconstruction and Development Programme (RDP) and in subsequent decisions taken by our first democratically elected Parliament, namely:
>
> - Achieving a 5% economic growth rate by 1999.
> - Building up to the creation of 300 000 - 500 000 sustainable non-agricultural jobs per annum by 1999.
> - Significantly raising the exports of manufactured goods to maintain macro-economic balances.
> - Substantially increasing net domestic and foreign investment in the manufacturing sector.
> - Industrial transformation.
>
> With regard to macro-economic targets for industrialisation, 1994 did not represent a healthy start. Although the gross domestic product (GDP) rose by 2.0% - 2.5%, growth was lower than required and it was largely due to improved contributions by agriculture (9%). In the manufacturing sector, growth was registered in the contribution of those sectors spurred by expenditure on the Columbus stainless steel and Alusaf aluminum megaprojects and other large-scale projects, mostly within the mineral processing, fuels-chemical complex (most of these megaprojects rely on very low prices for energy).
>
> The associated capital-intensive path for manufactures is reflected in its stagnant/declining employment patterns. Informal sector employment is known to have grown. A recent survey estimates that informal manufacturing activities (including sewing, weaving, shoe repair and food processing) in 1994 was about 209 000 or 14% of that indicated by official statistics.
>
> Since the 1970s, investment in manufacturing has been concentrated in the three capital- and energy-intensive manufacturing subsectors of steel, basic chemicals and mineral processing. Lumpy private and public investments contributed to high capital absorption in these "primary" subsectors of manufacturing, and these megaprojects had a significant impact on the engineering subsectors of manufacturing. The latter sectors have traditionally "floated" on GDFI (gross domestic fixed investment).
>
> The challenges for the future are twofold. In the first instance, we (the DTI) must ensure that the intermediate commodities that will be produced from these megaprojects, are made available to domestic industries for further processing at competitive prices. Secondly, investment in the relatively more labour-intensive downstream or "finished manufacturing" activities should be encouraged. In 1992, for the first time since 1970, GDFI in the non-primary subsectors of manufacturing overtook "primary" sector investment. This trend in the composition of investment needs to be encouraged along with overall levels.
>
> South Africa's balance of payments on the current account has deteriorated. Previous surpluses have masked a crucial structural deficiency in the overbearing dependence of our economy on the import of finished manufactures (including capital and intermediate goods) and the export of primary commodities (raw materials and, to a lesser extent, agricultural products) and processed primary commodities (or "primary" manufactures). The manufacturing sector's trade balance highlights this weakness and outlines the positive correlation between growth and increasing imports.

The contribution of the industrial sectors associated with such exports, namely mining, mineral processing and chemicals (which are often integrated in mineral production), has not diminished. More than half of South African exports are produced within four "primary" manufacturing subsectors. In fact, their contribution to exports is likely to increase in 1995 as the large and continuing investments made in these sectors in recent years come on-stream. Exports from "finished" manufacturing sectors have risen only slightly in real terms from their 1972 levels. If this trend continues, it will undermine the employment creation objectives of the RDP. In determining export promotion strategies, the DTI will, therefore, aim to increase the contribution of finished manufactures produced far downstream of primary and processed primary commodities.

Emerging vision

The economy in general, and much of South African manufacturing in particular, is uncompetitive. Industrial and trade policy will be aimed at moving from a low-wage, low-consumption economy (on aggregate), based on an old technological capacity and dependent on the export of primary and primary processed commodities, to an economy characterised by high wages, higher consumption, developing and using leading-edge technology and exporting finished and increasingly complex manufactures and services. Some difficult decisions, will have to be taken by policy makers, firms and participants in the economy in order to shift to this path.

The above extract from the DTI report is important for energy demand in that it indicates that future industrial policy will have to take into account the large investments in energy-intensive mega-projects of the past. However, policy for the future will attempt to move away from the focus on these industries and attempt to encourage less capital and energy intensive industries. The emphasis will be on moving downstream from primary or beneficiated primary commodities towards manufacture of high value finished goods requiring high wages, leading-edge technology and greater scientific and economic support and integration. The implication is that higher quality but lower volume energy services will be required. This means decreasing energy intensity for the South African economy if the policies are effective.

3.3 Global supply and demand

In addition to changes related to internal transformation in South Africa, two other factors are important in considering the economic context of the energy sector: firstly the effect of the opening of the South African economy to the world economy and, secondly, changes in the world energy economy.

In terms of the first factor, South Africa's energy policy has already responded to the new openness of the economy. A good example is the decision by the South African Government to phase out the subsidy to Sasol. Whereas a cornerstone of the apartheid government's energy policy was the establishment and support of manufacture of liquid fuels from indigenous coal and natural gas, one of the first major energy policy moves of the new government has been to plan to end that support. The macro-economic result is that more than R1.5 billion extra per annum will be made available to the fiscus when the support has been completely phased out.

Changes and trends in the global energy economy have become more important because of the new openness of the South African economy. However, predictions of the world energy market, which is strongly affected by the volatile oil market are fraught with uncertainty.

Mindful of this uncertainty the best approach is to avoid speculation on the world market and to refer the reader to the many volumes covering this topic. A standard reference would be the International Energy Agency: World Energy Outlook. The most important conclusion for South Africa in this publication is that energy demand in most developing countries is set to increase significantly. The base case scenario indicates that, while the share of OECD countries' demand of world energy will fall from 53% in 1991 to 46%, in 2020 the demand in the developing countries will rise from 27% to 40%. This will be based on growth in demand by both groups. What this means is strong growth in energy consumption in countries such as South Africa and corresponding growth in the energy supply industries. As will be seen in chapter 4 there is already evidence of this in South Africa. The South African oil refineries have recently undergone large capacity expansions and more are planned. The electricity system is also undergoing rapid expansions and coal production, both for local consumption and export, is rising.

3.4 Energy demand by different subsectors

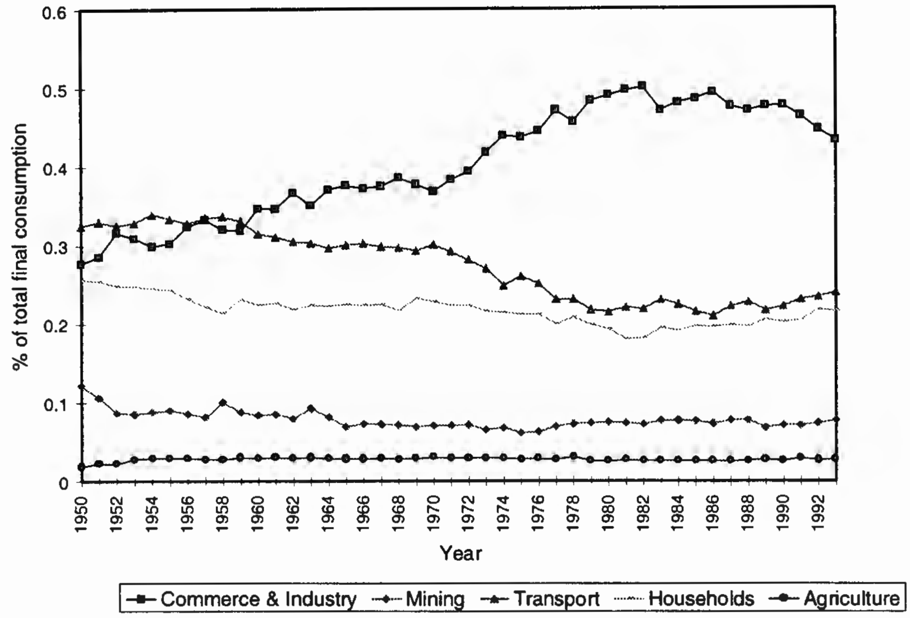


Figure 3.4.1: Final energy consumption by main user categories 1950 - 1993 (DMEA 1995)

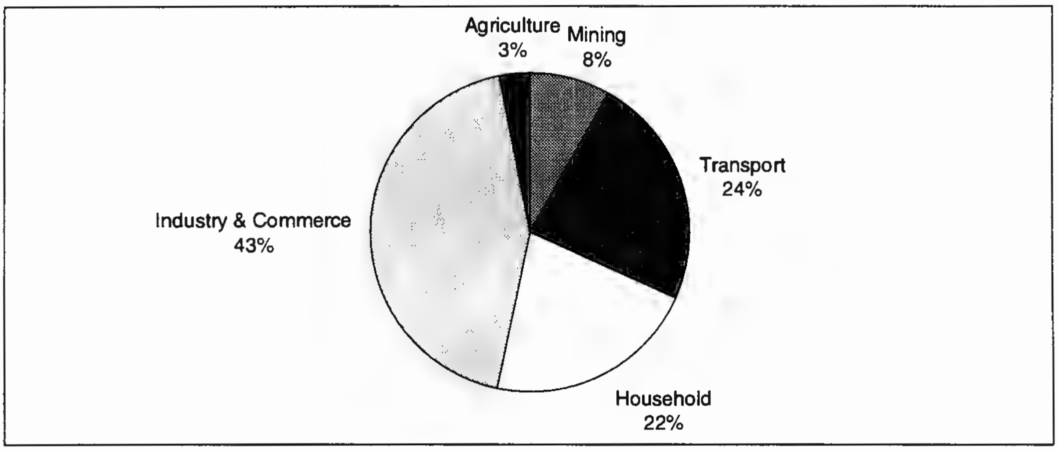


Figure 3.4.2: Net energy consumption in South Africa in 1993 by sector. (DMEA 1995)

The figures above show that in terms of quantity of energy used, industry is the most important consumer, accounting for nearly half of total consumption. Households and transport make up most of the other half consuming roughly a quarter each. Agriculture accounts for only 3% of energy consumed. The proportion of total energy consumed by industry rose rapidly until 1982 but has declined since then. The commissioning of new primary beneficiation plants such as Columbus stainless steel and Alusaf aluminum may reverse this trend. However, rapid growth in household and transport energy, directly related to electrification and increased motor vehicle use could maintain their position. Overall, there is a strong likelihood of growth in all of these main sectors.

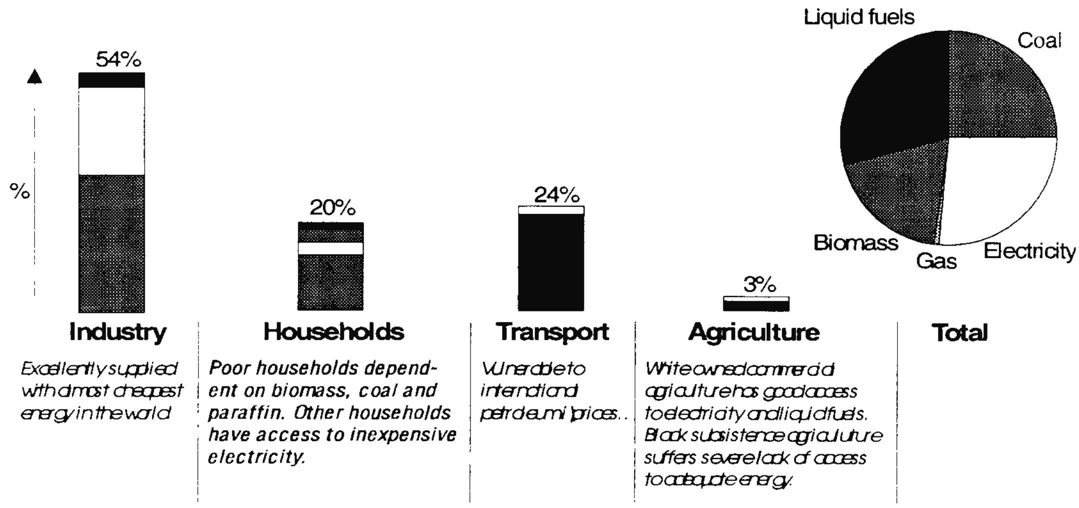


Figure 3.4.3 Net energy consumption by fuel and user group (1993) (DMEA 1995)

It is important to note the differences in fuels used. Coal and electricity make up nearly all industrial consumption and liquid fuels nearly 100% of the transport sector. Woodfuel dominates the household subsector although coal, electricity and petroleum fuels play an important role. Thus, even from this highly aggregated data, it is apparent that different subsectors have very different energy consumption patterns and needs.

Peta-joules				Elect-ricity				Solid fuels				Biomass	
	Heat	Mech-anical	Chem-ical	Light	Tran-sport	Non-Energy	Total	Coke heat	Coal heat		Total	Heat	
Industry	85.7	219.2	24.8	15.3	1.1	4.2	345.3	105.3	392.3		497.6	11.0	
Metallurgy	38.5	14.8	15.1	2.1	0.0	0.1	70.6	104.4	61.3		165.7	0.2	
Mining & quarrying	15.4	99.9	1.0	3.8	0.5	1.2	121.8	0.0	1.4		1.4	0.0	
Other industry	32.1	104.5	8.7	9.4	0.6	2.9	152.9	0.9	329.6		330.5	10.8	
Manufac-turing	18.1	49.4	5.5	6.3	0.6	0.4	75.0	0.3	108.1		108.4	10.7	
Chemicals	11.4	42.9	3.2	2.4	0.0	2.3	62.2	0.0	165.7		165.7	0.0	
Other	2.6	12.2.	0.0	0.7	0.0	0.2	15.7	0.6	55.8		56.4	0.1	
Commerce	37.7	11.6	0.0	8.7	0.0	0.0	58.0	0.0	32.5		32.5	0.0	
Transport	0.0	0.0	0.0	0.0	14.2	0.0	14.2	0.0	0.0		0.0	0.0	
Household	62.2	3.7	0.0	8.1	0.0	0.0	74.0	0.0	43.7		43.7	229.0	
Agriculture	8.8	5.1	0.0	0.7	0.0	0.0	14.6	0.0	0.0		0.0	0.0	
TOTAL	**194.4**	**239.6**	**24.8**	**32.8**	**15.3**	**4.2**	**506.1**	**105.3**	**468.5**		**573.8**	**240.0**	
Peta-joules				Liquid fuels				Gase-ous fuels				TOTAL	
	Heat	Mech-anical	Light	Tran-sport	Non-Energy	Total	Coal heat	Blast furnace heat	Coke oven heat	Pro-ducer - heat	Re-finery	Total	
Industry	22.4	2.0	0.0	19.2	0.0	43.6	19.4	15.2	13.2	4.3	1.8	53.9	951.4
Metallurgy	1.2	0.2	0.0	0.7	0.0	2.1	4.1	15.2	13.2	4.0	0.0	36.5	275.1
Mining & quarrying	0.2	1.5	0.0	0.6	0.0	2.3	0.1	0.0	0.0	0.0	0.0	0.1	125.6
Other industry	21.0	0.3	0.0	17.9	0.0	39.2	15.2	0.0	0.0	0.3	1.8	17.3	550.7
Manufac-turing	6.4	0.1	0.0	11.0	0.0	17.5	9.2	0.0	0.0	0.0	0.0	9.2	220.8
Chemicals	13.3	0.0	0.0	0.6	0.0	13.9	2.0	0.0	0.0	0.3	1.8	4.1	245.9
Other	1.3	0.2	0.0	6.3	0.0	7.8	4.0	0.0	0.0	0.0	0.0	4.0	84.0
Commerce	0.2	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	90.7
Transport	2.6	0.0	0.0	455.5	1.0	459.1	0.0	0.0	0.0	0.0	0.0	0.0	473.3
Household	23.3	0.0	1.1	0.0	0.0	24.4	0.0	0.0	0.0	0.0	0.0	0.0	371.1
Agriculture	2.7	38.6	0.1	12.9	0.0	54.3	0.0	0.0	0.0	0.0	0.0	0.0	68.9
TOTAL	**51.2**	**40.6**	**1.2**	**487.6**	**1.0**	**581.6**	**19.4**	**15.2**	**13.2**	**4.3**	**1.8**	**53.9**	**1955.4**

* Note: Although the total consumption does not tally exactly with totals from other sources the table is still very useful because of the level of detail provided. The total does not tally because the information is compiled from energy survey returns and not all users have submitted returns. The difference between this total (1955 PJ) and the official DMEA total (2083 PJ) is believed to be insignificant for the purposes of this analysis.

Table 3.4.1 Net energy consumption in South Africa by end-use and sector 1993 (Cooper 1993)

The table above gives a more disaggregated view of energy consumption by considering to what use the energy is put by the various consumers. Although the table appears dense with data, closer inspection reveals that energy needs are concentrated in different subsectors. The clearest example is liquid fuels in the transport sector. The data in this table also gives an idea of where fuels may be substituted, - for example the large amount of heat energy provided by electricity to industry, and where fuels could probably only be substituted at significant extra cost - such as the coal used for heat in industry or the electricity used for mechanical energy in industry. The table is rich with information of which the above are only a few examples.

3.4.1 Energy use in industry and mining

Peta joules	Electricity	Coal & coke	Other fuels	Total	% of Total
Mining	118	9	8	135	16
Minerals & metals	85	174	75	334	40
Manufacturing*	94	164	51	309	37
Sub total	297	347	134	779	93
Other industry**	-	-	63	63	7
Total	**297**	**347**	**197**	**841**	**100**

* Includes chemicals
** Accounts for data inadequacies

Table 3.4.2 Energy consumption by industrial and mining subsectors 1993 (Cooper 1995)

The industry and mining subsectors accounted for 51% of energy consumption in 1993, making them the most important subsectors in terms of energy consumption. The table above gives consumption figures for the two most important fuels, electricity and coal. Roughly equivalent quantities of these two fuels are used and together they make up about three-quarters of fuels supplied to these subsectors. The balance is made up largely by coal, coke and blast furnace gases, and small amounts of heating oils. The different industrial sectors are also clearly dependent on different fuels as shown below.

Percent	Electricity	Coal & coke	Other	Total
Mining	87	6	7	100
Minerals & metals	26	52	22*	100
Manufacturing	30	53	17	100

* Nearly all of this is coke oven gas and blast furnace gas in basic ferrous metals beneficiation.

Table 3.4.3 Percentage contribution of fuels to subsectors 1993 (Cooper 1995)

The mining industry depends heavily on electricity, and accounts for 87% of consumption. Supply of electricity to the mines was the main factor which spurred the initial development of South Africa's large electricity sector. Minerals and metals uses large amounts of both electricity and coal, mostly in large scale minerals benefaction. Manufacturing also uses large amounts of coal and electricity. Both these fuels are extensively used for heating applications.

Energy intensity in South African industry

Major groups	Net energy consumption (PJ)	Value added (R million)	Energy intensity (Mj/Rand)
Coal	11.1	4 797	2.3
Metal ore	29.4	2 910	10.1
Gold and uranium	87.2	13 138	6.6
Diamond	3.7	1 390	2.7
Other	5.3	4 770	1.1
Total mining	136.7	27 005	5.1
Food	90.0	8 697	10.4
Beverages	11.0	2 685	4.1
Tobacco	0.9	401	2.2
Textiles	17.5	2 617	6.7
Clothing	1.6	2 099	0.8
Leather	1.3	277	4.8
Footwear	0.4	759	0.6
Wood except furniture	8.0	1 404	5.7
Wood furniture	1.1	1 015	1.0
Paper and paper products	66.4	3 319	20.0
Printing	2.9	2 863	1.0
Industrial chemicals	54.9	1 860	17.1
Other chemicals	12.8	1 982	6.5
Rubber	5.8	991	5.8
Plastics	3.6	1860	1.9
Pottery	2.3	111	21.1
Glass	8.1	781	10.4
Other non-metal minerals	82.9	2 170	38.2
Ferrous basic metals	288.1	4 413	65.3
Non-ferrous metals	25.4	1 407	18.0
Fabricated metals	14.0	4 888	2.9
Machinery	5.8	3 407	1.7
Electrical machinery	5.1	3 175	1.6
Motor vehicles	6.5	3 699	1.8
Transport equipment	1.1	1 082	1.0
Professional and Scientific	0.4	360	1.2
Other manufacturing	7.3	583	12.5
Total manufacturing	725.3	60 254	12.0
Total industry	862.0	87 259	9.9

Table 3.4.4 Energy intensity of South African industry (De Villiers 1994)

It is apparent that base metals, the largest single industrial energy consuming subsector, is also by far the most energy intensive industrial subsector. The pattern of energy expenditure by some other industrial subsectors is also important. The food sector shows both a high total use and relatively high intensity, although, in terms of value added its energy requirements are very modest in comparison with the basic minerals and metals industries. The chemicals and paper and pulp industries consume large amounts at high intensities. South African industries exhibit energy intensities similar to other developing countries, typically 15% to 50% higher than equivalent industries in Western Europe and the USA.

The table below shows a comparison of some important industrial subsectors. The study that produced these figures (de Villiers 1993) suggests that amongst the chief causes of South Africa's poor efficiency are cheap prices of energy, the fuel mix (with South Africa having amongst the world's highest uses of coal and electricity and lowest of fuel oil and gas) and the use of older, less efficient plant and technologies.

	Paper	Bricks	Cement	Steel
	GJ/ton	GJ/ton	GJ/ton	GJ/ton
South Africa	31-37	4.0-4.5	4.6	29.0
USA	28-35		4.1	21.4
UK	26	2.9		19.8
Sweden	22			19.7
Japan			3.0-4.0	17.6
Brazil	20		4.2	20.6
Hungary			4.2	25.6
Taiwan			3.7	23.2
Canada		3.5		23.7
Western Europe	22-29	2.6-3.8	3.6-3.8	16-21
Developing Countries	23-54	4.0-5.0	4.0-6.0	24-39

Table 3.4.5 International comparison of energy consumption in large industrial subsectors (de Villiers 1993)

3.4.2 Transport

Liquid fuels comprise 92% of energy consumption for transport. Availability is good and prices are average and stable by international standards. Rail transport accounts for 5% of total electricity consumption. Although some electricity and coal are used in transport they are relatively unimportant in this sector and this section focuses on liquid fuels. Electricity makes up 2.5% and coal less than 1% of demand.

Total demand in South Africa for petrol in 1994 was 9 600 Ml and for diesel 5 100 Ml. This represents market growth of 4-5 % for petrol since 1993 and 3-4 % for diesel. The markets for petrol and diesel can be expected to grow by approximately 3 % per annum over the next six years. South Africa is a spacious country with 202 00 km of roads in relatively good condition and six million motor vehicles. The total number of vehicle kilometres travelled in South Africa in 1992 was 98 000 million, ranking South Africa fifteenth in the world on this statistic. Changes in socio-economic policy of the post-apartheid government aim to spread the benefits of the economy. In other countries similar increases of wealth have led to rapid rises in the number of motor vehicles and in vehicle usage. A corresponding rise in South Africa will most probably lead to an extremely sharp rise in the demand for the associated transport fuels.

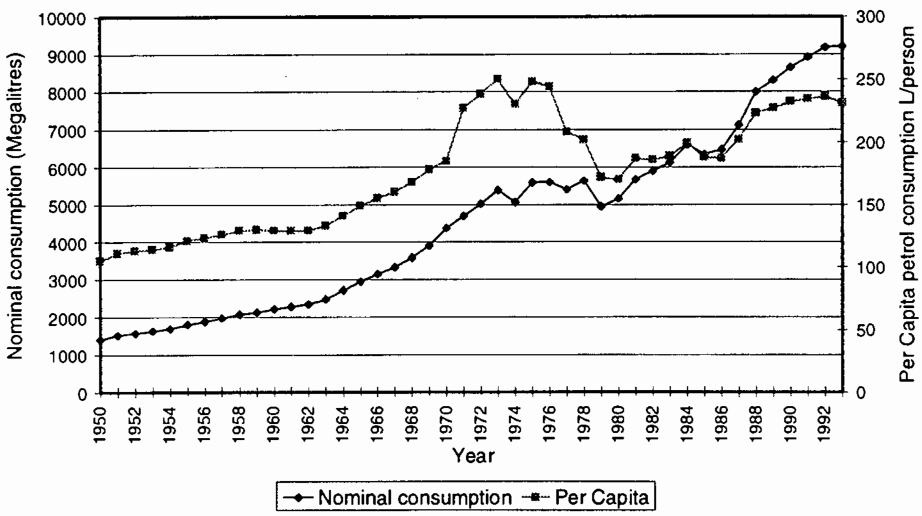


Figure 3.4.4 Nominal and per capita consumption of petrol 1950 - 1993 (DMEA 1995)

Excepting the dips corresponding to the oil crises of 1973 and 1979, when strict conservation measures were implemented, nominal petrol demand has shown steady growth. Considering that South Africa was in economic recession from 1989 to 1993 it is expected that the current upturn in the economy (1996) will increase demand substantially.

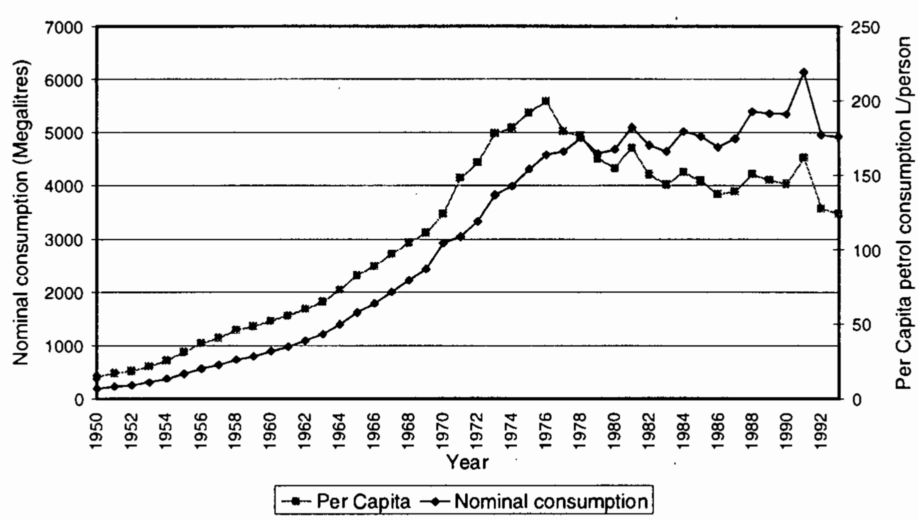


Figure 3.4.5: Nominal and per capita consumption of diesel 1950 - 1993 (DMEA 1995)

Demand for diesel, on the other hand, has remained relatively flat since the beginning of the 1980s. This is to be expected as diesel is largely used in the commercial transport sector and by industry-and agriculture. The demand in these sectors is less price-elastic than the demand for petrol by private motorists. Demand for diesel is also strongly coupled to economic output because of the role in the economy of commercial transport. The sluggish demand for diesel mirrors the sluggish economy over this period.

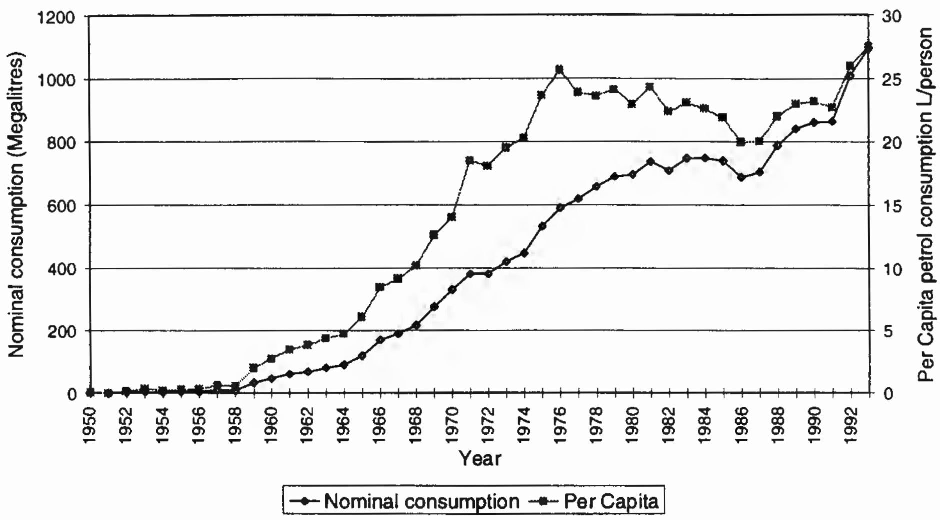


Figure 3.4.6 Nominal and per capita consumption of jet fuel 1950 - 1993 (DMEA 1995)

Jet fuel demand is affected by a complex group of factors ranging from tourist travel to business confidence. The strong dip in the mid eighties reflects South Africa's increasing international isolation and economic crisis towards the end of the apartheid era. However, with most economic indicators in South Africa having improved considerably since the democratic elections in 1994 it is likely that jet fuel will continue with a strong upward trend.

3.4.3 Energy demand by households and community facilities

Households can be divided into the four categories shown in the table below.

Household category	Energy use pattern
Poor rural households	- dependent on often inadequate supplies of fuelwood - increasing use of paraffin, candles, batteries but find these very expensive and a drain on cash resources - fuelwood related indoor air pollution is a major health problem
Poor non-electrified urban households	- use paraffin, coal (in areas where coal is cheap), LPG, candles and batteries - purchase of these fuels a very heavy burden on resources - coal related air pollution is a major health problem
Poor electrified households	- largely use electricity but keep paraffin,, LPG or candles for security because of supply quality except that households in areas where coal is cheap maintain high usage of coal stoves for cooking and space heating - coal related air pollution is a major health problem
Non-poor households	- all have access to electricity - electricity use dominates and is not a burden on household

Table 3.4.7 Household energy use (Eberhard & Trollip 1994)

At the end of 1995 only about 50% of households had access to electricity. However, the government's RDP electrification programme plans to electrify a further 2.5 million households by the year 2000, raising this proportion to 64% Other key issues facing households are the security of fuelwood supplies, and cost, health and safety issues related to coal and paraffin use.

The low-income household sector has historically been ignored in government energy policy. Because major changes are not expected in the non-poor household category this section focuses on the energy demand of the urban and rural poor

Energy demand by the urban and rural poor

The household sector is characterised by its extreme diversity in energy use paterns.The figures below are an example of the distribution of household energy use across household types and geographic region. These figures indicate the large number of permutations of the key variables. (An exhaustive description would be out of place in this document; the reader is referred to the EPRET outputs (EDRC 1995) for details on household energy usage.)

In addition to extreme diversity, low-income urban households in South Africa exhibit three main characteristics in their energy usage patterns. First, for individual households, multiple fuel use is common, and it is not unusual to find two, three or more fuels being regularly used for the same end-use. Second, the structure of energy usage is different for differing types of households. Third, patterns of consumption are dynamic, changing over time and social contexts, reacting to fuel price movements, changes in access to fuel sources and many other factors. Moreover, with security of service being of prime importance to poor households, which often experience interruptions in supply and volatile economic conditions, appliance-fuel combinations for different end-uses change frequently.

Urban households

In South Africa it has been found that one of the primary macro-determinants of energy consumption patterns in a low-income urban household is its geographical location. Two major geographical factors appear to be relevant: climatic conditions and access to cheap coal. It is informative to compare the distribution of these two factors with the percentage use of various fuels at different geographic locations. The figure below depicts an overview of percentage use of different fuels in households in major urban centres. Where coal prices are low, coal use predominates. Paraffin is important in all regions but where coal prices are higher non-electrified low-income households depend on paraffin.

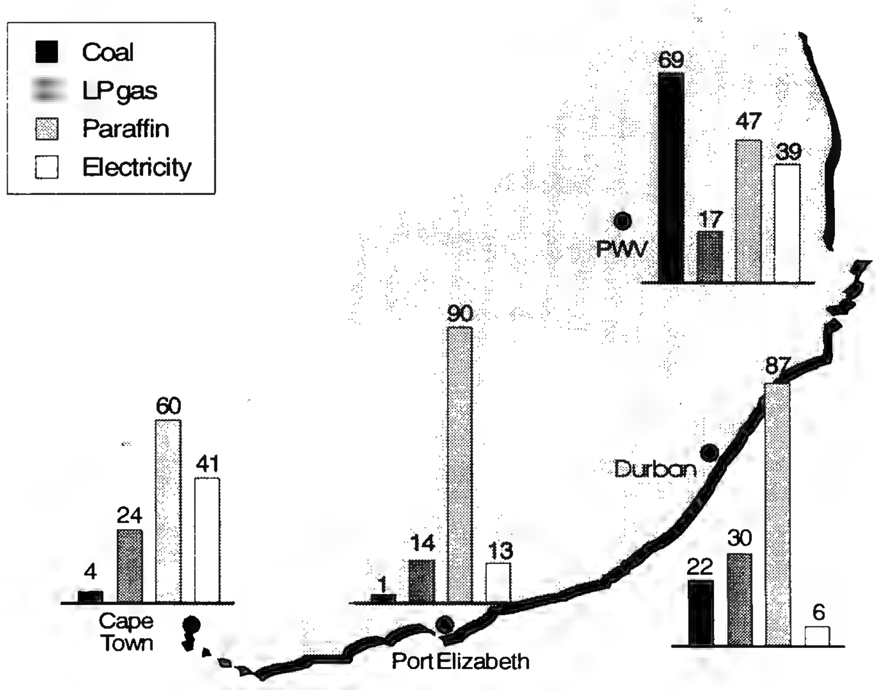


Figure 3.4.8 Map showing the percentage usage patterns of different energy carriers in different regions (Trollip 1994)

The quantities of different energy carriers used are often problematic to measure. The data in figure 3.4.9 and 3.4.10 were compiled from the EPRET (Trollip 1994) database and are indicative of the demand for household fuels in two representative areas of South Africa.

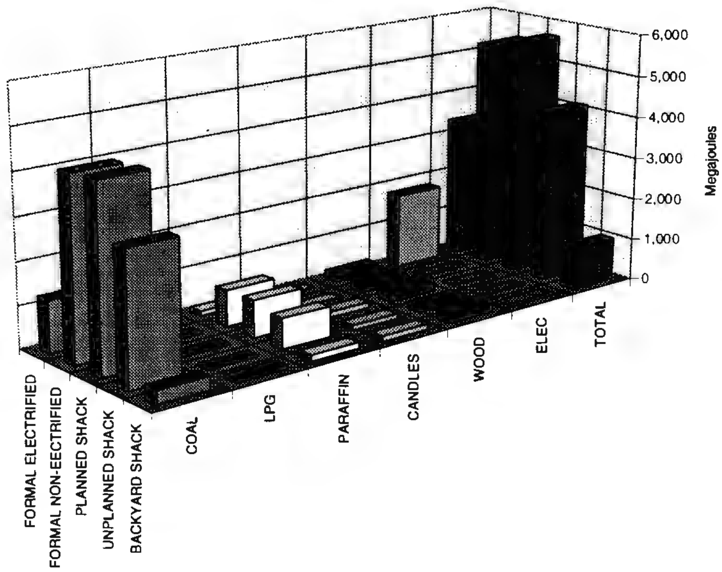


Figure 3.4.9 Monthly delivered energy consumption in Megajoules in the PWV (Trollip 1994)

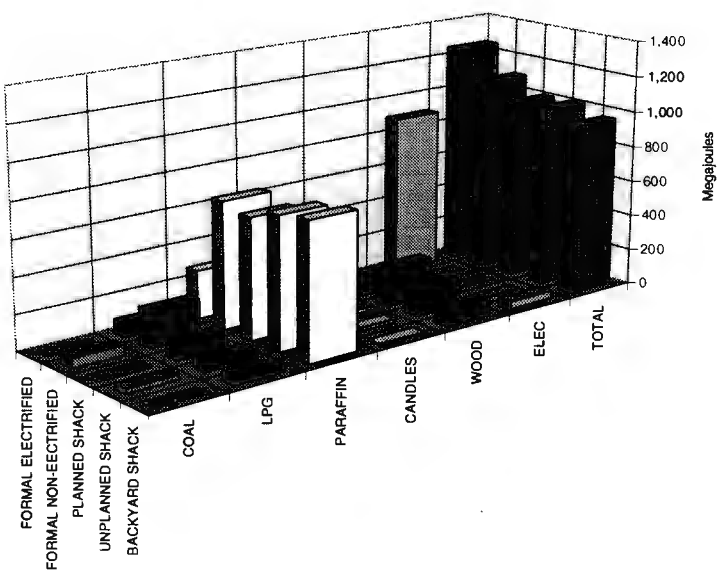


Figure 3.4.10 Monthly delivered energy consumption in Megajoules in East London and Port Elizabeth (Trollip 1994)

These figures are used as representative examples of a region with low-priced coal and cold winters and a region where the coal price is high and the climate can be described as temperate coastal. The total quantity of energy delivered to households in the Gauteng is far higher than in the Eastern Cape. The availability of cheap coal lessens general energy poverty although the health and safety implications of the resulting pollution are severe (Terblanche et al 1992). It can be seen that when electricity is available it is used and that paraffin use is pervasive.

Significant quantities of paraffin are used in all non-electrified households. In areas where coal is expensive the major source of energy for poor is paraffin. The figure below shows the consumption of paraffin in South Africa since 1950 - households account for most of this.

The consumption record raises two issues. The large dip between 1976 and 1988 corresponds with a rise in the paraffin price starting in 1973 and sharpening in 1979. The recovery in consumption levels in 1983 matches a decrease in the paraffin price. This corroborates other evidence (Mc Gregor 1992) of paraffin demand being price-elastic. The reality described by these figures is of the poorest of the poor, already suffering serious energy poverty, having to cut their paraffin consumption even further in the face of price increase.

A second observation based on the figures above is that concurrent with the mass electrification programme of the past years paraffin consumption has risen steeply. Thus, issues of paraffin price and availability remain crucial to poor households.

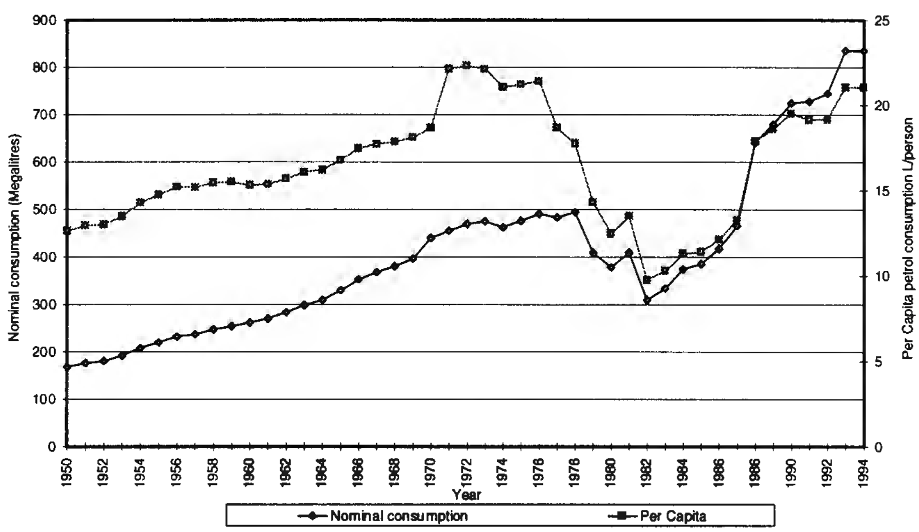


Figure 3.4.11 Nominal and per capita consumption of illumination paraffin (DMEA 1995)

Expenditure on fuels

A good indication of the energy burden that poor South African households experience is given in the figure below. Note that this only includes actual consumption expenditure on the fuels themselves and does not include the costs of appliances, - which can be high and are an integral part of acquiring energy services.

The most significant feature is the high percentage of income spent on energy by the poorest category. The high expenditure suggests that a certain minimum energy consumption is required to sustain very basic needs and that poorer South African households forego many other items to satisfy this need.

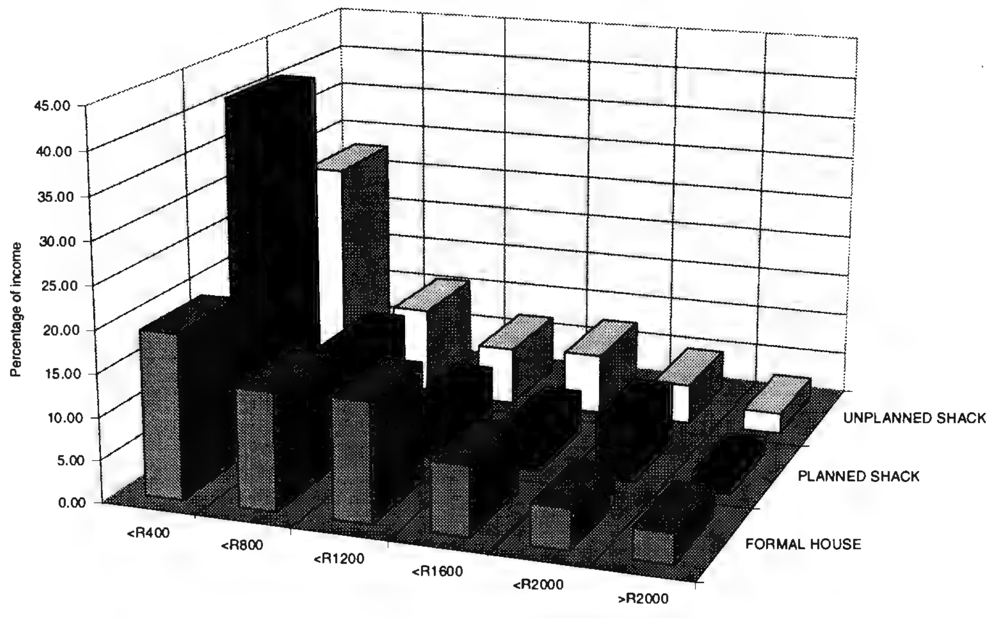


Figure 3.4.12 Energy expenditure as a percentage of income in Gauteng (Golding & Hoets 1992)

Rural households

Rural households comprise the majority of poor homes in South Africa. About 0.9 million of the 3.2 million households are farmworkers on commercial farms while 2.3 million are situated in previously defined "homeland" areas. Most of these households are characterised by severe poverty and in terms of basic energy services the energy poverty is exacerbated by growing denudation of local biomass resources. Wood and paraffin are the main energy resources for rural households with only about 2.5% (Horvei & Dahl 1994) of homeland houses and 15% (Hofmeyr 1993) of farm worker households having access to electricity. High coal use is found in a few areas and LPG is also used in some cases although prevalence of this is low.

The overall picture that emerges from an examination of many rural energy surveys that have been undertaken is one of a multiple fuel economy adapting to changing conditions. As local biomass resources are put under pressure these are commercialised and other commercial fuels, mainly paraffin, are introduced. While in the not too distant past wood was a "free" fuel, collected by household members, it has become increasingly commercialised and in many areas household expenditures on wood and paraffin are reaching parity (Ward 1994). This reliance on commercial fuels is not welcomed by poor rural households and expenditure on both paraffin and wood is often seen as an onerous burden on meagre cash resources and in many surveys is cited, together with wood fuel shortages, as one of the biggest problems experienced by these households (Ward 1994).

There is a considerable range in living conditions experienced by farm worker households, largely determined by the farm owners. In energy terms farmworkers are often better off than other poor rural dwellers because commercial farms often have considerable fuelwood resources (Hofmeyr 1993). However, despite this, there are many cases where workers do not have access to these resources and experience shortages. Because of their lack of ready access to commercial centres, farmworkers are obliged to pay high prices for alternative fuels at rural retailers, placing a heavy burden on their often extremely low cash incomes.

Community facilities

The results of apartheid planning have had a similar effect on community facilities as on households. Facilities in the former black "homelands" and black townships are poorly resourced. 80% of South African schools do not have electricity and many clinics are also not supplied.

Household electricity

One of the many blatant inequities of the apartheid energy system was the unequal access to electricity offered to households in previously defined black local authority areas compared with white local authority areas. In general, just about all white households have access and most black households do not. One of the cornerstones of the RDP is the national household electrification programme. The table below indicates the achievement of the programme to date.

Electrification					
	1992	1993	1994	1995	Inception to date
Eskom	145 522	208 801	254 383	313 179	921 885
Farmworkers**	12 698	16 074	16 838	15 134	60 482
Local authorities	62 214	91 222	129 951	118 173	401 560
Other	12 121	16 074	34 584	32 281	95 060
Total	232 555	331 909	435 756	478 767	1 478 987

** 1992 figure is connections from January 1991 to December 1992

Table 3.4.8 The electrification programme to date
(National Elecricity Regulator 1996)

By the end of 1995, 20 million South Africans (about half the population) still did not have access to electricity. (A large scale electrification programme is described in section 4.3 on Electricity). Eskom has been given responsibility for a portion of the urban areas and all rural areas. The arrangements for the remainder of the urban areas are not clear and are bound up in the problems caused by the fragmented supply of services which resulted from previous race-based local authorities. The degree of resolution of the arrangement of urban electricity supplies could have a large impact on the success of the programme.

Agriculture

Liquid fuels account for 78% of energy consumption in this sector. Electricity allows use of sophisticated technology on commercial farms whilst subsistence agriculture is severely hampered by lack of access to electricity and other fuels even for basic services such as water pumping.

Diesel plays a major role in commercial agriculture. In 1995 the agricultural subsector's expenditure on liquid fuels was R1.72 billion, making up 15% of the sector's total intermediary goods and services bill (Business Day, 3 April 1996). Diesel is currently priced in the same range as petrol in South Africa (an abnormal situation internationally - see section 4.3 on liquid fuels), and large amounts of diesel are currently exported because of a structural local surplus of diesel.

3.5 Net energy consumption of different fuels

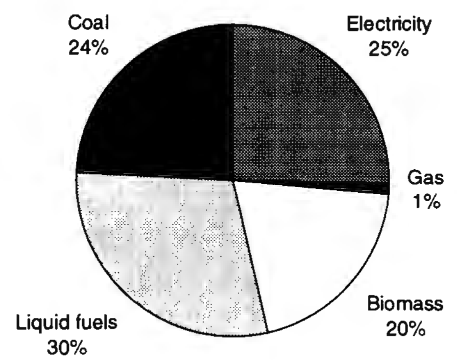


Figure 3.4.13 Net energy consumption by energy carrier 1993
(DMEA 1995)

The pattern of fuel use has changed over time as shown in the figure below. It can be seen that the complete dominance of coal which made up 65% of consumption in the 1950s has been steadily eroded and now accounts for about 25%. The change in consumption patterns reflects the changing structure of the economy and society. For example, the rapid increase in motor vehicle use has led to liquid fuels accounting for the largest amount of final energy consumption. The growth in consumption of liquid fuels reflects both the increase in ownership and use of private motor vehicles and minibus taxis and the use of heavy diesel-powered road transport. The growth in electricity reflects both a changing industrial structure, with higher technology manufacturing taking an ever-increasing share over primary industries and also the substitution of fuels such as coal in the household sector.

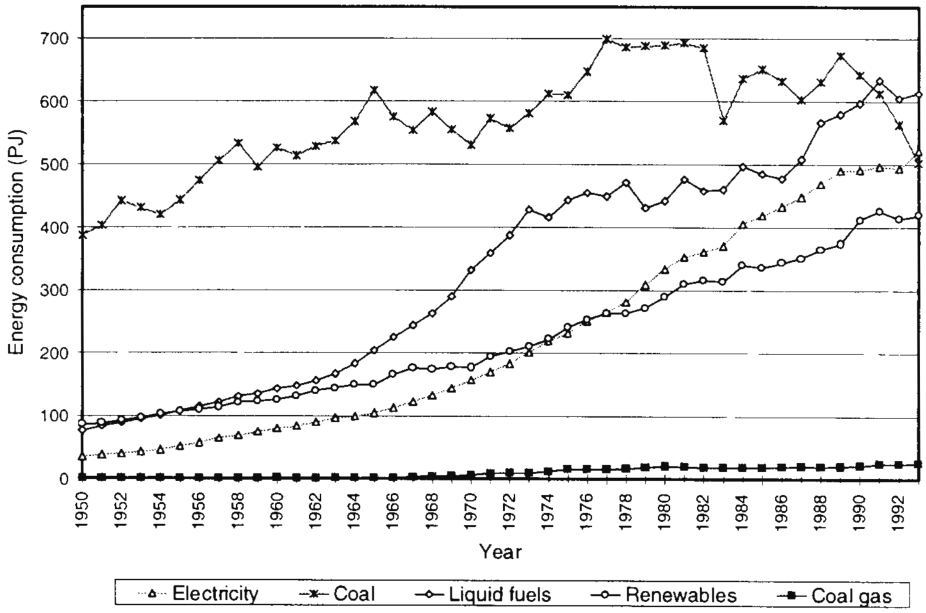


Figure 3.4.14 Use of different fuels from 1950 - 1993 (DMEA 1995)

Growth in electricity consumption has also been very strong. In terms of economic development, electricity is acknowledged as being of particular importance. The portion of electricity utilised by different sectors is shown in the figure below. This illustrates the relative importance of electricity in different subsectors, with the combination of industry, commerce and mining making up more than three quarters of the demand. Mechanical energy and heat energy are the main end-uses.

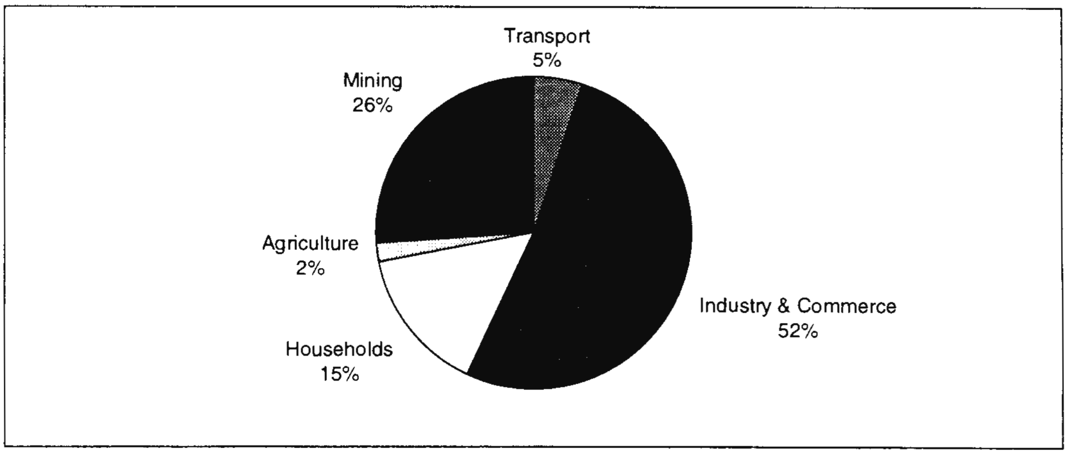


Figure 3.4.15 Sectoral consumption of electricity in South Africa (DMEA 1995)

Whilst households only consume about 15% of the energy component of electricity their effect on the capacity of the electricity sector is far greater. Firstly, the complexity and cost of installing and operating the household distribution system is far higher, per kWh sold, than that for bigger consumers. But the second effect, on the shape of the daily demand curve, has very important implications, both for system capacity and for demand side management. The figure below shows the daily demand curve, on the day of peak electricity demand on the national network in 1994.

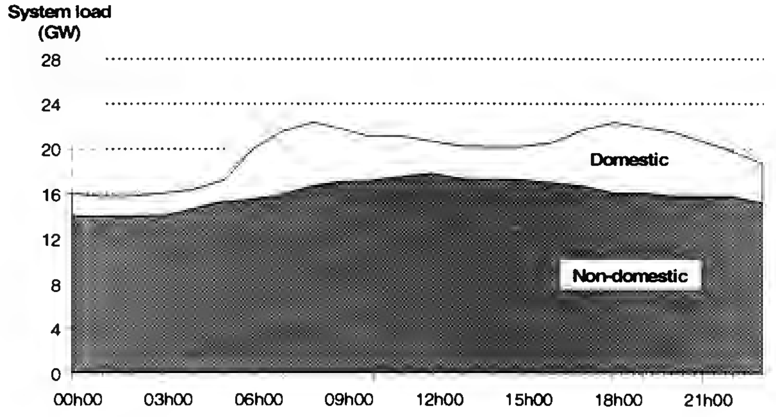


Figure 3.4.16 South African electricity system demand on day of peak demand 1992 (Eskom 1994b)

The peak demand occurred at about 18h00 on a cold day and coincided with the peak demand from residential consumers. Electricity load research in low-income residential areas shows a high correlation between demand and low temperatures (Berrisford & Bluff 1991).

This has implications for all components of the South African energy system. The political and economic recovery in South Africa, combined with the mass housing and electrification programmes, will lead to rapid growth in the total number of households using electricity. If growth in the demand by households for electricity is allowed to go unchecked, the form of the daily demand curve shown above will dictate a requirement for huge additional capital expenditure in generation plant. This will have a considerable negative impact on electricity costs.

3.6 Primary energy consumption

The nett energy consumption above refers to energy, such as petrol for example, consumed in its final state. However, most energy consumed in South Africa has first been *transformed* from some other energy carrier. For example, petrol is produced from crude oil (imported to South Africa) or coal or natural gas. Most electricity in South Africa is produced from coal. The next chapter deals in detail with energy supply, which considers these transformation industries in detail. However, in terms of demand, the nett energy demand described in the proceeding sections of this chapter expresses itself in the primary demand for energy shown in the figure below.

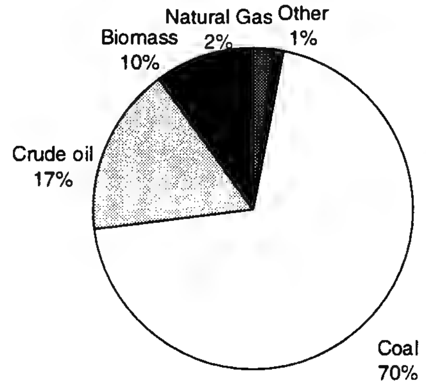


Figure 3.4.17 Primary energy demand 1993 (DMEA 1995)

Chapter four

South African energy supply

This chapter aims to describe the energy supply sector in terms of institutional arrangements and main quantitative parameters for each of the main subsectors.

Energy supply industries in South Africa are owned and managed by a mixture of private and state-owned organisations. Commercial energy production is dominated by a limited number of large organisations. With one main exception, these large organisations currently specialise in one energy subsector: coal, electricity or liquid fuels. Whilst these large organisations also have a strong presence in retailing, the retail component of the supply chain is largely characterised by a large number of smaller operators.

4.1 The coal subsector

Overview

The indigenous South African energy resource is dominated by coal. Many of the very large coal deposits can be exploited at extremely favourable costs and as a result a large coal mining industry has developed. Proven reserves total 61 billion tonnes (the seventh largest in the world) and annual production exceeds 200 million tonnes (Chamber of Mines 1995a). In addition to extensive use of coal in the domestic economy, large amounts of coal are exported, making an important contribution to South Africa's foreign exchange. South Africa is the world's sixth-largest coal producer and the second-largest exporter of steam coal.

To achieve success the coal industry has had to overcome problems with poor quality coal. Much of the coal has a high ash content making it unsuitable for export and problematic for local utilisation. However, the local electricity generation, synthetic fuels and chemicals industries have overcome these problems. For export and specific local purposes beneficiation (largely washing) processes have been developed.

1994	Million Tonnes	Million Rands
Run of mine production	243	
Salable quality	196	
Sales	194	10 412
- local	139	5 525
- export	55	4 887

Table 4.1.1 Basic coal production and sales statistics for 1994. (Chamber of Mines 1995a)

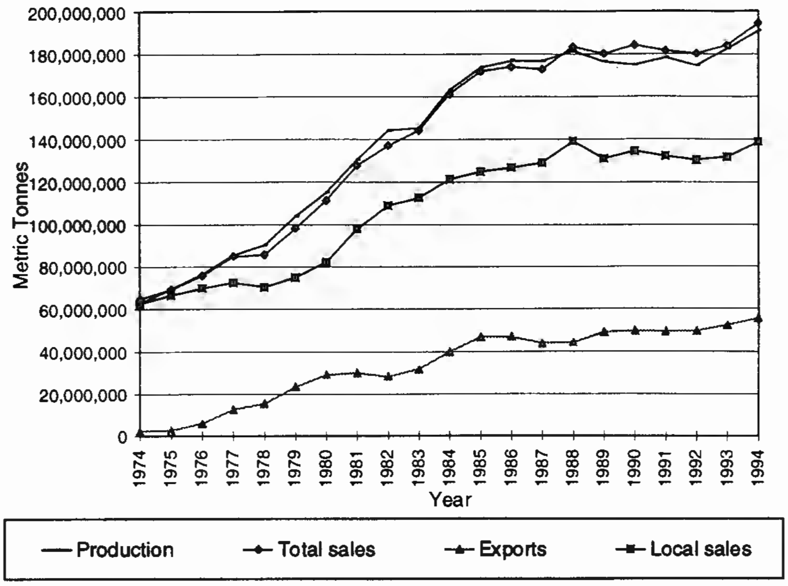


Figure 4.1.1: South African coal production, local sales and exports 1974 - 1994 (Chamber of Mines of South Africa 1995a)

Figure 4.1.1 above shows trends in production and sales since 1974. The South African coal industry has experienced rapid growth over the past two decades. Total production in 1994 was nearly three times what it was twenty years before. Growth was fastest over the period from the early nineteen-seventies until the mid eighties. However, since then a combination of the effects of sanctions on exports and the local economic downturn stopped growth. While the coal industry expects the local market to show negligible growth in the short term (Munro 1995), export sales value for 1995 was expected to rise almost R1 billion to R5.5 billion, owing largely to increased prices. (Munro 1995).

Since 1987 coal sales have exceeded saleable production with resulting stockpile draw down. Most coal for export first goes through a beneficiation process which produces up to 30% discards. The increased focus in the industry on exports, and also an increase in the supply of beneficiated coal locally, resulted in an accumulation of more than 500 MT of coal discards in the decade to 1993.

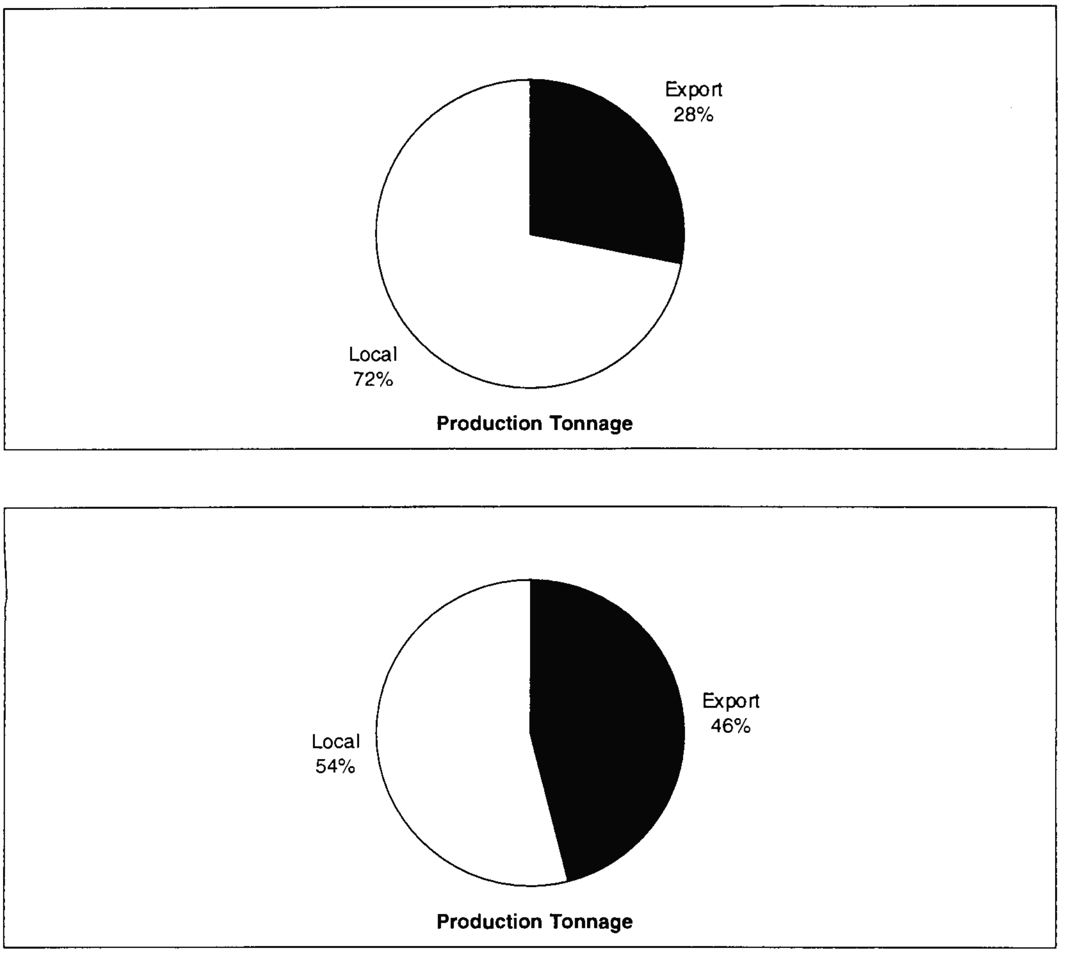


Figure 4.1.2 Coal production and sales 1994 (Chamber of Mines 1995a)

Most (91%) coal consumed locally is not utilised as a final energy product but in the production of other energy carriers, namely electricity and synthetic fuels. Both these industries have large capital investments in coal-using plant and the demand for coal by these entities is expected to remain firm. Sasol is unlikely to expand its oil-from-coal synfuel operation, but Eskom demand for coal will probably grow in the medium term as its surplus coal-fired electricity generating capacity is more fully utilised.

4.1.1 South African coal resources

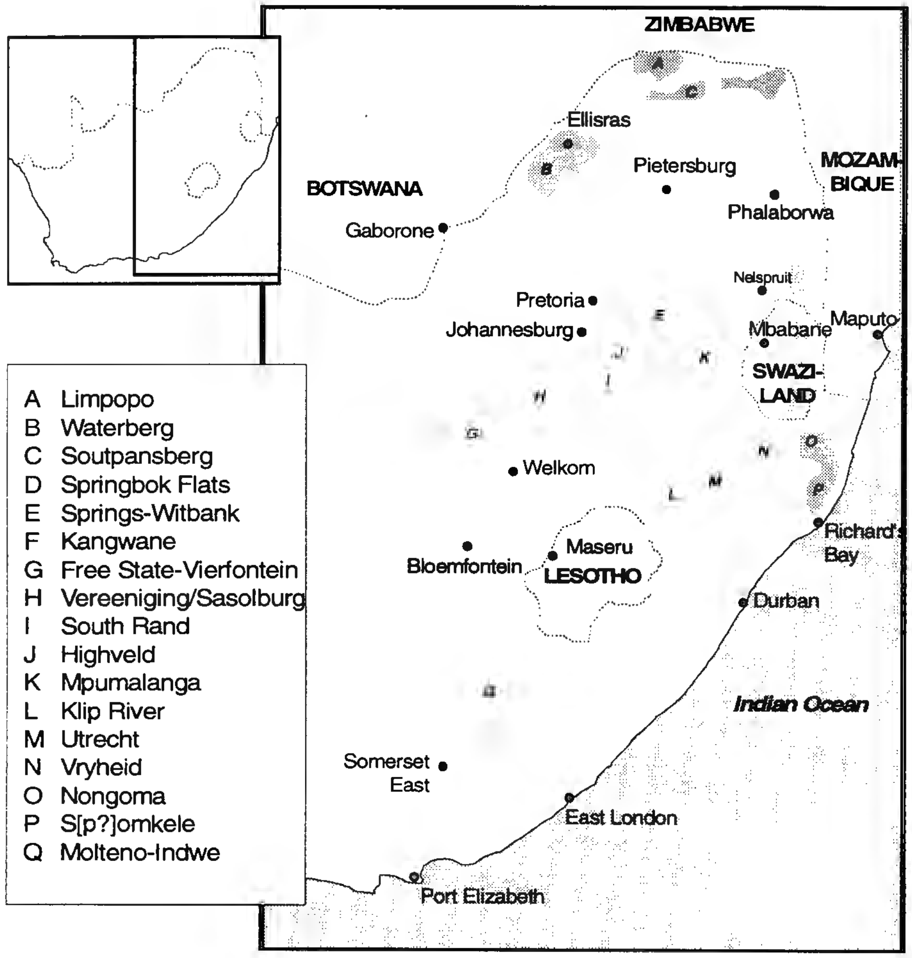


Figure 4.1.3: Map of coal fields of South Africa

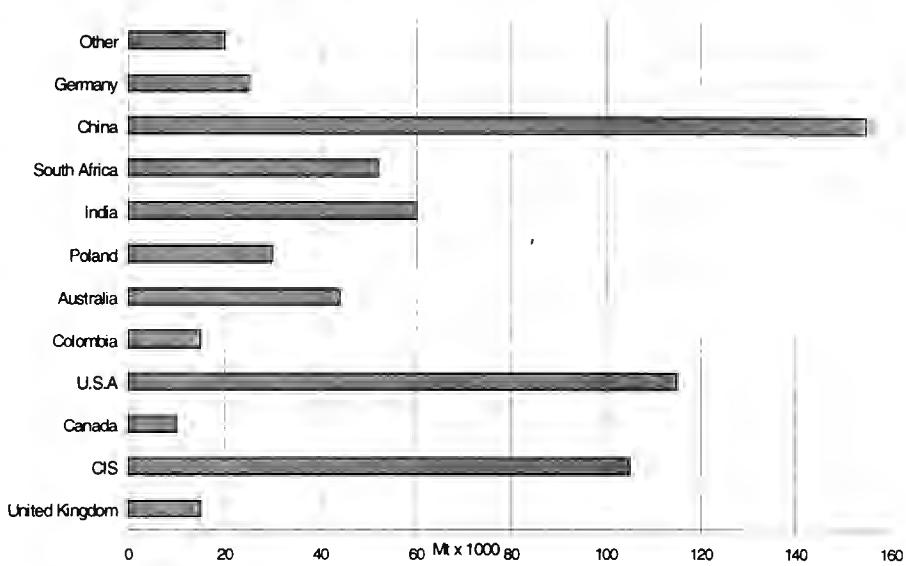


Figure 4.1.4 South African coal reserves in comparison to other coal producers (Thamm et al 1995)

Estimates of South African coal reserves vary and are confused by a lack of uniform terminology. Terms such as "mineable reserves" depend on opinions on technology and future markets, and measures of in-situ reserves depend on survey methods that can be less than exact.

The following extracts from Dutkiewicz (1994) and Thamm et al (1995) give an indication of the different measures and the spread of estimates.

Dutkiewicz 1994 states -

> Estimates of South Africa's coal resources have been confused by the lack of uniform terminology. Estimates go back to the work of Wybergh in 1928, but the first significant analysis was carried out by the Coal Advisory Board who differentiated between in-situ, extractable, and saleable.
>
> The Table below shows various estimates that have been made of coal resources over the years.

Coal reserves (million tonnes)		
Year	In-situ	Mineable
1947		11 065
1969		18 877
1975		24 915
1981	110 000	51 000
1982	113 329	57 541

Table 4.1.2 Coal resource estimates for South Africa (Dutkiewicz 1994)

> The general increase in the reserve estimates is similar to that of world oil reserves which increased over a number of years and are now approaching an asymptote. It is likely that the true South African reserves will be higher than current estimates.

Thamm et al 1995 state -

> Estimates of South African coal reserves are 121 218 Mt of which 55 333 Mt are expected to be economically recoverable (Bredell and Louw, 1992). Other published estimates are 117 675 Mt (Coakley et al, 1992) in-situ resources, reliably estimated. The Council for Geoscience classifies resources in terms of proven, probable and potential reserves. Its estimate is 96 699 Mt proven, 33 850 Mt probable and 28 084 Mt potential coal reserves.
>
> In the Witbank coalfield, depths of the upper seam (# 5) are in the region of 30m, the deepest seam (# 1) at approximately 90m depth, with seam dips usually less than 5 degree's. The Highveld coalfield has the #5 seam at an average 20-80 metres, the # 1 at 80-170m depth and dips less than 5 degrees. The Eastern Transvaal coalfield seam depths range from 50-150m. In the Northern Transvaal coalfields such as Limpopo, Soutpansberg and the western parts of the Waterberg depths are greater and usually in excess 200m. The depth to which local opencast collieries can operate profitably is in the region of 60-65m. The Waterberg coalfield is South Africa's largest reserve of unexploited coal, where some 36% of the in-situ reserves are estimated (Dreyer, 1991) to be extractable by opencast methods. Ninety percent of mineable reserves are at depths less than 200m (NCA, 1993).

Although the estimates in the two quotations above vary considerably they give a reasonably useful picture of the size and main characteristics of the reserves. For mineable (economically recoverable) reserves, a figure of around 56 000 MT would seem to be acceptable while in-situ resources are at least 113 000 MT and increasing steadily as more exploration is done. In terms of quality, South African coal in general has a sulphur content below 1% but is high in ash.

Dutkiewicz (1994) comments as follows -

> Most of the in-situ coal (66%) has a calorific value of between 20 and 26 MJ/kg, and 11% is better than 26 MJ/kg. Most of the coal is of steam quality, with only small amounts occurring sporadically mainly in north Natal, of coking coal. It is estimated that of the total coal reserves of 57 541 million tonnes, some 947 million are suitable for metallurgical purposes if beneficiation is employed. There are only small amounts of anthracite and reserves are estimated at 1 112 million tonnes.

Discards

The benefication of coal, particularly for export, results in large quantities of coal discards being produced. Close to 50 MT of discards are produced annually. Thirty percent of coal mined for the export market is discarded and between 15% and 25% of local demand (excluding power station coal) is discarded (Dutkiewicz 1994). Total discards by the year 2020 are estimated at 2 300 MT. There is opinion that greater quantities of discards can be utilised and that policy should be developed to this end (Dutkiewicz 1994).

Resource depletion

Opinions on resource depletion depend on the estimates of the reserve - including as yet undiscovered or un-measured reserves and estimates of demand.

Dutkiewicz (1994) produces the following scenario -

> If it assumed that the production of coal with time will follow a "bell-shaped" curve, then there will be a period of exponential growth followed by a decrease in the rate of increase leading to a peak in production followed by a general decrease. Such a curve would translate into an "S-shaped" curve of production. Figure 4.1.5 below has been shown to show the shape of a production curve to a total coal reserve of 60 000 million tonnes, i.e. 57 541 million tonnes of reserves at 1982 and a cumulative production of 2 400 million tonnes up to 1982. It will be seen that up to the present South Africa has used approximately 7% of its total mineable reserves. This will increase to around 11% by the turn of the century.

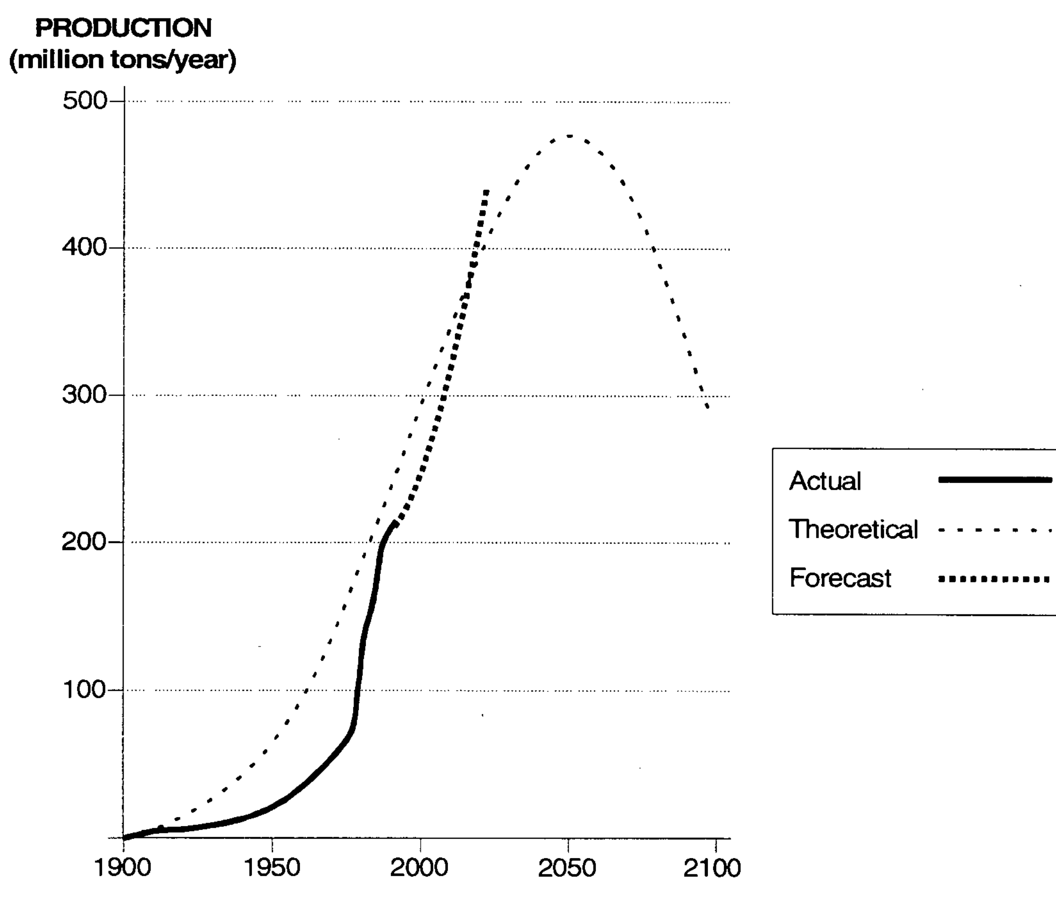


Figure 4.1.5 Coal production - actual and theoretical (including discards) (Dutkiewicz 1994)

The actual mathematical shape of the curve is not important, but it is indicative of the fact that there is not likely to be a shortage of coal in the medium term, even at a greatly increased coal export trade. By around 2012 the inflection point of the curve will be reached and there will thereafter be a growing pressure on coal and a need to start the introduction of alternative energy sources.

The peak demand for coal will be reached around 2070. It is worth noticing that, with the assumptions made, the production in 2150 will be the same as it is at present.

Whilst the production curve in the future will be a function of supply and demand economics, the above shows that there clearly does not have to be any urgent attempt to contain coal production expansion and that the export market could be an increasingly important contributor to foreign exchange.

4.1.2 Coal production

South Africa's coal production comes from collieries ranging from amongst the largest in the world to small-scale producers with outputs in the range of 5 000 tons per month. Sixty one collieries were active producers in 1994. Of these, a relatively small number of large-scale producers supply coal to the electricity and synfuel producers. About 50% of South African coal mining is underground and this makes it difficult for South Africa to reach the productivity levels of Australia, for instance, where 60% of mining is open cast. Some 4.6% is produced by long walling, 12% by stope recovery, 33.7% by board and pillar mining, while 49.6% is produced by open cast methods (Chamber of Mines 1995a). Bord and pillar was more extensively practiced in the past and this has resulted in vast coal reserves being locked up in previously formed pillars. Work is underway to investigate recovery of this reserve.

The coal mining industry is highly concentrated. Three companies, Amcoal, Ingwe Coal and Sasol, account for 75% of local production. Production is concentrated in large mines with 13 mines accounting for 70% of production.

Major companies	Production (saleable) MT	%
Ingwe	50.2	28
Amcoal	41.6	23
Sasol	41.3	23
Iscor	10.6	6
Goldfields	8.4	5

Table 4.1.3 Major South African coal producing companies (USA DOE 1995)

The coal mining sector employed around 59 000 people in 1994 as compared with 100 000 in 1986. Of labour, 68% is drawn from within South Africa while 22% are migrant. (Ruiters 1995).

Institutional and regulatory aspects related to coal mining

Thamm et al (1995) state -

> Entrepreneurs and new entrants to this industry are regulated primarily by the provisions of the Mineral Act (No. 50 of 1991) and its amendments and provisions of the Income Tax Act as applied to mining and prospection activities. In South Africa, mineral rights are held both privately and by the state. Future ownership of these rights is subject to active debate (Jourdan, 1994; Segal, 1994). Coal utilisation, marketing and exports in particular have been deregulated since the enactment of the Coal Resources Repeal Act (No. 2 of 1992). Industry exports are primarily self regulating, with volumes limited by the capacity of the Richards Bay Coal Terminal (RBCT), Durban and Maputo harbours. In recent years producers who are not part of the RBCT consortium have been investigating the viability of a second terminal at Richards Bay, the proposed Coalex terminal.
>
> In practice those who wish to explore for minerals negotiate contracts of "options to purchase" with the minerals rights owners. When enough acreage has been secured the DMEA Regional Director is approached for a prospecting permit and later, if exploration is successful, a mining authorisation. If exploration is successful then the options to purchase are exercised and the contract of sale concluded or a mineral lease is obtained.

A number of state departments are responsible for the management of the environmental impacts of mining - the DMEA, Water Affairs and Forestry, Agriculture, Environmental Affairs and Tourism and Health. Mining environmental impact assessment is managed depending on which business phase the mining proponent is operating i.e. construction, operation or decommissioning. Until a closure certificate is issued by the DMEA, the owner is legally obligated to manage environmental impact, rehabilitation as directed and make financial provision as necessary.

The most important financial measures that affect mining or prospecting are ring fencing provisions. These ring fencing provisions exist to isolate certain types of mining related activities with respect to income or losses for tax purposes (Greyling Odendaal 1992) and were introduced to protect the tax base of the fiscus. The most important of these are:

1. the tax payer ring fence, in which taxable income is determined separately for each taxpayer,
2. the mining activity ring fence which taxes mining separately from non-mining income,
3. the capital expenditure "per mine" ring fence which in effect restricts the capital expenditure on a particular mine against income from that mine only, subject to a 25% breach and
4. prospecting ring fences, which isolates prospecting deductions outside lease areas.

Expenditure related to prospecting operations and capital expenditure is deductible against mining income. Mining operations can deduct capital expenditure immediately as opposed to the 20 % over five years as in the case with other companies. South African company tax rates typically 5-10% higher than those countries actively seeking (mining) investment.

4.1.3 The market for South African coal

There is a synergy between local consumption of poor grade steam coals for large, stable users such as Eskom and Sasol and the development of exports of better quality beneficiated coals. For example, the development of infrastructure and a stable market for the very low grade (up to 40% ash) coals connected to supplies to Eskom has allowed the development of the benefication industry supply of coals with ash contents of less than 16% to be exported to international electricity utilities (Chamber of Mines 1995a).

The localmarket

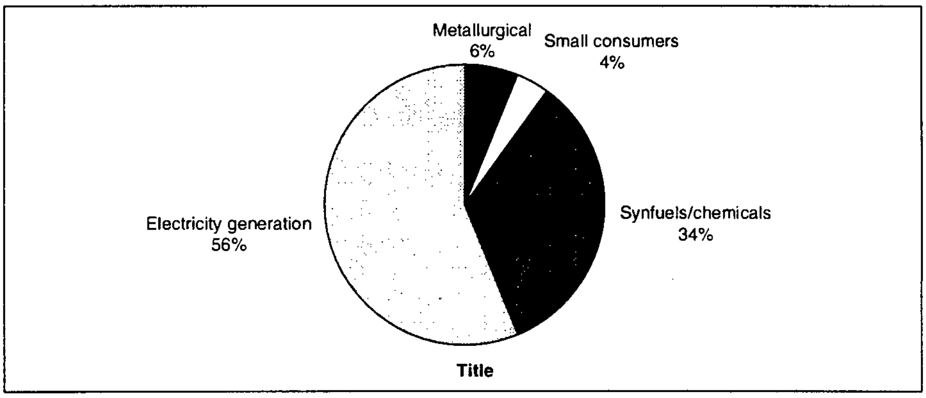


Figure 4.1.6 Local coal market 1994 (Chamber of Mines 1995a)

In 1994 138.8 MT of coal was consumed in the local market. As can be seen in the figure above, 90% of this was used in electricity and synfuels/chemical production. The electricity, exports, synfuels and chemicals sectors are characterised by economies of scale which dictate that security of supply, quality and reserve base are prime considerations when sourcing supplies. Thus, in order to secure their requirements these sectors can either integrate backward, as Sasol and Iscor did, and run their own collieries or enter into long-term supply agreements with close links to suppliers such as Eskom has done. Eskom invites tenders for supply of coal to power stations resulting in contracts between 20-40 years, with coal suppliers being guaranteed an average return of 18% on their investments.

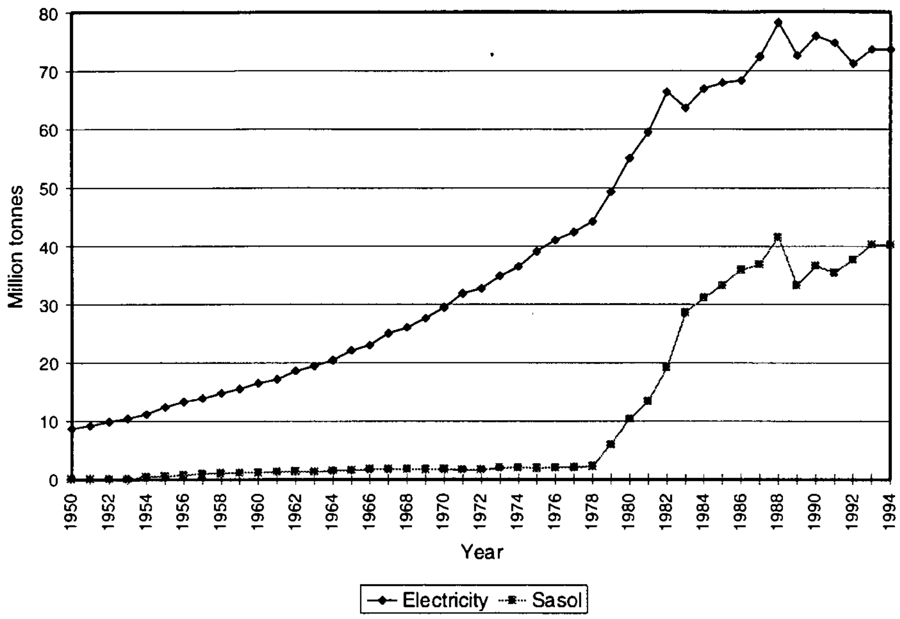


Figure 4.1.7 Coal used in electricity and synfuel production

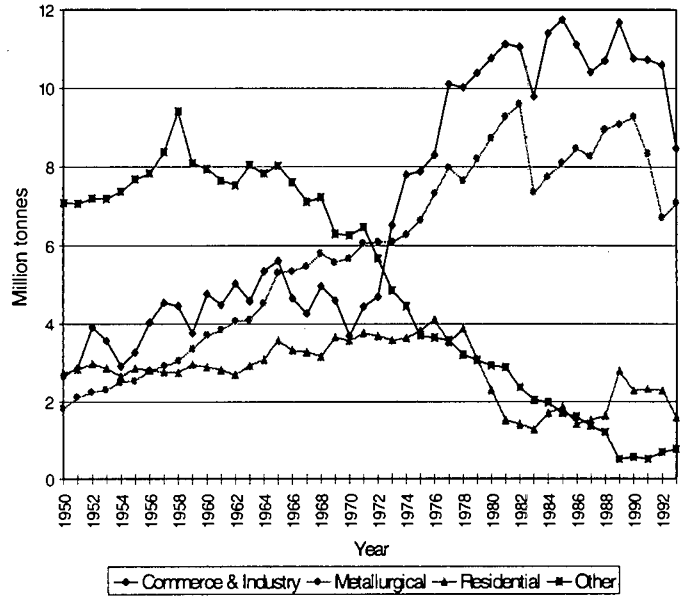


Figure 4.1.8 Subsectoral coal consumption (excepting electricity generation and synfuels production) 1950 - 1993 (DMEA 1995)

Local coal consumption in sectors other than electricity, exports, synfuels and chemicals was about 18Mt in 1993 and has ranged from 15 to 25Mt since 1950. Industry, including metallurgical minerals beneficiation accounts for most of this coal consumption.

Coal prices

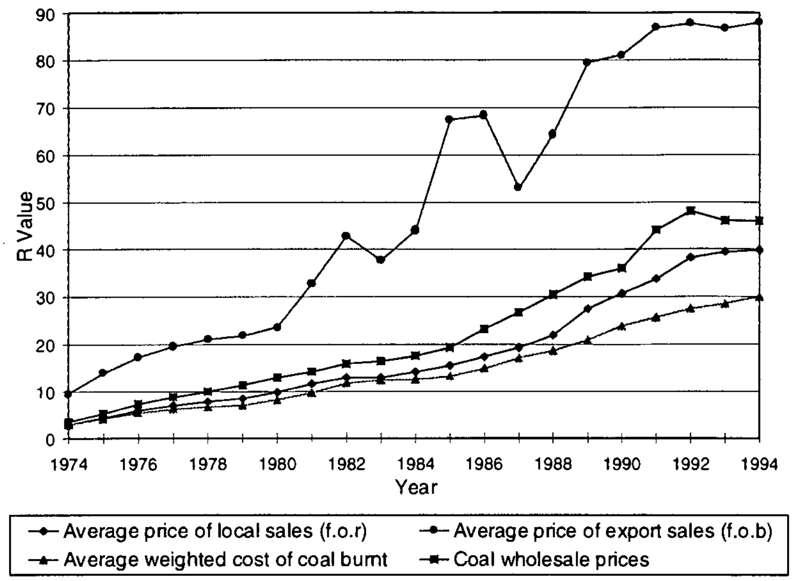


Figure 4.1.9 Coal prices
(Eskom 1994b, Chamber of Mines 1995 South Africa, DMEA 1995)

Most local consumption is for electricity generation by mine-mouth power stations. Prices for this coal are very low by international standards (Section *4.3 - Electricity* provides details). The second largest consumer, Sasol Synfuels, sources its coal from mines owned and operated by Sasol so these prices are not subject to market pricing. For other areas, the current F.O.R. price is R45/tonne (1996 figure - DMEA 1996b) also low by international standards. Export prices allow South Africa to compete on world markets but railage costs, owing to the distance of the coalfields from export ports add considerably to the low mine-mouth prices.

Figure 4.1.9 shows price trends. The export price has consistently been significantly higher than local prices. As the proportion of coal exported begins to increase, the export price can be expected to have an effect on local prices. The cost differential attributable to beneficiation and transport from the mines to the coast will play a moderating factor. Also, long-term contracts will provide protection to prices for power station coal.

The household market:

Households are supplied largely by coal traders who have established informal but organised networks in townships. Wholesale mark-ups are of the order of 75% and in the areas where coal is commonly used wholesale prices are constant, of the order of 9c/kg (Palmer 1994). However, retailers are believed to apply excessive mark-ups with prices ranging from 17c/kg to 32c/kg. Prices increase between pithead and the end consumer by 306% and 166% in urban and rural areas respectively. The urban (Gauteng) household price of D-grade coal is in the region of R200/ton delivered) (Palmer 1994).

The export market

Steam coal makes up 87% of exports with metallurgical and anthracitic coals making up the balance. The market has grown rapidly, both in terms of volumes and sales revenues and is expected to be R5.5 billion for 56 million tonnes in 1995 (Munro 1995) - accounting for more than 5% of total exports. South Africa accounted for 23% of the 1994 world seaborne steam coal market, making it the second largest exporter of steam coal in the world. The bulk of consumers of South African coal on international markets were from Europe (55%), and the Far East (33%).

Country	Contribution 1994 seaborne steam coal (2 195 Mt) %
Australia	26
South Africa	23
China	9
Indonesia	9
USA	8
Columbia	8
Other	17

Table 4.1.4 World seaborne steam coal market 1994 (Chamber of Mines 1995b)

Most of South Africa's export coal is sold on a contract basis. Contract prices were negotiated up by over of 20% in US$ terms in 1995 and spot prices have risen sharply in the period since mid 1993 reflecting tighter market conditions.

Most South African coal is exported through the Richard's Bay Coal Terminal (RBCT) which is the largest coal export terminal in the world. Transport costs from the mines are of the order of R30/tonne. The nominal terminal capacity is 60 Mt, per annum. The terminal is controlled by Amcoal and Ingwe through their large shareholdings, and the frustration of other exporters such as Sasol at limits imposed by the terminal have led to (as yet unsuccessful) initiatives to build another terminal. Sasol has recently been provided with an allocation by the RBCT shareholders which has resulted in it shelving plans for another terminal (DMEA 1996b).

4.1.4 Transport

Whilst much of South Africa's coal is consumed at the mine-mouth a large amount is also transported by rail, either for export, to power stations not situated on mines, or to the industrial and other markets. Although definitive data are lacking, comments have been made that some coal railage tariffs are excessively high. For example railage charges from Saaiwater to Cape Town in August 1995 were R190.95/tonne and R218.31/tonne for coal and anthracite respectively.

4.2 Liquid fuels and gas

Overview

South Africa consumes about 20 billion litres of liquid fuels annually. Thirty-eight percent of the demand is met by synthetic fuels (synfuels) produced largely from coal and a small amount from natural gas. The rest is met by products refined locally from imported crude oil. Synfuels production is not expected to increase and in the medium-to-longer term may be curtailed. Thus, unless large commercially viable oil fields are discovered, South Africa will be increasingly dependent on imported crude for liquid fuels production.

Apart from limited gas and oil reserves in the Mossel Bay area South Africa does not have significant commercially exploitable gas or crude oil reserves. If exploration and/or development costs are written off, production of some of the small gas and oil fields can be viewed as commercially viable and this is being done for the F-A gas field and the E-BT oil fields. In addition, further larger gas discoveries are considered a possibility.

4.2.1 Oil and gas resources and production

Oil (Strategic stock)	40 million barrels
Oil (E-BT field)	20 000 b.p.d. potential
Natural gas	20 bcm (proven reserves)
Natural gas production	1.8 bcm/year (Mossgas)
Coal bed methane	134 bcm (recoverable)
Coal gas production	0.6 bcm/year
Crude imports	109 million barrels p.a

Table 4.2.1: Basic upstream oil and gas statistics 1994

Petroleum and gas production is currently limited to the F-A gas field producing 1.8 bcm/year. In 1995 the CEF chairperson gave the go-ahead for development of production of the 20 000 b.p.d. E-BT oil field also in the Mossel Bay area.

The physical environment

There is potential for the discovery of more oil and gas in South Africa, and a description of the energy sector would be incomplete without details of the South African exploration environment and history.

South Africa has a relatively large surface area of about 1.2 m sq. km and a coastline of about 3 000 km. The west coast from the Orange River to Cape Point is about 900 km long and the remainder, from Cape Point to Ponta do Ouro on the Mozambican border, is more than 200 km long. The continental shelf is 20-160 km wide off the west coast, 50-200 km wide off the south coast but rarely more than 30 km wide off the east coast. Similarly the continental slope is fairly wide on the west and south coasts but narrow to the east.

South Africa's offshore basins can be divided into three distinct tectono-stratigraphic zones

1. The western offshore comprises a broad passive margin basin related to the opening of the South Atlantic in the Early Cretaceaous. This is known as the Orange Basin.
2. The eastern offshore is a narrow passive margin that was formed as a result of the breakup of Africa, Madagascar and Antarctica in the Jurassic. Very limited deposition has occurred here and only the Durban and Zululand Basins contain an appreciable sedimentary section.
3. The southern offshore region, known as the Outeniqua Basin, shows a history of strong strike slip movement during the late Jurassic- Early Createaceous break-up of Gondwanaland. The Outeniqua basin consists of a number of en echelon sub-basins (the Breadasdorp, Pletmos, Gamtoos and Algoa basins) each of which comprises a rift half graven overlain by various thickness' of drift sediments.

The onshore areas of the Karoo, Algoa and Zululand basins are thought to have poor potential.

Exploration history

The first organised search for hydrocarbons in South Africa was undertaken by the Geological Survey of South Africa in the 1940's. In 1965 Soekor (Pty) Ltd was formed by the government and began its search on shore in the Karoo, Algoa and Zululand Basins.

In 1967 a new Mining Rights Act was passed and offshore concessions were granted to a large number of international companies including Gulf Oil, Esso, Shell, ARCO CFP and Superior. This led to the first offshore well being drilled in 1969 and to the discovery by Superior of gas and condensate in the Ga-A1 well situated in the Pletmos Basin.

In 1970, Soekor (together with Rand Mines) broadened its efforts to the offshore whilst, despite further encouraging discoveries, international companies gradually withdrew, largely as a result of political sanctions against South Africa. Effectively, Soekor has been the sole exploration company operating offshore in South Africa since the mid 1970s, although it is now partnered by Engen, a South African listed company, in part of the Bredasdorp Basin. Soekor has carried out an active exploration and appraisal programme during the past 20 years of offshore activity. Including work by previous operators, some 180 exploration and 60 appraisal wells have been drilled. In addition, approximately 157 000 km of 2-D seismic and 23 000 km of 3-D seismic have been acquired. Exploration drilling was most active from 1985 - 89 when 71 exploration wells were drilled.

Work to date has resulted in 20 gas and nine oil discoveries. These discoveries are almost entirely within the Bredasdorp Basin which has been the focus of most of the activity since 1980. The F-A gas field is in production and Soekor is in negotiations with potential partners regarding the development of at least one other discovery. The gas is supplied to the Mossgas facility, the core of which is a large petrochemical plant located at Mossel Bay. This was designed to take gas from the F-A field and its satellites and to convert the gas and condensate into liquid fuel at the rate of 25 000 barrels per day for 25 years, although limited gas reserves will probably curtail this life drastically.

Institutional and legal framework

Soekor

Soekor is a wholly owned subsidiary of the Central Energy Fund Pty Ltd (CEF). The main business of Soekor is the coordination, promotion and undertaking of oil and gas exploration activities of South Africa and to exploit any oil and gas fields which are discovered.

Soekor was responsible for the management of the F-A Platform in terms of a management agreement with Mossgas (Proprietary) Limited, until 31 October 1993, at which date management was relinquished to Mossgas.

As part of re-alignment with new policies of the post-apartheid era Soekor has been re-structured into three units: exploration and production, offshore drilling, and licensing. Since 1993 Soekor has shed more than two-thirds of its staff and now employs 262 people. From 1 April 1985 the company has been financed by CEF (Pty) Limited by means of loans for capital expenditure of a material nature and grants for exploration costs. Since 1 April 1988 all activities of the company have been financed by means of loans.

The Auditor General reported that the total amount made available to Soekor for the search for petroleum and natural gas and to finance related activities has amounted to R2 351 779 000, up to and including 31 March 1994 (Republic of South Africa 1995). However, Soekor, in its 1995 annual report stated that accumulated funding by shareholder (CEF) amounted to R1 316 million. This is the total for loans advanced to Soekor.

Consolidated net expenditure for 1994/1995 was R112 million and Soekor's loan liability to parent CEF increased by R113 893 for the year. Net exploration cost for the year was R52 996 million.

Cash used for operating activities	(45 995)
Cash utilised in investing activities*	(67 898)
	(113 893)
Cash effects of financing activities	
- increase in long-term liabilities (holding company)	113 893
	113 893

* This item was almost wholly due to an increase in investment in subsidiary companies of R68 831 million.

Table 4.2.2: Summarised cash flow statement - Soekor 1994/1995 (CEF Annual report 1994/1995)

Soekor undertook a major planning exercise in 1994/95 and reports the following outcome for plans for the future:

It proposed the separation of the company into three separate business units.

- A joint venture to manage Soekor's drilling rigs on a commercial basis.
- An independent agency responsible for petroleum exploration licensing and regulation which would ensure the optimal development of the off-shore hydrocarbon potential.
- An exploration and development company that would move rapidly to gain economic independence.

Soekor will continue with a much-reduced commercially driven exploration and production programme in South Africa. In addition, assistance will be provided to neighbouring countries in the optimal development of their own gas and oil resources for the benefit of the entire region. Soekor will align its domestic activities with the RDP through the following key issues:

- International licensing of exploration off South Africa's coast. The closing date for the submission of bids for licences was targeted for mid-April 1995. However, in view of the vast amount of data to be processed and the relative lack of knowledge of the complicated geology of South Africa offshore, purchases of data are being responsibly accommodated where extension of time is required. Sales of technical data are very encouraging and data to the value of R7 - million have already been sold. The award of exploration sub-leases will benefit the country by reducing the need for committing government funds to exploration off our coast, providing income to the state through sub-lease fees and royalties (and, in the case of production, tax), and by attracting new ideas and technology.
- The exploration of the E-BT oil field with Engen as partner. The success of this project will open the way for the development of a number of already discovered small oil fields in the Bredasdorp Basin with a resultant positive impact on the economy.
- Active exploration for further oil fields within a 15 km radius of the E-BT development, for tie-back into this facility.
- The promotion and development of gas as an alternative, affordable and clean energy fuel for industry and the people of South Africa. Studies initiated by Soekor are very encouraging. The market shows promise of sufficient present and future growth potential to take additional gas from other off-shore gas discoveries owned by Soekor.
- Active exploration and appraisal of further gas fields adjacent to the F-A platform facility.
- The development of the regional gas potential with provision of assistance to neighbouring countries which will contribute to overall regional prosperity in Southern Africa.

Database

A substantial database has accumulated over more than 25 years of offshore exploration. This includes basic well, seismic, gravity, magnetic, geochemical, biostratigraphic and other data together with a large volume of interpretation reports and related studies. All this material is held by Soekor and is well organised and accessible and is the basis of Soekor's promotion operations. The quality of this database varies considerably from area to area. Seismic data coverage for example, varies greatly in quantity and vintage from one basin to another. Drilling activity shows a similar pattern with a heavy concentration in the Bredasdorp Basin.

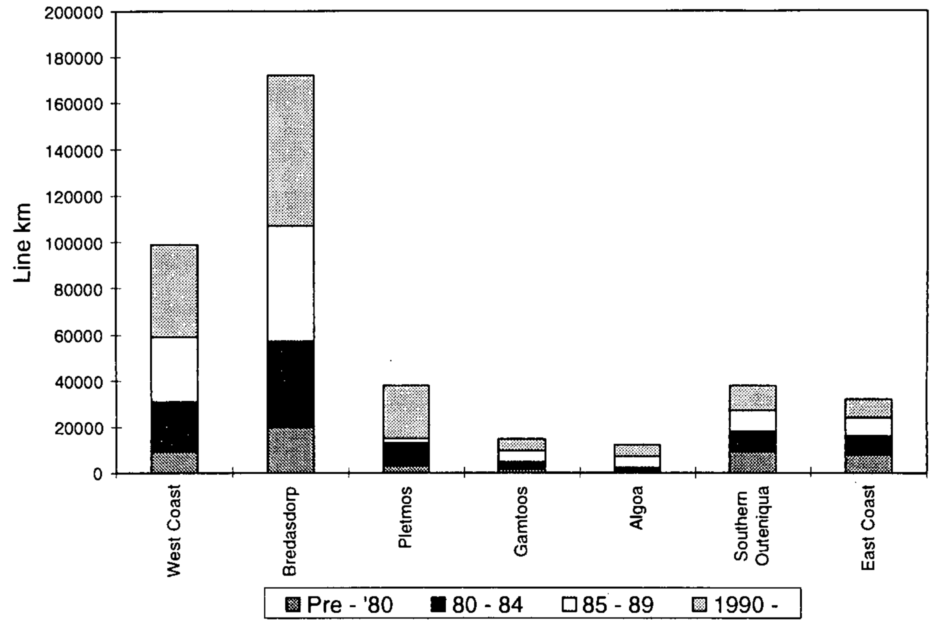


Figure 4.2.1 2-D seismic acquisition by basin (Soekor 1994)

Legal framework and fiscal terms for oil and gas exploration and production

Legal framework

Soekor is the controlling and coordinating body dealing with petroleum exploration offshore.

Soekor functions in two ways:

1. As an agent of the government to allocate areas to others for exploration, subject to ministerial approval; to regulate and supervise the conduct of other exploration companies; and to encourage, through various means, the efficient conduct of exploration of the country.
2. As an exploration company involved in joint ventures, farmouts and operating in dependantly in unallocated areas.

The South African legal regime for petroleum operations is characterised by the fact that the entire offshore area is held by Soekor under a long-standing prospecting lease. Soekor is empowered by the state to regulate and coordinate prospecting in two ways, either by sub-lease or by participation agreement.

The prospecting sub-lease

The contractor incurs 100% of the exploration costs. Upon discovery Soekor has the right to retain a negotiable percentage age of the mining lease without reimbursing past costs. This percent is negotiable but is normally 20%. Key features of the sub-lease arrangement are summarised below:

- Contractor participates in Soekor's exploration rights granted to it by its prospecting lease OP 26.
- Contractor's participation level corresponds to a 100% interest in the exploration block cut out of Soekor's lease area.
- Exploration period is negotiable but likely to be 5-8 years.
- Periodic partial relinquishments will be required.
- Work programme and minimum exploration commitment will be negotiable.
- During the exploration phase the contractor's rights are purely contractual. The state does not directly transfer any right to the contractor. All rights of the contractor are contained in the sub-lease document which is binding on the state, Soekor and the contractor.
- During the production phase Soekor has the right to retain a participating interest share in the mining lease. Soekor also has the right to enter into a joint operating agreement. All relevant terms are contained in these documents.

The participation agreement

Soekor retains operatorship but the contractor participates in the operations at a negotiable level.

Fiscal terms

- A license fee, negotiable gross royalty (typically 5%) and income tax are payable.
- All allowable costs are immediately expensed for income tax purposes.
- Outstanding capital expenses carry interest of 12% for offshore fields.
- The basic income tax rate is 35%; an additional profits tax is levied as a function of the ratio of accumulated net revenues (revenue loss operating costs) to accumulated capital costs. If the ratio is <1 (i.e. costs have not been fully recovered) the additional tax rate is 20%. It the ratio is between 1 and 2 the additional tax rate is 30%, and thereafter it is 40%.
- State participation through Soekor of up to 20% is carried through exploration. There is no direct reimbursement of exploration costs by Soekor but all exploration costs are recoverable against income tax.

The ring fence for cost recovery is around all oil and gas activities.

4.2.2 Procurement, crude refining, synfuels production and liquid fuels marketing

Industry size

In 1994 total oil industry sales, including Sasol, amounted to an estimated R36 billion. Of this amount R12 billion is estimated to have been collected in taxes. The estimated gross profit margin on revenue amounted to R3.2 billion, including the Sasol subsidy. Excluding the Sasol subsidy the profit margin would have been R2.1 billion (Sapia 1995)

Brief history of the South African liquid fuels industry

Countries in Southern Africa began importing liquid fuels initially for lighting purposes in the late nineteenth century, and by 1897 demand was sufficient for the establishment of the first overseas oil company's local operation based in Cape Town. All fuel consumed in South Africa prior to 1954 was imported. The products were distributed and marketed by the local subsidiaries of four international oil companies, BP, Caltex, Mobil and Shell or their predecessors.

During the 1930s the government first became involved in the oil industry to prevent cartel practices and to promote fuel availability and the stability of the strategic industry. Government involvement has continued until the present day.

Demand increased to the extent that by 1954 commercially viable domestic refining became possible. Standard Vacuum Refining Company, which later became Mobil Refining Company, commissioned a crude oil refinery in Durban in January of that year. As demand grew other refineries were established as shown in the table below.

Year	Location	Refinery's current name	Established by
1954	Durban	Genref	Mobil
1955	Sasolburg	Sasol 1	South African state
1964	Durban	Sapref	Shell, BP
1966	Cape Town	Calref	Caltex
1971	Sasolburg	Natref	Sasol (South African state), Total, National Iranian Oil Company
1980	Secunda	Sasol 2	South African state
1982	Secunda	Sasol 3	South African state
1992	Mossel Bay	Mossgas	South African state

Table 4.2.3 Liquid fuels production plants in South Africa

From the beginning of the 1950s, for political, strategic and economic reasons, the South African government, firstly using Sasol as the vehicle, embarked on a programme to manufacture fuel from indigenous coal and to have a presence in crude refining. This began with the Sasol 1 plant in 1954 and culminated with the commissioning of the Mossgas plant in 1992. While the Mossgas plant is uneconomic the Sasol plants could have been competitive with crude refiners if crude oil prices had been higher by a margin quite conceivable in the years during which they were planned. They have, however, received large state subsidies over the years. Recent studies (Arthur Andersen 1995) indicate that they are profitable and the subsidy to Sasol has been halved for 1996 and will be completely phased out by 1999.

It is more difficult to adjust the output proportions of the various products of synthetic fuel plants than those of conventional crude refineries as market demand changes. Also, for reasons of effective utilisation of capacity, the government has had a strong interest in running the state-sponsored synfuel plants at full capacity. These factors led to an ever increasing influence of synfuels production on the entire structure and operation of the liquid fuels industry. For example, after the state (with partners) established the Natref crude oil refinery close to the physical location of the Sasol 1 synfuel plant (and far from the coast, an unusual practice for crude refiners) an agreement was established whereby Sasol undertook not to establish a service station network and in return, the oil companies would uplift the synthetic fuel product. The agreement was extended when the oil companies agreed to uplift all of Sasol 2 and Sasol 3's product even though this resulted in the mothballing of part of their crude refining capacity. The agreements were complicated further by complex considerations of the economic value of the positioning of Sasol's refineries close to major markets in terms of avoided transport costs (further complicated by non-regulated tariffs of government owned-rail and pipeline networks).

The government played an active role in this structuring, instituting state-controlled mechanisms by which the oil companies were partly compensated for not utilising their investments in refinery capacity but also for staying in South Africa in the face of intense international political pressure to divest. All of this was carried out in a climate where the Petroleum Products Act (No 120 of 1977) prohibited the "publication, releasing, announcement, disclosure or conveyance to any person of information or the making of comment regarding the source, manufacture, transportation, destination, storage, consumption, quantity or stock-level of any petroleum product acquired or manufactured or being acquired or manufactured for or in the Republic".

The development of the oil industry in this climate of secrecy, and with the introduction of huge state owned synfuel production capacities leading to overall refinery over-capacity and complex industry agreements, led to an overall industry structure including marketing and retailing that was closely controlled by government and a complex set of agreements between Sasol, Mossgas and the oil companies. In general, profit margins for refining, marketing and retailing were set by government and prices controlled. This situation, with modifications, continues today. The relaxation of the pressure of international sanctions is leading to re-evaluation of the appropriateness of the industry's structure in terms of new economic and social imperatives. The government, now no longer as concerned about divestment, has not met obligations to oil companies such as synlevy payments, and the adjustment of wholesale margins in terms of the MPAR system. (The synlevy and MPAR are examples of a complex set of payments, levies, and profit margin calculations around control of the liquid fuels industry; they are explained later).

The lifting of sanctions pressure has also led to a re-evaluation of subsidies to Sasol. A Cabinet decision on 6 December 1995 will lead to Sasol subsidies being phased out. The decision will mean that Sasol will receive about R500 million less in the year to come (1996) than it would have under the old arrangement. (It received R1.1 billion in 1995 - the subsidy amount depends on international product prices. The subsidy will then be reduced yearly until it is entirely removed by mid 1999. Sasol will now receive R1.8 billion in subsidies over the phase-down period instead of the R5.2 billion it would have received under the previous system (Sunday Times, December 10, 1995).

The Cabinet has also accepted proposals by the DMEA minister that an attempt be made to dispose of the R12 billion Mossgas investment. However, evidence is mounting that a buyer will be difficult to find unless very favourable conditions are offered.

In conclusion, the above brief history shows a strong involvement by the state in the oil industry for at least sixty years, which involvement increased during the oil sanction years. However, after the 1994 elections the industry has entered a state of flux.

The next section attempts to describe the basic system of procurement, production and marketing assets and physical product flows and financial flows associated with the institutions that control them.

Procurement and strategic storage

Sasol and Mossgas are situated directly on their feedstock sources and the feedstocks are owned by the producers. However, the crude refineries rely totally on imported crude. During the years of oil sanctions South Africa built up a considerable stockpile of crude oil owned and managed by the Strategic Fuel Fund (SSF), a subsidiary of the Central Energy Fund (CEF) a wholly state-owed company. the strategic stock is stored in containers in disused coal mines at Ogies, in conventional steel tanks in Cape Town, and in underground concrete containers at Saldanha. The mine containers have a capacity of 118 million barrels and this method of storage has proven very efficient. The six tanks at Saldanha each have a capacity of 7.5 million barrels.

From the early 1980s the Strategic Fuel Fund (SFF) was responsible for coordinating the procurement of crude for South African refineries in the face of sanctions. SSF then re-sold the crude to local refiners. Since 1993 operations have changed, and almost all crude is currently procured directly by the refiners.

The 1988 SSF crude stock levels of 158.5 million barrels (about 1.5 years supply) have been drawn down to 45 million barrels (February 1996 - CEF 1996). The SSF storage facilities at Saldanha with a capacity of 45 million barrels remain a useable asset in terms of South Africa's energy system. This facility is conveniently situated at the port of Saldanha with facilities for handling super-tankers. The Iranian government has shown a strong interest in utilising some of this capacity as trade storage for its markets in northern and western Europe and the Americas, although no agreement has been concluded.

	Million barrels
1988	158.5
1989	135.2
1990	110.8
1991	94.7
1992	84.7
1993	76.0
1994	56.1
Current*	45.0

* February 1996

Table 4.2.4 South African strategic crude oil stocks (Sapia 1995, CEF 1996)

At 1994 year-end strategic crude-oil stock amounted to 56,1-million barrels stored in the following locations:

	Millions of barrels
Ogies	37.3
Cape Town	1.1
Saldanha	17.7
Total	**56.1**

Table 4.2.5 Crude oil storage at 31 March 1995 (CEF 1995)

The target level strategic stock, as approved by the government, is 35 million barrels, which equates to four months of import requirements. Thirteen million barrels of crude oil from the mine containers in the Eastern Transvaal were sold during the SFF 1994/95 financial year to the operators of the Natref refinery. Crude oil sold from these facilities is replaced in Saldanha in order to achieve a target of 25 million barrels in Saldanha and 10 million barrels in the mine containers.

Figure 4.3.4 below gives an indication of South Africa's recent crude oil requirements. The decrease in imports shown after 1992 is due to the drawing-down of crude stocks.

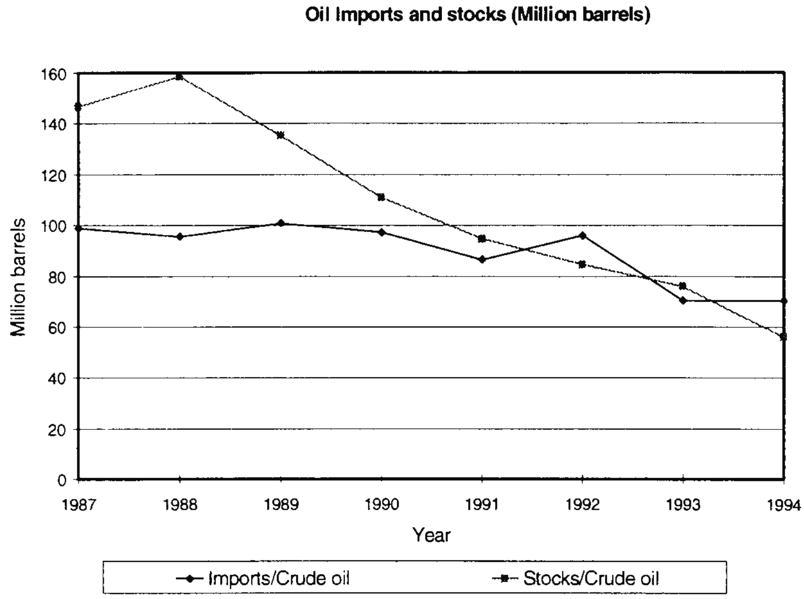
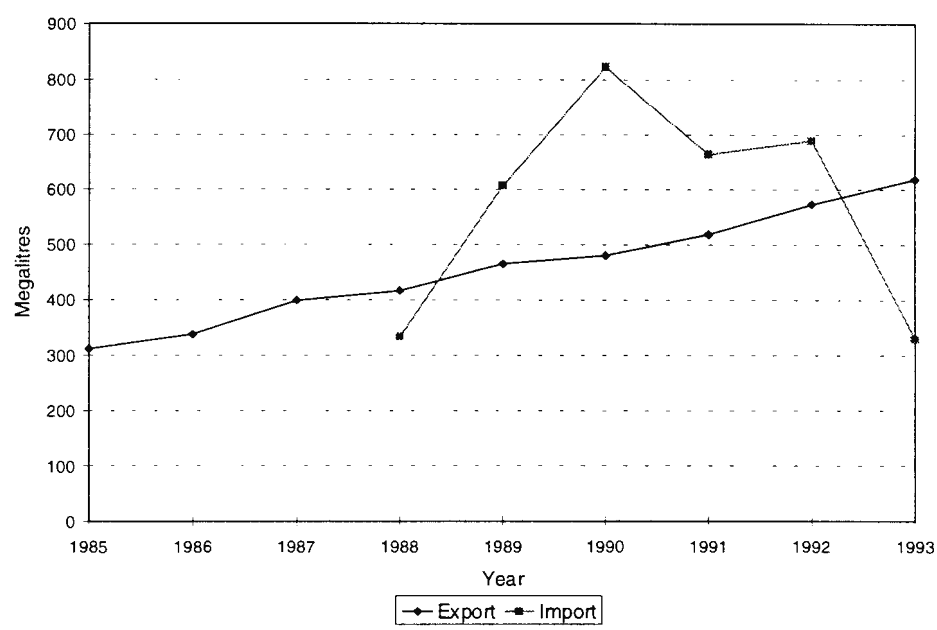


Figure 4.2.2 Imports of crude and crude stocks 1987-1995 (Sapia 1995: Wong & Dutkiewicz 1995)

The value of crude imports, of course, is closely related not only to import volumes but also to the volatile price of crude. In 1994 crude imports cost South Africa R4.3 billion.

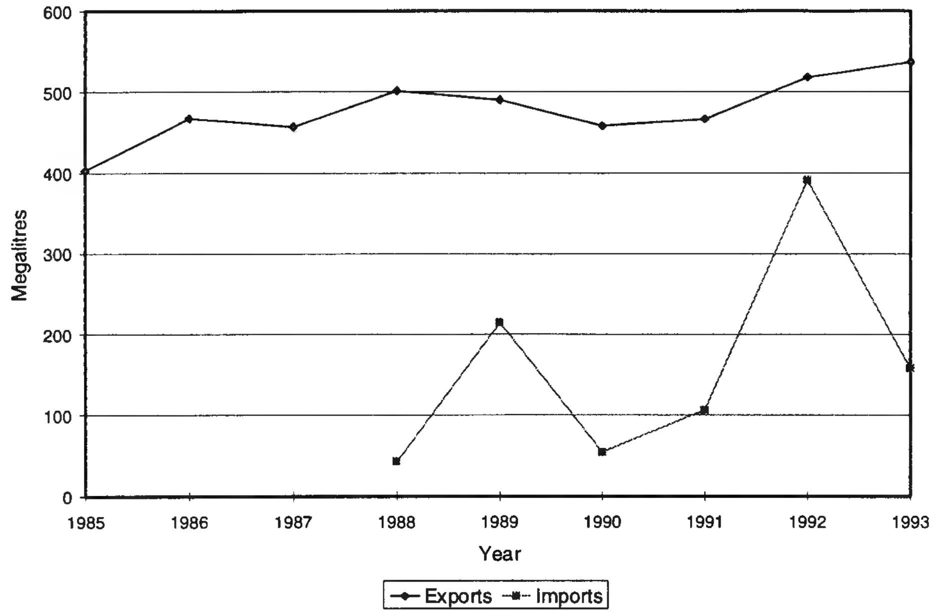
Imports and exports of fuel products

Import of products is restricted to special cases where local producers cannot meet demand. The state controls such imports with a view to promoting local refinery utilisation. Small amounts relative to local production are imported. For example in 1993 just over 300 Ml of petrol was imported, representing 3% of local production. Export permits are required and these are granted, provided that both South Africa's and other South African custom union member's requirements are met. The two figures below show export and import quantities for diesel and petrol.



South African Petroleum Industries Association data (SAPIA 1996) gives 1993 petrol imports at 329 Ml and exports at 1 780 Ml. These figures differ significantly from Wong and Dutkiewicz above.

Figure 4.2.3 Petrol imports and exports 1987 - 1994 (Wong & Dutkiewicz 1995)



South African Petroleum Industries Association data (SAPIA 1996) gives 1993 diesel imports at 368 Ml and exports at 1 780 Ml. These figures differ significantly from Wong and Dutkiewicz above.

Figure 4.2.4 Diesel imports and exports 1987 - 1994 (Wong & Dutkiewicz 1995)

More diesel than petrol is exported due to the balance of supply and demand of petrol and diesel in South Africa relative to refinery configurations. Demand for petrol, in comparison with diesel, has risen sharply over the past few years with the growth of South Africa's petrol-powered minibus taxi fleet from a small number to around 100 000. If the skew in petrol demand continues additional excess diesel will be produced because each barrel of crude produces approximately the same amount of petrol as diesel.

Although petrol and diesel make up 85% of total liquid fuel exports, South Africa is also the main supplier of all other liquid fuels to Botswana, Namibia, Lesotho and Swaziland. These countries also provide most of the export market. In 1993 export proportions of a total of about 1 400 Ml were as follows:

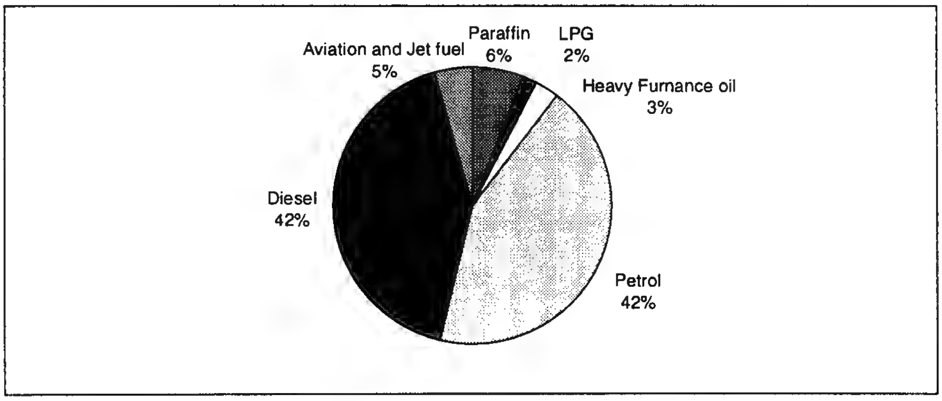


Figure 4.2.5 Exports of liquid fuels 1993 (DMEA 1995)

Production of liquid fuels

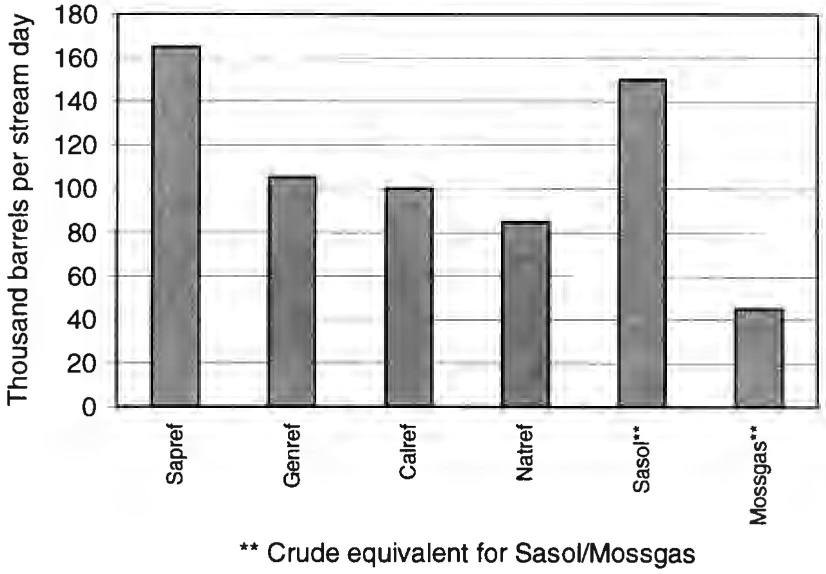
The refineries mentioned in the brief history above have undergone significant expansion and upgrading over the years and currently have the capacities shown in the table below.

Refinery	Location	Capacity**1	Ownership
Sapref	Durban	165	BP 50%, Shell 50%
Genref	Durban	105	Engen
Calref	Cape Town	100	Caltex
Natref	Sasolburg	85	Sasol 64%, Total 36%
Sasol 2+3	Secunda	150	Sasol
Mossgas	Mossel Bay	45	Central Energy Fund
Total		**650**	

**1 TBSD - thousand barrels per stream day (Crude equivalent for Sasol/Mossgas)

Table 4.2.6 Current liquid fuels production capacities and ownership 1996 (Sapia 1995)

International oil companies own 62% of capacity. Engen is a South African company that was formed when Mobil divested from South Africa in the apartheid era and currently contributes 16% of refining capacity. Thus, the international oil majors, with their resources, international expertise and trans-national nature, are very strongly represented in terms of liquid fuels production capacity in South Africa.



** Crude equivalent for Sasol/Mossgas

Figure 4.2.6 South Africa refinery capacity

Feedstock quantities for 1994 were as follows:

Crude refineries	115 million barrels
Sasol (1992)	25.5 million tonnes of coal
Mossgas	1.8 bcm natural gas

Table 4.2.7 Feedstock quantities for 1994 (DMEA 1996; Sapia 1995)

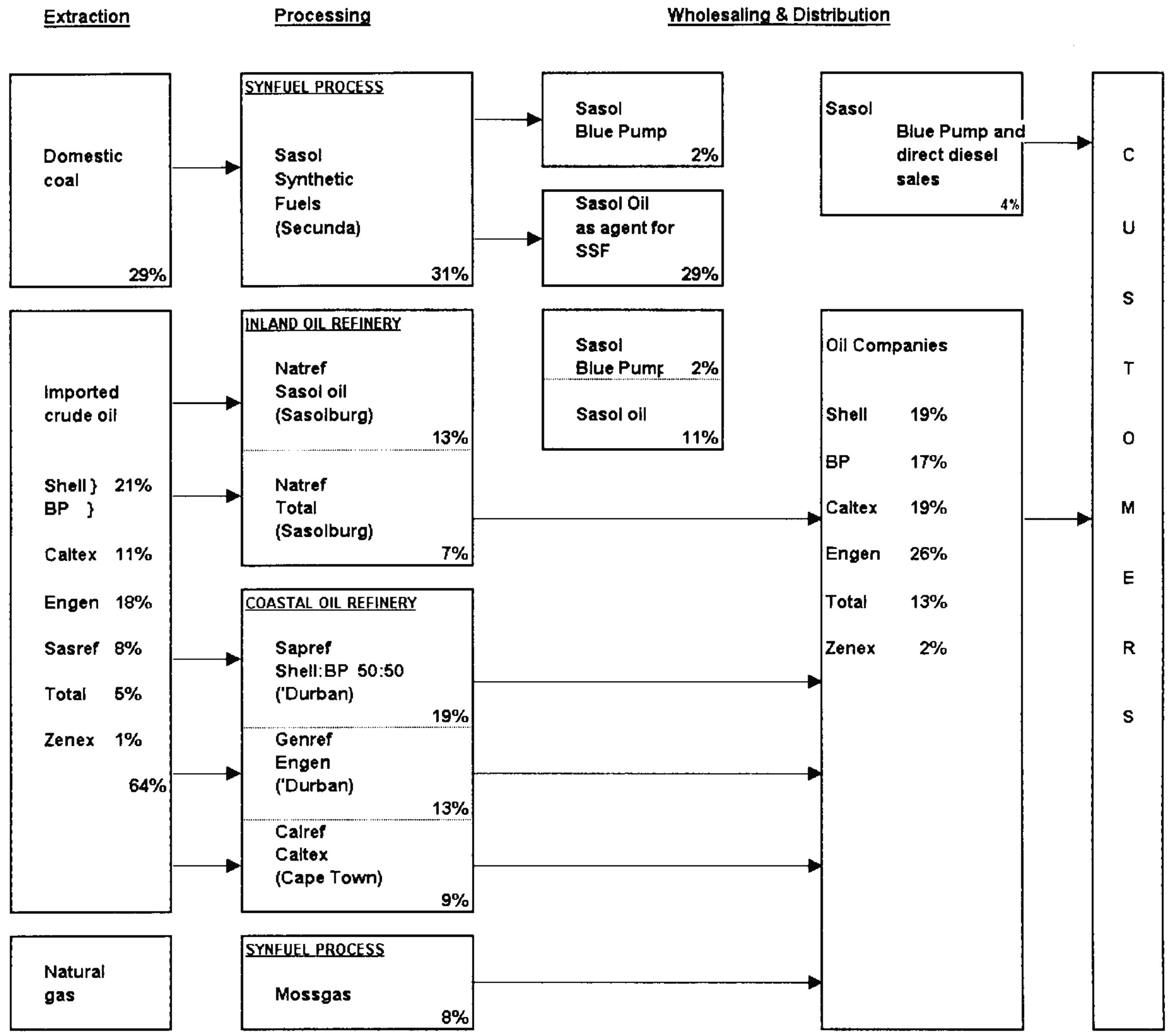


Figure 4.2.7 Production of liquid fuels in South Africa (Arthur Andersen 1995)

Figure 4.2.7 shows four main components of the South Africa liquid fuels production industry drawing on three main feedstock sources. Total demand for liquid fuels in South Africa in 1994 was 18.8 billion litres. Figure 4.2.8 below shows historic consumption of fuels since 1950.

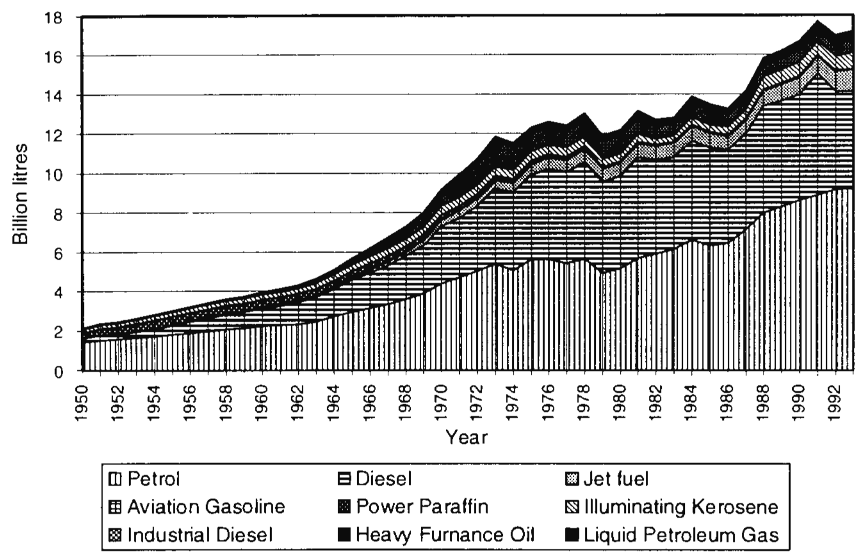


Figure 4.2.8 Demand for liquid fuels by fuel type 1950-1993 (DMEA 1995)

In terms of percentage consumption of fuel products, petrol dominates as shown in the figure below.

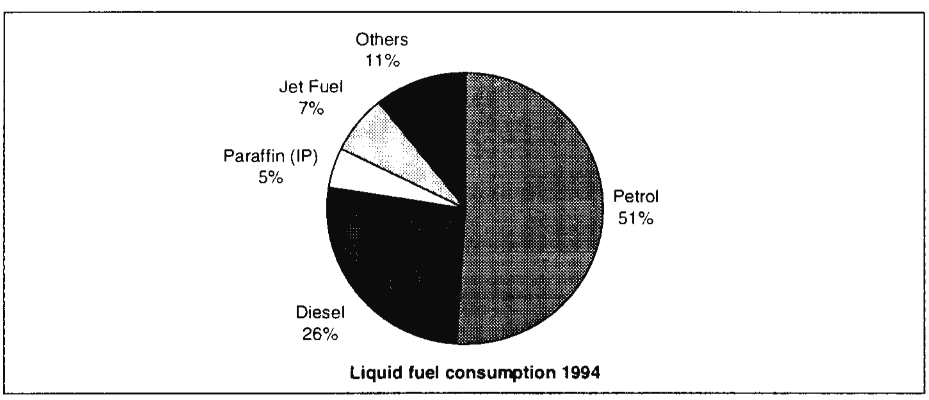


Table 4.2.8 Structure of liquid fuels demand by product 1994 (SAPIA 1995)

The crude oil refining industry

Apart from the Natref refinery which is owned by Sasol and which was positioned in Gauteng to act in conjunction with the Secunda plants and strategic oil stocks in the sanctions era the crude refineries are located at the major ports of Durban and Cape Town. Because an attempt is made to operate the oil-from-coal Secunda plants at full capacity and because their output mix is not flexible, the crude refineries operate as so called "swing" producers, catering for variations in demand. In 1993 the product mix from the crude refineries was as shown below:

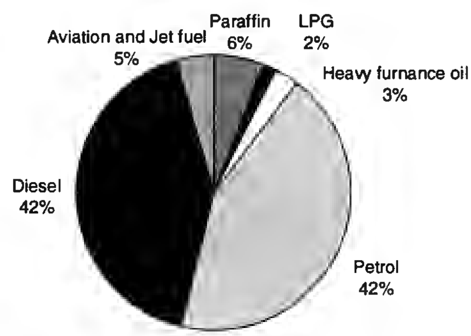


Figure 4.2.9 Crude refinery product category mix (Wong & Dutkiewicz 1995)

In the past four years crude refiners have embarked on a large expansion of their refining capacity.

	Post- expansion	Pre expansion
	'000 Bpd	'000 Bpd
Sapref	165	120
Calref	100	50
Genref	105	70
Natref	85	78
Total	455	318
Expansion	130	

Table 4.2.9 Crude refinery expansion programme (SAPIA 1995)

A total of 137 000 barrels a day has been added to the pre-expansion capacity of 318 000 for crude refining adding 43% to crude refining capacity and 21% to overall South African capacity. The accumulated cost of this expansion has been R3.2 billion (US$ 823 million x 3.9)(SAPIA 1995). Most of the expansion has been de-mothballing. Recent statements by the oil industry suggest that, including expected increased demand by the Southern and East African regions, an equivalent increase will be required every five to six years in the coming decades.

The crude refineries represent a considerable asset for South Africa. In terms of value added they are estimated to contribute around R1.4 billion to the South African GDP on turnover of R10.4 billion. Foreign exchange savings are estimated at R1.2 billion. Valued at historic cost the refineries' combined book value is about R6.5 billion. The recent expansion programme represented an investment of about R3.2 billion. The crude refining industry employs about 4 000 employees (Sapia 1995).

The synfuel production industry

The synfuel industry comprises Sasol Synthetic Fuels (Pty) Ltd, a wholly owned subsidiary of Sasol and Mossgas (Pty) Ltd, owned by CEF (Pty) Ltd. The sole shareholder of CEF is the South African government. The development of the South African synfuels industry started after the Second World War when internationally, some experts predicted that world oil reserves would run out within 10 to 15 years. The State, convinced of the strategic importance of indigenous fuel production and mindful of the fact that South Africa had no crude oil reserves, granted the first licence to produce synfuels in terms of legislation at that time, namely the Liquid Fuel and Oil Industry Act of 1947. This legislation granted a measure of protection to the proposed synfuels industry.

Synthetic fuels

The first oil-from-coal enterprise (Sasol 1) was incorporated in 1950 in terms of the provisions of the Companies Act. The state provided the share capital through the Industrial Development Corporation (IDC). The Sasol 1 plant was commissioned in 1955 and Sasol concluded an agreement with the oil industry whereby Sasol was allowed one pump per service station in a limited geographic area, to market its total petrol production. During the 1960s the company started diversifying into chemicals, producing ethylene, butadiene, styrene, ammonia and downstream nitrogenous fertilisers. Gaskor was formed by Sasol 1 in 1964 for the distribution of manufactured pipeline gas, a by product of the synfuel process, to local industries. Sasol also acquired a majority shareholding in the Natref crude-oil refinery built in Sasolburg and commissioned in 1971.

Partly as a result of the international oil crisis of 1973 resulting in world crude-oil prices increasing from around $3 to $12 per barrel, the State established a second Sasol plant, Sasol 2, at Secunda, which was commissioned in 1980. While Sasol 2 was still under construction, the second world oil crisis of 1979 resulted in the world price of oil escalating from $12 to well over $30 per barrel, and a decision was taken in 1979 to build a duplicate oil from coal plant alongside Sasol 2, which started production three years later. The full costs, met by the state, to build Sasol 2 and Sasol 3 are estimated at R35.1 billion (in 1994 Rands) (Sapia 1995).

Currently the synfuel capacity of Sasol is of the order of 150 000 barrels per day (crude-oil equivalent). Products include petrol, diesel, illuminating paraffin, LPG, solvent gas and a variety of chemical feedstocks. The synfuel capacity of Sasol represents about 23% of the total South African refined petroleum production capacity.

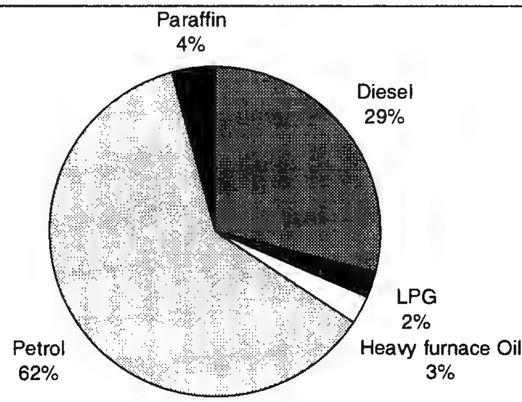


Figure 4.2.10 Synthetic oil product category mix (Wong & Dutkiewicz 1995)

The Sasol synfuel process produces a far higher proportion of the lighter products than the crude refineries. Diesel is currently priced at a higher level than petrol in South Africa (March 1996) despite a large surplus- almost a unique situation, as most countries price diesel much lower for example, in the USA the diesel price is about 65% of the petrol price.

Petrol, diesel, paraffin, LPG and other fuel products are sold on a long-term contractual basis to oil companies operating in South Africa. This agreement provides for the upliftment of products from Sasol Synthetic Fuels to a specific maximum volume at a price determined in a formula based on international product prices (see pricing section later).

In 1994/95 more than 75% of Sasol Synthetic Fuel's production volume was supplied to fuel markets, with fuel product volumes totalling about 5 600 Ml although output of chemical feedstocks have grown faster than output of fuels. Since 1991/92 fuel sales volumes have increased 8% while chemical feedstocks have increased 30%. The table below summarises overall Sasol Synthetic Fuels operating statistics.

	1995	1994	% Change
Turnover (Rm)	**5 667**	5 374*	5.4
Operating profit (Rm)	**1 224**	1 200	2.0
After-Tax profit (Rm)	**710**	603	17.7
Contribution to Group			
operating profit	**43.7%**	47.6%	
Number of employees	**8 150**	8 444	(3.5)
Production			
(million cubic metres)	**8.0**	7.5	6.7

* The turnover for 1993/94 has been reduced in order to exclude feedstocks returned from chemical companies.

Table 4.2.10 Sasol Synthetic Fuels operating statistics (Sasol 1995)

In the 1994/95 financial year Sasol's Synthetic Fuels business produced a value added component of R1.3 billion (excluding protection or subsidy). It is estimated that in 1994/95 the crude import savings equivalent to the output of Sasols Synthetic Fuels business will be R3.1 billion. The foreign exchange profit made by the Sasol Synthetic Fuels business in 1993/94 was R1 190 million. This was on capital employed of R4 314 billion(Arthur Anderson 1995).

The changing situation regarding Sasol Synthetic Fuel's strategic position in South Africa in the post oil-sanctions era has been extensively discussed by the Liquid Fuel Industry Task Force (LFITF) of the National Economic and Labour Council over the past few years. A major output of this was a study, by independent consultants Arthur Andersen, on Sasol's subsidies. Because of Sasol Synthetic Fuel's importance in the South African economy owing to its sheer size and in particular its importance in the energy sector as a user of electricity, a miner and user of coal, a supplier of liquid fuels and gas, it is useful to look at the operation in more detail. Whilst this may not immediately appear to be of direct relevance to the fuels industry it is important in that an understanding of Sasol in the context of the South African economy requires an informed perception of the backward and forward linkages of Sasol into other sectors of the economy. Thus, additional information, drawn from the Arthur Andersen study and other sources, is presented here to provide more of an understanding of Sasol's context.

Although Sasol was initially set up primarily as a liquid fuels producer, the scale of the coal-to-fuels process has provided the opportunity, and necessity, for expansion into chemicals production and Sasol has become a major player in the South African chemicals industry as well as a significant exporter into world markets. The export of chemical products using feedstock from the synfuels operation is forecast to amount to R 978 million, and the value of products placed in South African markets that would otherwise have needed to be imported is forecast to be R 1 920 million for 1994/95 (Arthur Andersen 1995). The synthetic fuels business has thus become an important component of a large integrated operation. In 1994/95 Sasol Synthetic Fuels contributed only 38% to Sasol group turnover, about 5% down on the previous year, while Sasol industries increased their contribution by nearly 7% to 33%.

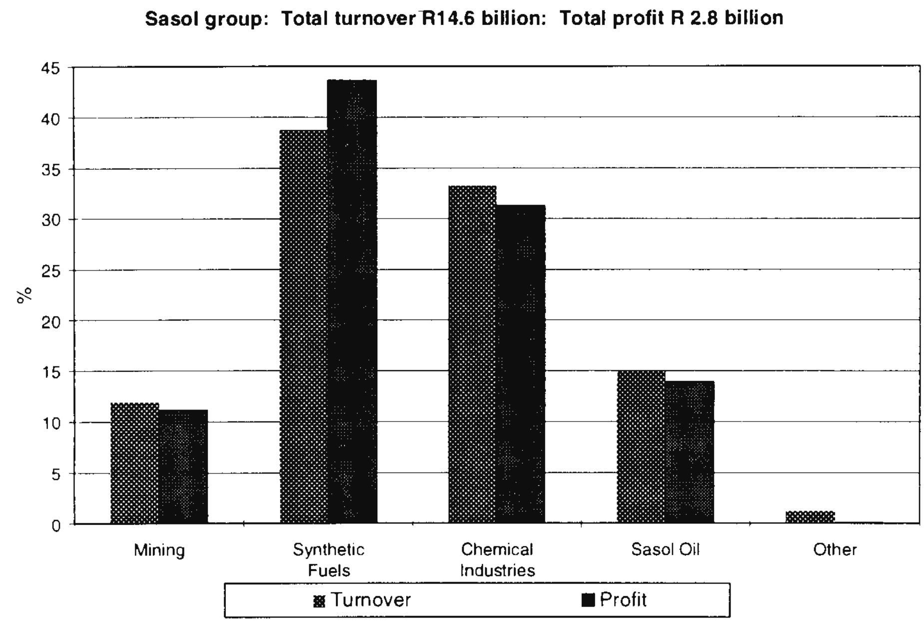


Figure 4.2.11 Contribution to turnover and profit of Sasol group divisions (Sasol 1995)

Contribution of Sasol Synthetic Fuels business to the South African economy

The South African Central Economic Advisory Services (CEAS) has developed an economic model which contains detailed information of the South African economic structure. The table below is a summary of the results of the model when it was used to consider the contribution of Sasol Synfuels to the South African economy.

The *direct* contributions refer to each businesses' own value added and employment plus any value added and employment arising from the immediate supply of intermediate inputs to that business. The indirect economic activity and employment's effects take the backward linkages one step further upstream to capture the relationship between immediate intermediate suppliers and their own suppliers

R million	Coal	Sasol Synfuel business	Down-stream chemicals	Total
Direct	1 084	2 122	1 812	5 018
Indirect	246	438	412	1 096
TOTAL	**1 330**	**2 560**	**2 224**	**6 114**
Employment				
Direct	11 914	17 382	11 068	40 364
Indirect	4 596	7 958	5 776	18 330
TOTAL	**16 510**	**25 340**	**16 844**	**58 694**

Table 4.2.11 Sasol contribution to South African economy (R million - 1995) (Arthur Andersen 1995)

Sasol Synfuel subsidies

Subsidies for the indigenous production of synthetic fuels dates back to the 1930s when the first oil was produced from oil shale (Torbanite) by Satmar at Boksburg in Gauteng. The subsidy was then two pennies per gallon, or about 20% of the price of fuel. Sasol 1 commenced production with the same protection as Satmar, plus a further half-penny refinery protection (the excise duty on refined petroleum products manufactured by the first crude-oil refinery built in the early 1950's in Durban was pegged at a half-penny lower than for imported products).

When Sasol was privatised in 1979 subsidies of 4.5 c/litre (3.6 c/litre actual protection plus 0.9 c/litre rebate on excise duty) were applicable for all liquid fuels produced from indigenous sources. The state gave an undertaking to the shareholders, in terms of the prospectus of the share offer, that protection might be adjusted upwards or downwards should the ratio between the rise in general cost factors and the rise in the prices of petroleum products materially deviate from assumptions used in the economic evaluation of the Sasol 2 and 3 projects. The subsidy received by Sasol has averaged 12.5% since 1979 (i.e. the nett back on its fuel products was 12.5% higher than the IBLC of imported fuels).

No subsidy was received by Sasol during 1985 and part of 1986 as a result of the high price of imported crude. The subsidy was introduced again when the crude-oil price dropped from about $28 per barrel in 1985 to below $15 per barrel in 1986.

This subsidy received by Sasol's synthetic fuel business is funded from the proceeds of the Equalisation Fuel Levy, administered by CEF.

	Volume	c/l on synfuel production	R million (MOD)	1994 R million
1980	2750	4.5	124	758
1981	2750	4.5	124	658
1982	2750	4.5	124	573
1983	5500	4.5	248	1021
1984	4801	4.5	217	798
1985	5159	0.0	0	0
1986	5494	0.9	49	132
1987	5394	3.6	194	447
1988	5502	6.0	330	674
1989	4529	8.2	373	664
1990	4892	6.2	305	475
1991	5456	6.0	325	438
1992	5552	10.5	581	689
1993	5580	13.6	761	822
1994	5552	20.8	1 155	1 155
TOTAL			**4 912**	**9 306**

Table 4.2.12 Sasol subsidy provided since 1980 (SAPIA 1995)

As mentioned before, the Cabinet decision (6/12/1995) will lead to the Sasol subsidy being phased out by 1999. While one of the reasons has been the lifting of UN sanctions the other has been a debate which has become increasingly heated, over the need for the subsidy. South African crude oil refineries represented by the South African Petroleum Industries Association (SAPIA), have been an active player in the debate. They claim that their members earn 6.8% after tax return on total assets excluding cash against Sasols' 12.7%. The table below, from the official government investigation in Sasol's "tariff protection" also indicates that the profitability of Sasol at R2.8 billion (more than R1 billion of which was subsidy for 1995) was out of line with norms (Business Day, November 29, 1995). Whilst the December decision to phase out the subsidy decreases this profitability substantially it seems that, until the subsidy has in fact been stopped, the area will remain contentious, particularly as, on the one hand, Sapia members believe that no subsidy should be given, and on the other Sasol holds such an important position in the economy.

SSF (with protection)	20.7 %
SSF (without protection)	3.3 %
Benchmark groups:	
Overall	9.4 %
Refining	3.8 %
Chemicals	10.1 %
Integrated	14.5 %

(The benchmark groups are broadly-based South African and international companies including integrated oil companies, refining companies, and petrochemical companies).

Table 4.2.13 Comparison of Sasol profitability with benchmark companies 1995 (Arthur Andersen 1995)

Mossgas synfuel production

The Mossgas project was one of three synfuels projects proposed to the government (the others being an AECI coal-based synfuels project and a Gencor Torbanite project) in the late 1980s. In terms of the energy policy of the time, a target level of self-sufficiency of 40% of liquid fuel requirements (petrol and diesel), which was achieved after the completion of Sasol 3, was to be maintained for the foreseeable future. This strategy was mainly because of the increasing isolation of South Africa and the UN oil boycott in reaction to its apartheid policy. Due to increasing fuel demand, forecasts indicated a drop in the achieved level to about 30% by the mid-1990s, unless a further synfuels project could be brought on-stream. The three projects were evaluated and it was decided that the Mossgas project, utilising the recently discovered off-shore gas reserves near Mossel Bay in the Cape Province, was the most favourable from a macro-economic perspective. The project was approved by the Cabinet in 1987 at a cost of about R6 200 million and predicted lifespan of over 25 years. It was finally completed in 1991 for nearly twice this estimate due to cost escalation's, which resulted in several official enquiries and a detailed investigation by the Auditor-General, published in 1993.

The Mossgas project currently produces about 1 350 Ml per year, or about 8% of South Africa's present liquid fuel demand, resulting in foreign exchange savings of around R500 million per year. About 1 200 people are employed. The complex includes an offshore production and treatment platform with nine wells. Gas and condensate are separated offshore. Two lines take condensate and gas to shore. To ensure reliability of supply, a small LNG plant and storage tank have been constructed onshore. The whole output of this operation is owned by and dedicated to the Mossgas liquids synthesis plant. Gas production is currently running at about 1.8 bc/y.

Summarised income statement	R'000	
	1995	1994
Sales at selling price	729 706	562 294
Synthetic-fuel levy	117 500	123 981
Sales at IBLC	847 206	686 275
Operating expenditure	(615 983)	(628 050)
Net surplus before tariff		
Protection	231 223	58 225
Tariff protection	285 480	110 700
Net surplus	516 703	168 925

Table 4.2.14 Summarised income statement for Mossgas for the 1994/95 financial year (CEF 1995)

If the capital cost of Mossgas is seen as a sunk cost and written off then the project can be seen as cash-positive at R114 million p.a. Gas production estimated at 1.8 bcm/yr would place a value of R1.70 (or $0.47) per GJ on the gas production as utilised in the synfuel plant. (This is in comparison to a price of R30/GJ paid for Gaskor gas in Gauteng).

Gas reserves in the FA-field will run out at the beginning of 1997, four years after Mossgas start-up. An amount of R850 million has been estimated as necessary to extend the life of the gas fields by five years (Report of CEF request in Mail and Guardian 16 to 22 February 1996).

Mossgas upliftment

At present the upliftment of Mossgas fuels by the oil industry is taking place without a formal long-term agreement. The wholesale price paid for Mossgas products is not import parity (based on Singapore/Bahrain postings), but a lower price based on the commercial value of these products to the oil industry. This is determined by establishing the value of these products in the export market (mostly other African countries) using Mediterranean postings plus transport differentials. Mossgas product volumes marketed locally displace similar volumes to those produced by the coastal refineries into foreign markets. Due to shipping cost differentials and other pricing considerations, the nett back is usually lower and thus Mossgas receives less than the IBLC price. At present the state makes good this difference by way of a compensation payment to Mossgas.

Distribution, wholesaling and retailing of liquid fuels

This section considers the regulation, structures and operations concerned with taking liquid fuels products from the refineries to the points of final delivery for use.

History of government regulation of petroleum product marketing[1]

Prior to the establishment of the refining industry in the 1950s, petrol was distributed at first by general dealers, then by service stations as the motor vehicle population increased during the 1930's and 1940's. Selling prices were determined by the oil companies in consultation with the Government Motor Traders' Association (MTA), presently the Motor Industries Federation (MIF). Retail price maintenance (RPM) resulted and price cutting was excluded.

The government adopted the Unlawful Determination of Prices Act (UDOPA) in 1931 with the aim of leaving price determination to market forces. A price war developed leading to poor service station quality and closure of the smaller service stations. UDOPA was amended in 1937 authorising RPM in respect of petrol. Agreement was also reached with the MTA to control the number of service stations. Applications for service stations had to be made to committees called Joint Petrol Advisory Committees (JPACs). In practice the MTA exercised a measure of control, resulting in protectionism. Numerous appeals against these monopolistic practices were made against the state by the public. A National Appeal Board was created in 1947 to deal with applications for retail outlets rejected by the JPAC's, but failed to function effectively.

Subsequently, the government introduced the Undue Restraint of Trade Act of 1949 (UROTA). Petrol was declared a controlled article under the Act and qualifying standards for service stations, including the provision of a workshop and the employment of a qualified mechanic, were mandated. This led to increased competition and a reduction in profits. The application of UROTA in the strict form prescribed by the regulations was too rigid and consequently the Act was revoked. The oil companies did, however, undertake to honour the obligations originally imposed, and this arrangement has been operative until recently.

One of the problems experienced with the UROTA system was that, while applicants often met the qualifications, the volumes of fuel accruing to these outlets were too small to economically justify the installation of pumps by all companies, as was originally done. The oil companies and the states then together devised a roster system which obliged one company to supply the necessary pumps and equipment to such sites, even though conditions were frequently unprofitable.

The growth in the number of retail outlets contributed to a general reduction in fuel sales at individual outlets and because the oil companies were represented at so many outlets, unnecessary capital investment and high operating costs were incurred. A single-brand marketing system of marketing petrol in all towns with more than four retail outlets was subsequently approved by the government in 1951, on condition that indigenous fuel produced by Sasol (as from 1956) should also be sold. In 1958 the single brand-system was extended to all towns, resulting in additional sites being established.

Prior to 1984 the marketing margin was kept as low as possible by state control, and the oil industry was able to survive through rationalisation, the implementation of efficiency programmes and other measures. At that stage the refining margin provided a higher return compared to the marketing margin, which was inadequate. In effect, therefore, the poor return on marketing activities was subsidised by the higher return on refining activities. The state then commissioned an investigation to determine the income on and assets of both the refining and marketing activities (known as the petroleum activities return, or PAR). A composite margin, called a post-refining margin, was introduced so as to provide a total return of 15% (before tax and interest) on the depreciated historical value of the assets employed in the refining and marketing activities.

In 1991 the Cabinet decided to lift control on return on refining investments but to retain regulation of marketing activities on this basis (by using a formula to calculate the so-called marketing petroleum activities return, or MPAR). It aimed to allow the marketing industry to earn a 15% return on marketing assets (before tax and interest). This has never been achieved.

[1] This section on the history of regulation of the industry was contributed by Dr. Robert Scott as an input to the Energy Policy Discussion Document project (see chapter 1: Introduction).

Current liquid fuels marketing arrangements

Distribution and wholesaling

It is immediately apparent from a cursory examination of the spatial locations of import ports, fuels production facilities and markets that, unless extensive duplication of facilities and the associated inefficiencies in distribution were admissible, the liquid fuels marketing industry needs to cooperate extensively. So, as in most countries, the refineries in each area effectively supply most of the fuel products for that area, regardless of the brand names the products are sold under. Transport and depot facilities are shared and the industry operates product exchange mechanisms. There are agreements between members of the oil industry on joint ventures and hospitality.

Wholesale marketers obtain refined products at the refinery gate and transport these products to some 200 depots throughout the country either by pipeline, rail tank cars, road or sea tankers. Products are then transported from the depots to service stations and other consumers by rail and road.

Eight oil companies market in South Africa under their own brand names. (In August 1995 a new company, Afric Oil, was formed).

	%	%
Company	Petrol	Diesel
BP	15.9	16.7
Caltex	18.5	17.7
Engen	25.8	25.4
Sasol	7.5	1.3
Shell	17.6	18.9
Total	12.1	15.4
Zenex	2.6	4.6

Table 4.2.15 Market shares of South African oil companies 1994 (SAPIA 1995)

Most petrol (92%) is sold by service stations while only 15% of diesel is sold by service stations. The rest is sold directly to bulk users. Illuminating paraffin is marketed through service stations, routers and general dealers.

The supply chain and pricing

In short, pricing in the supply chain works as follows (a detailed description is given later):

Feedstock price

- Procurement at prices negotiated privately with supplier

Product wholesale price

- Referred to below as Estimated landed cost or In-bond landed cost (IBLC).
- Calculated using a formula based on international product prices and transport costs.

Product retail price

- Petrol, diesel and IP prices controlled by government
- Calculated using a formula based on wholesale price plus a number of costs associated with transport, storage, distribution and retailing (plus taxes).

South African cents	Petrol 95 octane coast 7 Feb. 1996	Petrol 93 octane Gauteng 7 Feb. 1996	Diesel Gauteng 6 March 1996	IP Gauteng 6 March 1996
Estimated landed cost	51.903	51.903	68.755	76.730
NRSC	0.200	0.200	0.200	-
Customs and excise	4.000	4.000	4.000	-
MMF	9.000	9.000	5.800	-
Fuel Tax	62.900	62.900	55.400	-
Equalisation Fund	9.400	9.400	8.000	-
Transport cost	-	10.200	10.100	11.000
Wholesale margin	14.058	14.058	14.050	14.262
Delivery cost	5.100	5.100	5.100	12.100
Retail margin	18.100	18.100	11.900	-
Final price	**174.661**	**184.861**	**183.305**	**114.092**

Table 4.2.16 Price build up of liquid fuels (the components are explained below)

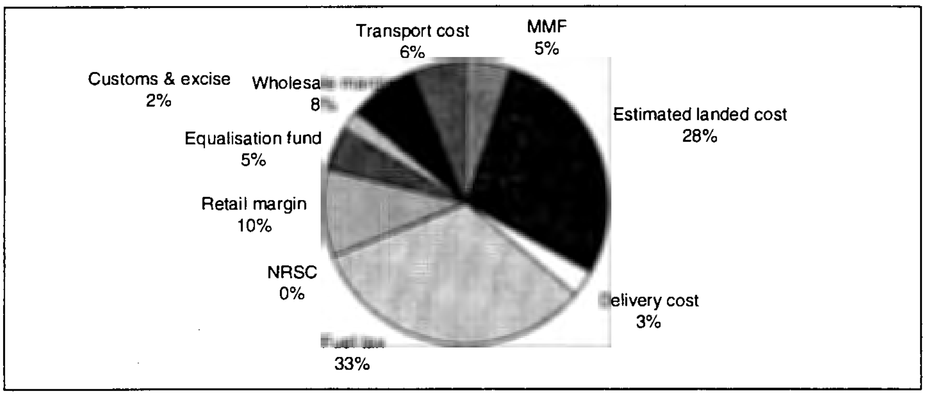


Figure 4.2.12 Composition of petrol price in South Africa in cents per litre, 26/1/96 - 26/2/96

Refinery gate price

The price of refined products is based on the in-bond landed cost (IBLC). The broad principle of the current South African pricing formula is that prices are based on, and thus influenced by, supply and demand for petroleum products in "east of Suez" markets such as the Arabian/Persian Gulf, Pacific Rim Countries and Australia. These prices would be the purchase prices should South Africa be required to import significant volumes of such products at the most economical freight rates.

The South African price of petrol (used as an example-other refined product prices are determined in a similar way) comprises international and domestic elements. The international element is the average of the free-on-board (FOB) petrol price listed by, in an 80/20 proportion, refineries in Singapore and Bahrain (combined with the spot price), plus freight, insurance and ocean leakage costs. Freight cost is determined on a monthly basis using a standard international tariff for product transport voyages from Singapore and Bahrain to South African ports. Insurance tariffs are determined by Lloyds of London according to prevailing risks for different product types. The ocean leakage element pertains to normal leakage, clingage and evaporation losses incurred during shipping (about 0.3%). Landing and wharfage charges (1.78% of FOB value) are added to arrive at the (IBLC). The IBLC (in US c/gallon) is converted to South African c/l by applying the average R/US$ exchange rate. This represents the transfer price from the refineries (including Sasol) to the marketing divisions of the South African oil companies.

The IBLC principle is regarded as an arms-length method of determining the basic prices of refined products which is an attempt to ensure that local refineries operate cost-effectively and as efficiently as their international counterparts.

Various costs are then added to the IBLC to make up the final pump price in a given price zone (magisterial districts are used as price zones). These costs are as follows:

Inland transport cost

Determined by the cost of transporting product from the coast (Durban, Port Elizabeth, East London, Mossel Bay and Cape Town) to the inland depot/s serving the zone.

Service differential

This element compensates marketers for the cost of operating the depots and distributing the product to the service stations. It is calculated on actual historic costs for the previous year for the whole oil industry, averaged country-wide.

Wholesale margin

The wholesale or marketing margin is monitored and controlled by the state using a formula known as MPAR (marketing of petroleum activities return). It is set at a benchmark of 15% (10% to 20% range) nominal return on the depreciated book value of assets (with allowance for additional depreciation and before interest and tax) as determined for the whole oil industry by an independent firm of accountants. The previous year's results are used to calculate profitability and determine whether adjustments to the margin are required. Although the benchmark is 15%, the margin is only adjusted if the return on assets is below 10% or above 20%.

Year	%
1991	3.40
1992	8.79
1993	13.90
1994	12.00
1995	8.70
Average returns, 1991 - 1995	9.60

Table 4.2.17 MPAR results since inception - return on assests before tax and interest (BP 1995)

	Rands
Marketing assets	8 149 000 000
Pre-interest and tax income	711 000 000
Return - pre-interest and tax	8.7 %

Table 4.2.18 MPAR returns 1995 (Sapia 1996)

Retailing

There are approximately 4 900 service stations in South Africa. Of these 58% are owned or leased by dealers, 24% are owned by oil companies and 18% are leased by oil companies.

Although the sizes of service stations vary greatly, the following rough estimates can be made of basic service station statistics. (McGregor 1995).

Number of service stations	4 900
Staff (per service station)	15
- service attendants	9
- workshop, cashier, management	6
Employment at service stations	73 500
- service attendants	44 100
- workshop, cashier, management	29 400
Total capital investment in service stations*	R3.8 billion

* It costs an average of approximately R2.5 million to build an urban service station, excluding the cost of land.

Table 4.2.19 Estimates of basic service station statistics (Sapia 1996)

Retail pricing

Retail price maintenance (RPM) on petrol is enforced by the DMEA in terms of the Petroleum Products Act (Act no. 120 of 1977). The retail price of diesel is not controlled, while in the case of illuminating paraffin a gross retail mark-up of 33% is permitted. The retail margin for petrol is determined by the DMEA on the basis of the actual costs incurred by approximately 80 representative service stations with an average monthly petrol sales volume equal to the country's average (153 000 l/month).

Equalisation Fund levy

For more than a decade until the early 1990s South Africa had to pay premiums for imported crude oil as a result of the oil embargo. These were financed by a levy on retail sales of petroleum products, known as the equalisation levy, which has been imposed since January 1979. The oil companies collect and pay the levy into the equalisation fund, managed by the Central Energy Fund (CEF) (Pty) Ltd and controlled by the Ministers of Mineral and Energy Affairs and of Finance in accordance with the Central Energy Fund Act, No. 38 of 1977. The levy is currently applicable to petrol, diesel and illuminating paraffin. Although the need to finance premiums on imported oil has fallen away, the equalisation fund is utilised for the following purposes by Ministerial directive:

- temporary financing of margin increases;
- payments to Sasol and Mossgas;
- synlevy payments to the oil industry for uplifting Sasol products;
- funding of fire-fighting and security projects at key fuel.

The need for an equalisation levy will depend on whether the above payments can be justified in terms of future energy policy. Most of the equalistion fund is currently used to pay subsidies to Sasol and Mossgas, although the recent decision to cut Sasol's subsidy in 1996 will make a surplus of about R600 million available in 1996. 3c/l has been transferred to the fuel tax from 3 April 1996 while a further 1c/l will be transferred in July 1996. This should raise approximately R610 million for the fiscus in the 1996/97 financial year.

Fuel tax, customs duty and excise duty

The state collects tax on fuel, currently equal to approximately 40% of the retail price of petrol and 30% in the case of diesel. An equalisation fund levy equal to 7% of the illuminating paraffin price used to be levied on illuminating paraffin used as a household fuel but this was discontinued in July 1996. The 3.6 c/l equalisation fund levy on LPG was also discontinued in July 1996.

Multilateral Motor Vehicle Accident Fund levy (MMF)

Compulsory third party insurance is financed via a levy on petrol and diesel. The exact amount is determined by the budget of the Fund, which is approved by the Minister of Transport in concurrence with the Minister of Finance.

The retail or pump price of petrol is the sum of all of the above elements. This is calculated by the CEF, and pump price adjustments are made on the first Wednesday of each month.

Paraffin marketing

Despite the quasi-regulated maximum retail mark-up on paraffin of 33% the actual practice in most cases is to apply a higher mark-up (Palmer Development Group 1993). Marketers buy paraffin in bulk from refineries and distribute to depots around the country. From the depots the fuel enters an often complex supply chain leading to retail outlets many of which are informal "spaza" stops which sell small amounts of paraffin in a variety of containers often supplied by the customers. While wholesale prices are relatively stable, fair and constant across many wholesalers surveyed retail prices vary widely and the average mark up at 505 dealers surveyed, in five townships in the Transvaal was 45% (Palmer Development Group 1993).

Price trends

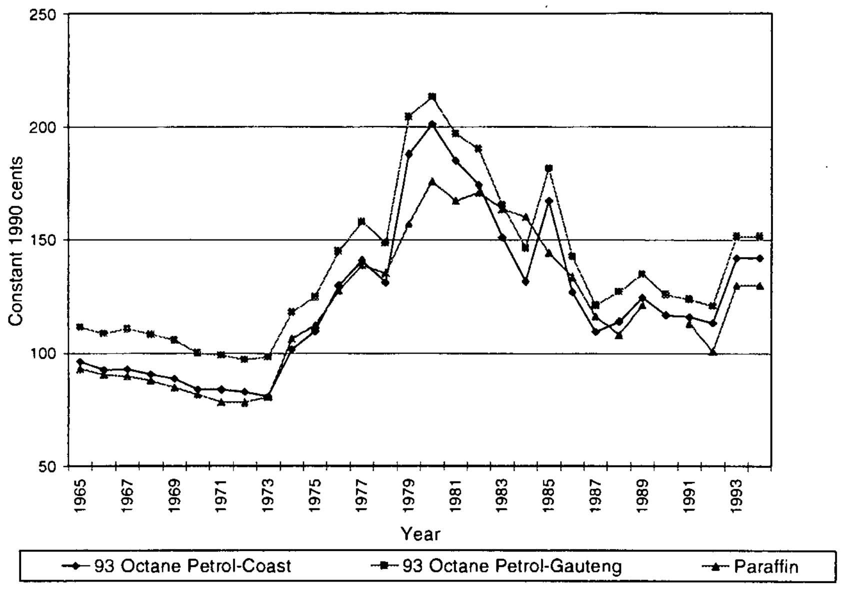


Figure 4.2.13 Real (1990 Rands) price of petrol, diesel, and paraffin (DMEA 1995)

Comparison of South African prices with other countries

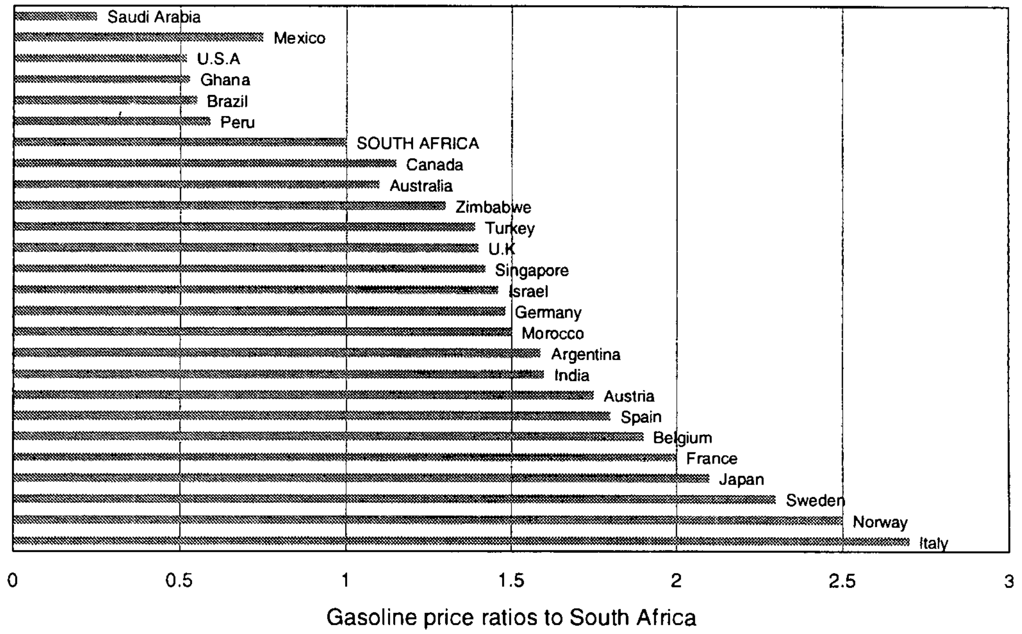


Figure 4.2.14 International comparison of South African petrol price 1990 (Dutkiewicz 1994)

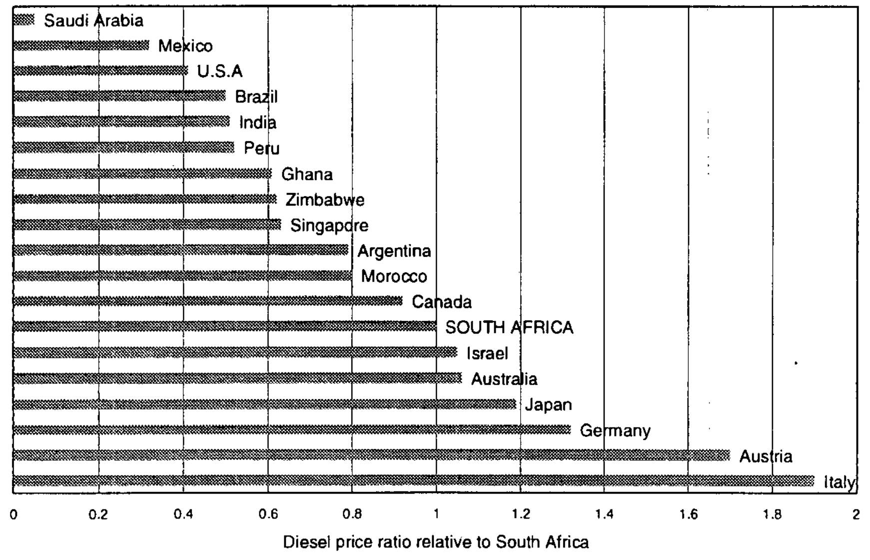


Figure 4.2.15 International comparison of South African diesel price 1990 (Dutkiewicz 1994)

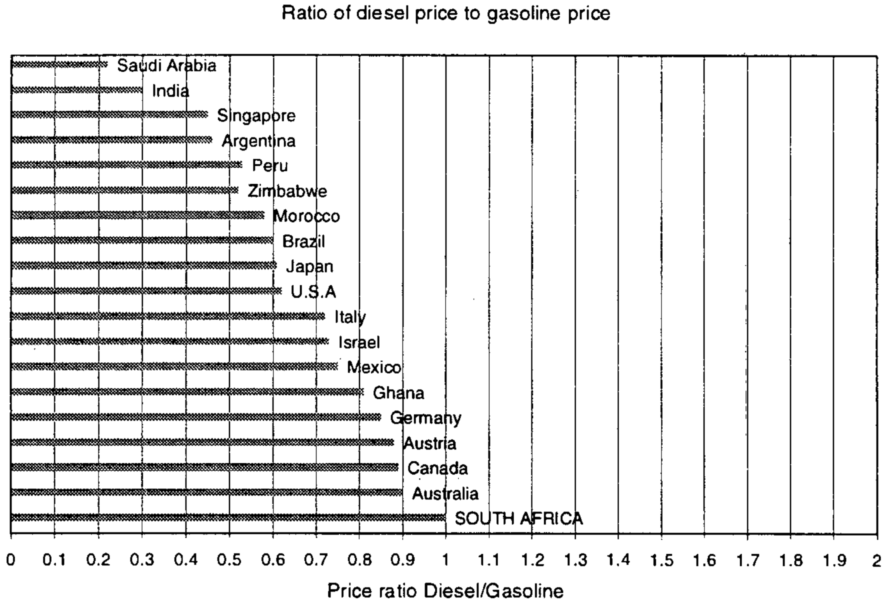


Figure 4.2.16 Ratio of diesel price to gasoline price 1990 (Dutkiewicz 1994)

Internationally many countries price diesel significantly below petrol largely using a duty on retail sales. The main reason for this is to encourage users to take advantage of the inherent technological advantages offered by diesel engines for public, freight and goods transport and commercial applications (Many users are discouraged by the higher capital costs of diesel equipment and therefore an additional incentive is required). An additional reason is that this is an effective policy instrument for differentiating between key economic sectors.

The vast majority of countries promote the use of diesel through a price differential. On average, world diesel prices are 28% lower than petrol prices. The figure above shows some typical prices.

There is a world-wide trend towards diesel use irrespective of price differentials. However, the higher capital cost of a diesel engine constrains uptake unless, either the vehicle is used for a high annual mileage, or there is a considerable pump price differential.

(Note: The South African pricing formula has recently led to diesel being priced above petrol in South Africa - March 1996).

Fuel Transport

Fuel is transported in four modes, namely coastal shipping (by oil industry-owned coastal tankers), road, rail and pipeline.

A number of companies in the oil industry own and operate a single buoy mooring facility outside Durban harbour. This allows for the discharging of crude oil from tankers without the necessity of entering the port. However, a wharfage charge is levied.

Portnet, the state port parastatal, handled 24.2 million tonnes (163 million barrels) of petroleum products at its harbours in 1994/95.

The transportation of crude oil from the coast to the only inland refinery, Natref, as well as from bulk-storage facilities to the refineries, and of petroleum products from the refineries and storage facilities to inland depots is largely carried out by Transnet, the state-owned transportation company. Transnet owns and controls all crude oil and petroleum-product pipelines in South Africa through its subsidiary Petronet. The transportation of fuel by rail and road is done by other Transnet subsidiaries, Spoornet and Autonet respectively, as well as the road tankers of the oil companies.

Petroleum products are distributed from the refineries or coastal supply points to the inland fuel depots and from the depots to the service stations mostly by oil industry-owned road tankers, in the most economical mode or combination of modes available. The transport cost element in the controlled retail price of fuel is dependent on the area in which the fuel is sold, increasing with distance from the coast. The country is divided into three zones, categorised by the dominant mode of transport in each, and the costs determined for the various magisterial districts which are used as pricing zones. DMEA uses Transnet rail tariffs as benchmark costs to determine the transport cost element of the fuel price for each zone.

It has been argued that the Transnet tariffs for transporting fuel, especially pipeline tariffs, are excessive and do not reflect an equitable return on the capital investment and operating costs. It is believed that there is a level of cross-subsidisation of other transportation activities operated by Transnet. Also, there are no economy-of-scale advantages (lower tariffs for high-volume areas and higher tariffs for low-volume, outlying areas). This is of benefit to fuel users in outlying areas but results in a higher transport cost-element in the price of fuel for the majority of users.

Also, even though fuel supplied in the Gauteng area by Sasol (which accounts for most of the supply) is not transported from the coast, the controlled price paid for this fuel contains a component reflecting the cost of transport from the coast.

Petronet[2]

The Petronet parastatal operates a network of some 3 000km of high pressure liquid fuels pipelines. The pipeline network was built over a 15-year period from 1965 onwards. Fuel products transported include white products (diesel, petrols, alcohol and jet fuel) for the oil industry and Sasol, and crude oil for the Natref inland crude refinery. Recently Petronet has entered into an agreement with Sasol to transport methane-rich gas from Secunda to the Durban area. A liquids pipeline is to be converted.

Petronet is a division of the Transnet parastatal transport conglomerate. In 1994/95 it transported 14.3 billion litres of fuel, an annual increase of 8.3%. The megalitre kilometres transported equalled 3.8 million. Its customers are the major oil companies in South Africa: BP, Shell, Engen, Caltex, Total, Zenex and Sasol.

The transportation of white products is done from three supply areas, namely:

- the two crude refineries in Durban (Sapref and Genref);
- the crude refinery at Sasolburg (Natref); and
- the two synfuel plants at Secunda (Sasol 2 and 3 plants).

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[2]Much of the following information comes from an unpublished internal Petronet document, titled: *Petronet*.

These products are delivered to 18 delivery points in five provinces and the existing pattern is that about 47% of all white products taken in and delivered originate from Secunda, 39% from the Coalbrook refinery Natref, and only 14% from the two coastal refineries.

The transportation of crude oil is done from two supply points to the Natref refinery. These intake points are in Durban (imports) and Kendal in the Mpumalanga province (from strategic stockpiles in old coal mines). At present (1995) about 56% of all crude transported is supplied from coast and 44% from the stockpiles.

Petronet's market share of the various market sectors is as follows:

- The pipeline share of petrol and diesel transported from the Secunda refineries is approximately 91%.
- The pipeline share of petrol and diesel transported from the Natref refinery is approximately 80%.
- The pipeline share of petrol and diesel transported from the coastal refineries by pipe, road, rail and sea cannot be determined due to insufficient information of the volumes transported by the other modes of transport. However, the volume of white products transported from the coast by pipeline was 1 442 billion litres for the period April 1994 to March 1995. Petronet believes this volume to be below 15% of all volumes transported from the coastal refineries.
- The pipeline share of crude oil from the coast and inland is 100%.
- The pipeline share of Avtur (aviation turbine fuel) transported from Natref to Johannesburg International Airport is 100%.

Since 1993 Petronet has also diversified into the area of depot management. This segment of the Industry was traditionally owned and operated by the oil industry. Petronet's Tarlton depot, with its tank farm ability to carry 30 million litres of fuel at any one time is a leader in this market.

Petronet has recently started diversification into the area of gas transportation. One of their liquid lines is being decommissioned during 1995 to be converted to transport gas by April 1996.

The current estimated replacement cost of the approximately 3 000 km of pipeline and related assets is about R4.5 billion. However, a recent revised estimate suggests that this could be as high as R6.5 billion.

	1994/95 Rm
Turnover	449
Operating income	286
Net profit after finance cost	140
Net income	1 433

Table 4.2.20 Petronet 1995/96 budget (Petronet 1995)

Petronet's return on assets managed (ROAM) is about 20%. In real terms this gives real return of about 10.5%. From an international benchmarking exercise undertaken, Petronet found UK and USA pipeline companies making between 7% and 14 % real return on assets managed. Petronet ROAM is determined largely by the existing pattern of supply and demand of fuel in South Africa and not the tariffs. The majority of fuel transported by Petronet is transported over short distances at tariffs leading to much lower income than would have been the case had all products been transported over the longer distances. Using the ROAM-arguments, therefore, is important in evaluating Petronet operations, because looking at tariffs in isolation can be misleading.

Although Petronet is a natural monopoly and is part of the highly regulated fuel industry, it is not formally regulated. This is an exception to common international practice where even state utilities are run along rules of a specific regulation regime.

Petronet's entire nett profit goes directly to Transnet to help address the Transnet Pension Fund liability.

The links between petroleum product pricing and Transnet tariffs

Three of Transnet's divisions (Spoornet (rail), Petronet (pipe) and Autonet (road) are involved in the transportation of fuel. These division's tariffs play an important role in the final price-setting of fuel products throughout South Africa. The country is divided into pricing zones by using the cheapest combination of modes (using Transnet tariffs) of transport from the nearest port where oil companies distribute petroleum products. This system had over the years ensured that products have been nationally available including rural areas. The published tariffs of the different modes of transport in Transnet are used to determine the cheapest transport cost from coast to inland sources. Some zones use the rail tariffs (where there are no pipelines), some road tariffs (where there is no rail or pipeline transport available), and there are the zones that use the pipeline and a combination of pipeline and rail (so-called onrailing) tariff to determine the associated transport costs. These transport costs are fully recovered in the pump price. The transport cost does therefore not add expenditure to the accounts of members of the oil industry - it gets fully recovered at the pump under the existing regulatory rules.

It is through this mechanism that the extent of Sasol's locational advantage is determined. Sasol charges the oil industry wholesalers the IBLC plus transport costs as if product had been transported from the coast but pays Petronet only for the transport from the inland plants and refinery - the difference being retained by Sasol. There is thus a clear link between Transnet tariffs and Sasol's revenues - even for the fuel not transported from the coast.

4.2.3 Gas

In addition to coal gas and LPG, South Africa produces about 1.8 billion cubic metres per year of natural gas from the F-A field near Mossel Bay in the Bredasdorp Basin off the South coast. The entire output is dedicated to the state-owned Mossgas liquid fuels synthesis plant and accounts for about 1.5% (70PJ) of total primary energy supply. (South Africa gas resources and Mossgas are dealt with in section 4.2.1 and 4.2.2). Gas manufactured from coal accounts for between 1% and 2% of total net energy consumption (about 24 PJ) and liquefied petroleum gas (LPG) accounts for about one half of a percent (about 12 PJ).

Natural gas and coal gas play separate roles in the energy system with natural gas being used solely as a feedstock for production of synthetic fuels and coal gas as an industrial and domestic fuel. However, current development of regional gas fields will most probably lead to gas becoming a more important fuel in South Africa.

Sasol Heating Fuels (Gaskor)

(As a result of changes at Sasol Gaskor has ceased to exist and Sasol Heating Fuels is now responsible for Gaskor's previous areas of business.)

In 1964, Sasol established the South African Gas Distribution Corporation Limited (Gaskor) for the distribution of gas which was a by-product of its synthetic fuel process from the plant in Sasolburg. Currently Gaskor, a not-for-profit, company, 100% owned by Sasol, accounts for about 90% of gas sales in South Africa. Gaskor owns about 700 km of distribution pipe and sells mainly to about 700 industrial customers in the Gauteng area. Gaskor sources its gas from the Sasol 1 plant in Sasolburg and the Sasol 2 and 3 plants in Secunda.

The gas from the Sasol 1 plant has a calorific value of 20.5 MJ/cm but the Secunda plants produce methane-rich gas which has a higher calorific value of some 34 MJ/cm (compared with a typical value of 38 MJ/cm for natural gas). Recent expansion in Sasol's gas business involves the higher calorific value gas. For example, the recently completed 100 km pipeline from Secunda to industries in the Witbank area and the Richard's Bay pipeline negotiated with Petronet (see earlier) are for methane-rich gas.

The price of Gaskor gas is geared to maximise the load factor. No volume discounts are given above the smallest loads and load factors are monitored closely. Customers have individual contracts, but prices are set by a published tariff that is reviewed annually although contracts for customers supplied by the new Witbank line have been negotiated outside of this tariff structure. A single sliding - scale tariff is used that ranges from about R12/GJ at load factors of 90% and above R31/GJ at load factors below 40% (World Bank 1995).

An interesting and pertinent point for future industry development is that depreciation on gas pipelines is not allowable for tax purposes. This has been connected with Gaskor's curious arrangement whereby it is set up as a "Section 21" non-profit company which owns pipeline networks but has no staff. Sasol carries out all sales, operation and maintenance.

Johannesburg Water and Gas Department.

Most of the remaining 10% of gas sales in South Africa is on-selling of Gaskor gas by the Johannesburg Water and Gas department (JWDG) which owns 1 300 km of distribution pipe and supplies 12 000 domestic and 3 000 industrial customers. The industrial customers take 87% of the gas and the domestic consumers account for the remainder. JWGD's prices are high compared with Gaskor's and are in the range of R28 to R30/GJ. JWGD claims that their position, in terms of sharing overhead costs and structures with other municipal service departments, makes it difficult to expand their business, and that it is in fact in decline.

Cape Town and Port Elizabeth

A small number of about 600 industrial and domestic customers in Cape Town are served by the privately-owned Cape Gas in Cape Town. Cape Gas operates a very old coal gas plant. A privately owned company in Port Elizabeth distributes a small amount of LPG/air blend by pipe.

Future development of gas in South Africa

There is consensus that any significant expansion of the South African gas industry would most likely firstly be based on piping gas from the Pande field in Mozambique, which has proven reserves of about 54 bcm, to the Gauteng, Mpumalanga and KwaZulu-Natal markets. Private investors have shown interest in the Pande development and there are strong possibilities that a pipeline from Pande to South Africa will be built in the next few years.

An additional source of gas could be the Kudu field in Namibia with a discovery of 57 bcm but this resource has yet to be proved up to reserve status. However, Kudu has upside possibilities of being up to ten times larger. If this is realised Kudu could represent a relatively large source of gas for South Africa.

The Central Energy Fund (CEF) has made estimates of the size of the potential gas market in South Africa and estimates that excluding large baseload customers, could be as large as 7 bcm p.a. by 2010 (compared with current Gaskor sales of 0.6 bcm p.a.). Additional baseload customers such as a 2000 MW power station and a large minerals beneficiation plant could increase this by 5 bcm p.a. This level of demand would represent about 10% of current primary energy supply in South Africa.

4.3 Electricity

4.3.1 Overview of the South African electricity supply industry

Industry structure

The electricity supply industry (ESI) in South Africa is structured in three layers as shown in figure 4.3.1 below:

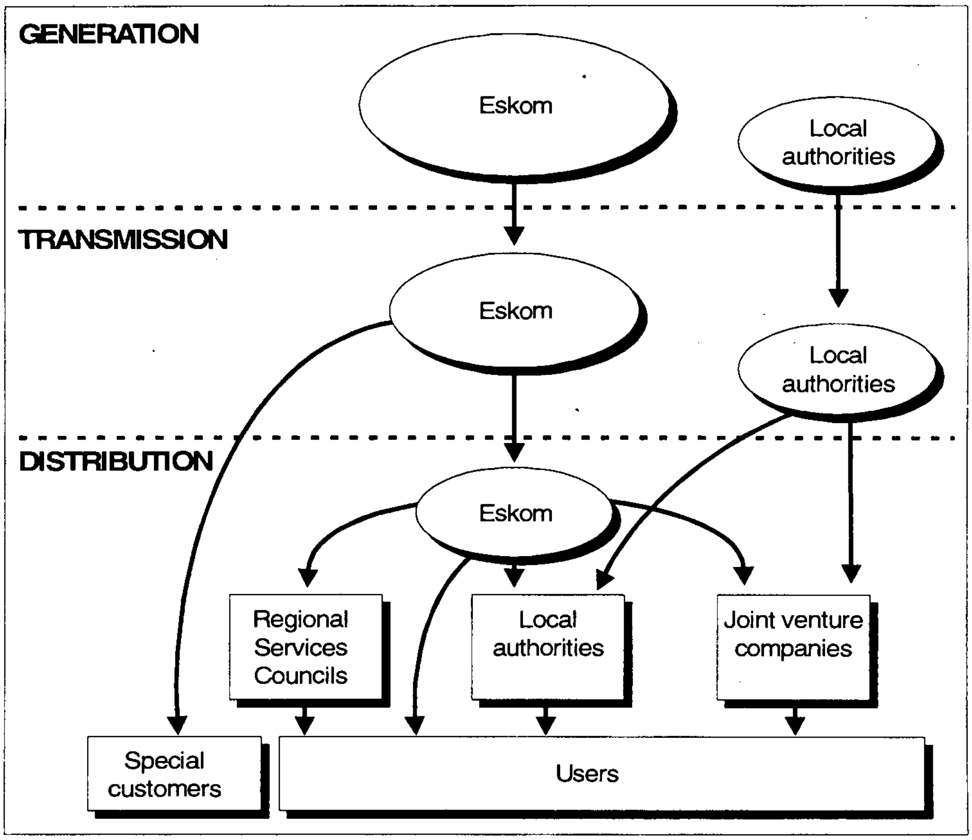

Figure 4.3.1: Structure of the electricity supply industry in South Africa

The backbone of the middle layer is the Eskom owned national grid which links all major power generating systems in the country to electricity distributors and large customers. It also has links to all neighbouring countries. Eskom generates about 95% (DMEA 1996b) of the electricity for distribution, with some large municipalities providing the balance. While the generation and transmission systems are well organised and efficient by world standards the lower layer in figure 4.3.1, the electricity distribution industry (EDI), is highly fragmented. About 400 separate distributors, ranging from Eskom through large metropolitan councils to small transitional management boards, are responsible for supply of electricity to consumers.

The re-structuring of the EDI has been affected by the re-structuring of apartheid local government which had wealthy white local authorities running profitable electricity distribution departments and 100% household electrification along side politically and economically impoverished black local authorities often with no households electrified in their areas. The white local authorities usually included the commercial and industrial areas within their jurisdiction and showed large surpluses on their electricity accounts. This annual surplus of some R1.7 billion is a key factor in the transformation of the EDI as it has historically been used by the previously defined white local authorities to subsidise other services.

Re-structuring of the industry

The need to overcome the lack of access to electricity by the majority of South African households has been recognised as a key element in the social and economic renewal of South Africa in the post-apartheid period. A range of electricity industry stakeholders, including the government of the day, formed the National Electrification Forum (NELF) in 1992. The NELF analysed the various obstacles to accelerating the national electrification programme and debated policies to overcome these. Following these debates certain recommendations were put to the Cabinet, an important component of which was a proposal to empower the existing Electricity Control Board (ECB) to regulate the entire ESI. This newly empowered National Electricity Regulator (NER) came into being on 1 March 1995. The NER has had considerable difficulties in its first period of operation. This led to the establishment of another policy advisory body, the Electricity Working Group (EWG) which is dealt with briefly at the end of section 5.1.1. on Electricity Governance.

Eskom

Before describing the different layers of the ESI in more detail it is useful to provide a description of Eskom because of it pervasive presence in all three layers. It is the world's fourth largest electricity utility, with an installed generating capacity of 39 000 MW. In 1994 it produced the cheapest electricity in the world (Van Horen 1995). The national electricity utility is the largest and most significant of energy institutions in South Africa, with fixed assets (in 1994) of R73 billion, revenue of R15.4 billion, a net income of R2.3 billion and 42 000 employees (Eskom 1994).

Eskom (originally the Electricity Supply Commission) was established in terms of the Electricity Act of 1922 and was controlled by a commission appointed by the State President. It is currently regulated by the 1987 Eskom Act and also by the 1987 Electricity Act. It is controlled by the Electricity Council which is appointed by the government according to specific categories defined in the Act.

While Eskom does not have an exclusive right to generate electricity (some industries and municipalities have their own generation plant), it has a practical monopoly in bulk electricity sales. In 1994 it supplied 9% (DMEA 1996b) of electricity in South Africa. Eskom operates the integrated national high-voltage transmission system and supplies directly to large consumers such as mines, mineral beneficiators and other large industries. It also supplies directly to commercial farmers and recently, to a large number of residential consumers. It sells electricity in bulk to local municipal authorities who in turn distribute to industry, commerce and residences within their municipal boundaries. It has also recently been made responsible for the national rural electrification programme.

Although Eskom is a public corporation, it is largely self-financing, through internal reserves and external borrowings. An exception regarding this financial autonomy, occurred in the form of *ad hoc* subsidies made available by the DMEA over the years for the electrification of remote commercial farms.

Eskom plays a significant role in the economy. This is particularly apparent if one examines the record of GDFI in the 1970s and early 1980s. During this period strong growth in GDFI by public corporations, except for a marginal lapse in 1976, was largely attributable to Eskom as can be seen in the figure below. Significant investments undertaken by Eskom included the commissioning of the Kriel (3 000 MW) and Arnot (2 100 MW) power stations in the period 1975-1977; the Matla (3 600 MW), Duvha (3 600 MW), Lethabo (3 708 MW) and Matimba (3 990 MW) power stations in the period 1977-1985.

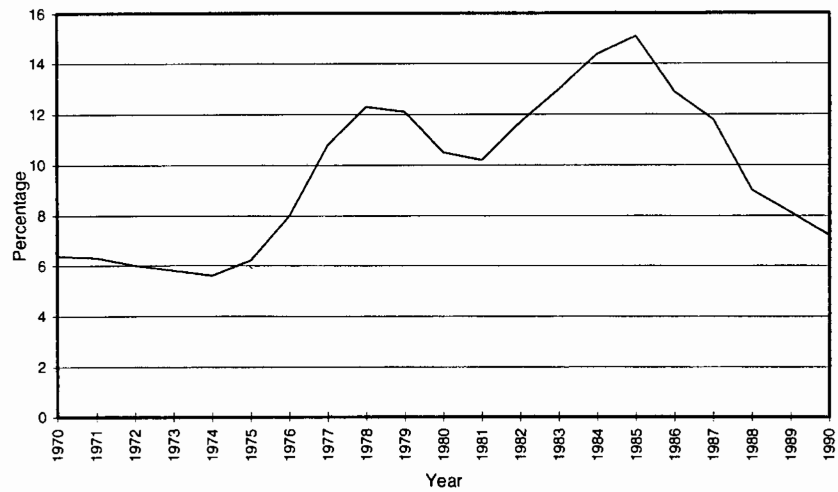

Figure 4.3.2: Contribution of investment in the electricity sector to total South African GDFI (Eskom 1992)

By the middle of the 1980s, however, it became apparent that Eskom had over-estimated the demand for electricity in South Africa, as is apparent in figure 4.3.3 below. Existing project plans, specifically the Majuba and Kendal projects, were deferred and the drop in investment from 15 % of GDFI to about 6 % by 1992 had a significant effect on South Africa's macro-economy and on the local construction industry.

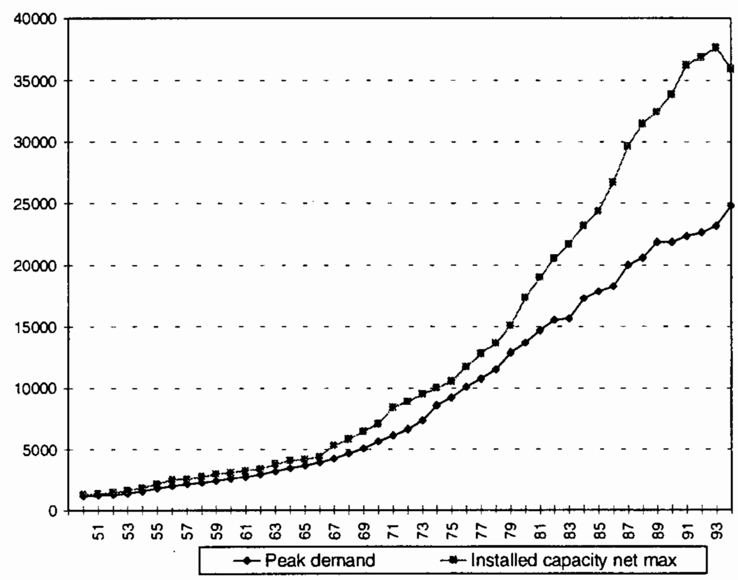

Figure 4.3.3: South African electricity generation capacity vs demand (Eskom annual reports)

An indication of the relative sizes of power station investments in South Africa is that the largest single current project in South Africa in 1995 in terms of capital investment is the Majuba power station which will have a nominal capacity of 4 149 MW. The total value of the project is R9.1 billion. The first of Majuba's six generating units is due to be commissioned in April 1996 with the final to be brought on line by the beginning of the next century. This rather more restrained style of investment is in contrast to the history of building six large power stations in the period 1975 to 1985.

Eskom value added

Another indication of Eskom's impact on the macro economy is the measure of "value added" by the parastatal. Table 4.3.1 below shows salient figures.

VALUE CREATED	1994 Rm	%	1993 Rm	%
Revenue	15 417		13 793	
Less: Cost of primary energy, materials and services	4 991		4 554	
SUB TOTAL	10 426	100	9 239	100
VALUE DISTRIBUTED				
To remunerate employees for their services*	2 868	28	2 562	28
To providers of finance for monies borrowed	3 186	30	3 147	34
	6 054	58	5 709	62
VALUE RETAINED				
To maintain and develop operations	4 372	42	3 530	38
	10 426	100	9 239	100

* Excluding capitalised manpower costs: 1994 (R297 million); 1993 (278 million)

Table 4.3.1: Eskom value added statement (Eskom 1994a)

Value created increased by 13% over 1993. Similarly, value distributed to employees increased by 12% during the same period. The value retained in the business for the replacement of, and addition to, assets has increased to 42%, which remains relatively high.

Eskom's financing

Eskom is largely self-financing through internal reserves and debt.

	Rm (1994)
Net interest bearing debt	27 884
Interest free liabilities	2 637
Reserves	16 105
Debt-equity ratio	1.73

Table 4.3.2 Eskom financing (Eskom 1994a)

Eskom's funding is managed in a single pool consisting of debt and investments made up as follows:

	Rm (1994)
Interest-bearing debt	33 154
Local registered stock	21 696
Other local debt	4 813
Foreign debt	
- Bonds and loans	4 315
- Project finance	2 330
Less: Investments	5 270
Net interest-bearing debt	27 884

Table 4.3.3: Eskom funding 1994 (Eskom 1994a)

Eskom has continually managed to attract finance on extremely favourable terms. The benchmark "Eskom 168" stock repayable in 2008 has an 11% coupon rate.

Eskom is exempt from paying income tax and, while VAT is payable on electricity, Eskom's contribution to the fiscus is limited. It is able to retain its full surplus which amounted to R2 268 million in 1994, a real return on assets of 4.3%. The surplus is retained as reserves.

Eskom employment

Employment by Eskom has dropped significantly from a peak of 66 000 in 1985 to 39 760 at the end of 1994 as shown in figure 4.3.4 below. This has occurred despite a 33 % increase in electricity production and a large increase in the number of customers, particularly household customers who require higher service levels per kWh sold.

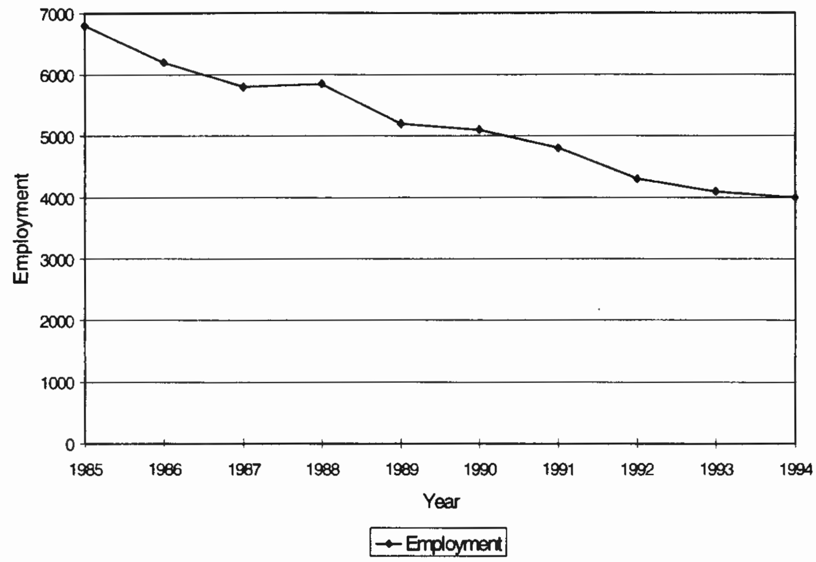

Figure 4.3.4 Eskom employment (Eskom 1994b)

Divisionalisation of Eskom

Eskom plays a significant role in generation, transmission and distribution. With efficiency improvements (evidenced by, for example, the employment figures shown in the figure above and a number of restructuring exercises) have come suggestions that Eskom separate its generation, transmission and distribution/sales functions. Current Eskom annual reports give a breakdown of these components in some aspects such as investment in plant. However, Eskom retains a high level of vertical integration (from outside measures a least). The rest of the electricity section now deals with each of these layers. However, information on revenues, profit levels or returns on assets for each of these levels is not immediately apparent from published data and so in many cases informed estimates will need to be made. Also, in many cases data for Eskom is readily available whereas data from the fragmented EDI is inconsistent.

4.3.2 Electricity generation

Table 4.3.4 below shows the main sources of South African electric power. The contribution of small coal-fired stations operated local authority electricity departments is not included. The map below shows the location of the main power stations

No.	Generation	1994 production (GWh)	%	Net max. capacity (MW)	% of capacity
12	Coal	148 003	94	31 744	88
2	Hydro	1 074	<<1	600	2
2	Pumped storage	1 517	<1	1 400	4
2	Gas turbine	2	<<1	342	1
1	Nuclear	9 697	5	1 840	5
	Total	160 293	100	35 926	100

Table 4.3.4 South African power generation mix - Eskom power stations (Eskom 1994)

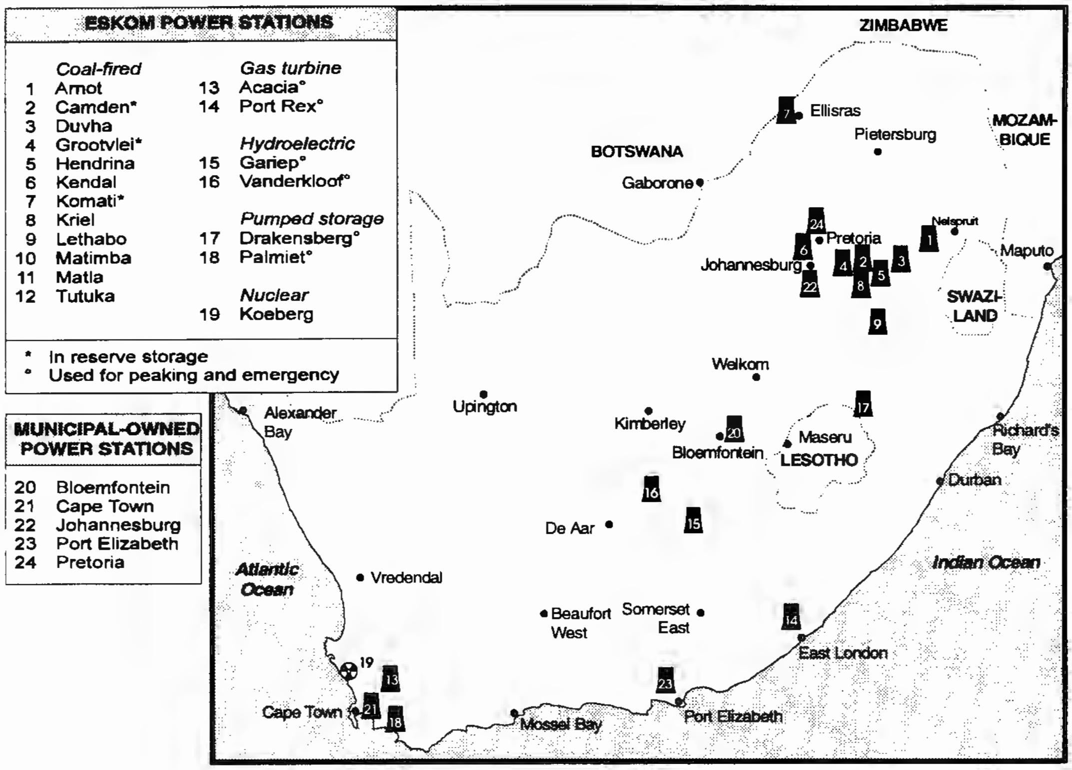

Figure 4.3.5 Map showing South African base-load power stations (EDRC map)

In South Africa, electricity is produced mainly from coal, with smaller amounts from nuclear, pumped-storage and hydro-electric power stations (1%), and very small amounts from stand-by gas turbines, diesel and petrol generators and photovaltaic panels. At the end of 1994 Eskom had 4 110 MW of generating plant on order and an equivalent amount of plant has been mothballed. The peak demand on the integrated Eskom system was 24 798 MW, an increase of 7% over 1993 but still indicating significant overcapacity in generation. However, demand is expected to grow by 6 000 MW p.a. over the next few years.

	Maximum simultaneous one-hour demand of total Eskom system MW	Date	Time
1994	24 798	26.07.94	19:00
1993	23 169	22.06.93	19:00
1992	22 640	08.07.92	*19:00
1991	2 342	21.06.91	09:00
1990	21 863	29.06.90	09:00
1989	21 871	21.07.89	09:00
Increase 1993-94 %	7.0		
Average yearly increase 1989-94 %	2.6		

*Note the shift to an evening peak reflecting the growing importance of household demand.

Table 4.3.5 Maximum demand on the Eskom system since 1989 (Eskom Statistical Yearbook 1994)

Electricity from coal-fired power stations

The abundance of coal reserves and low coal prices in South Africa results in most electricity being generated from coal. (Information on coal supplies to power stations is contained in section 4.1. on coal.) Eskom operates 12 coal fired power stations. In 1994 six power stations were decommissioned or disposed of. Its newer power stations comprise six turbo-generating sets each with installed ratings totaling 600 MW and more. They are generally located adjacent to dedicated coal mines. In 1994, Eskom burned 76.8 million tonnes of coal (45% of South Africa's coal output) at an average of 0.52 kg coal per kWh sent out. Eskom has developed expertise in the use of low-grade coal for power generation and the average energy content of the coal is

20.09 MJ/kg, not very much higher than fuelwood. The average cost of coal burnt was R29.98 per ton in 1994. The average thermal efficiency at Eskom power stations has increased from 30.5% in 1982 to 34.4% in 1994.

Most of Eskom's coal power stations are Mpumalanaga. Declining availability of consolidated coal fields, increased air pollution and water scarcity are becoming serious constraints to further development of very large coal-fired stations. Eskom has pioneered the development of dry-cooled power stations and its Kendal plant, near Witbank, is the largest indirect dry-cooled power station in the world (Eskom 1991).

Electricity from nuclear plants

Koeberg, South Africa's 1930 MW nuclear power station, is situated 30 km north of Cape Town and was commissioned by Eskom in 1984. On Eskom's own admission, it is very much more expensive than coal-fired stations and was built more for strategic than other reasons. Koeberg technology is based on the French pressurised water reactor system and reprocessing of expended fuel is undertaken in France. Low-and-medium level waste is buried in trenches at Vaalputs in the desert expanses of the Northern Cape, but no solution has yet been proposed for storage of high-level waste returned from France.

Electricity from pumped storage and hydro-electric power

Eskom's two hydro-electric power stations at the Gariep and Vanderkloof dams on the Gariep river (DMEA 1996b) have a sent-out rating of only 540 MW.

South Africa pumped storage schemes are used to provide electricity at peak demand periods. Water is pumped from a lower to a higher reservoir during periods of low demand and then run down through a hydro-electric turbine during periods of peak demand. Eskom's two pumped-storage stations (Drakensburg and Palmiet) have a sent out rating totaling 1 400 MW. The Cape Town City Council has a 90 MW pumped storage system at Steenbras.

A very small number of micro hydro-electric systems are installed on farms on the Eastern Transvaal escarpment, the Drakensburg foothills and the coastal belt from the Eastern Cape to KwaZulu-Natal.

Electricity from gas turbines and diesel and petrol generators

In the South African electricity supply system, gas turbine power stations are only used as stand-by units. Eskom's units have a sent out rating of 342 MW (DMEA 1996b) and are run for a few hours each year. They are able to come into instantaneous operation in the event of emergency failures elsewhere on the network.

Petrol and diesel generators ranging from less than one Kilowatt to a few Megawatts supply electricity in areas remote from the national electricity grid and also provide stand-by emergency power in mines, industry and institutions such as hospitals. Households in informal settlements also use small generators to produce electricity.

Electricity from renewable energy sources other than hydro-electricity

In areas remote from the grid, renewable energy technologies, particularly photo-voltaic (PV) systems, are increasingly cost-effective. Typical examples are power requirements for telecommunications, remote farm homesteads, water-pumping, vaccine refrigeration and educational television. Many thousands of small home-lighting kits have been sold. It is estimated that photovoltaic installations in South Africa total approximately 3 MW. Electricity from wind generators and biomass gasifiers is negligible and installations can be counted in tens rather than hundreds or thousands, although there are hundreds of thousands of windmills pumping water on farms, even in areas of fairly low wind potential.

The government has recently announced a programme to provide PV systems to 2.5 million rural households, 16 000 schools and 2 000 clinics. Eskom is playing a major role in this. It is a new area of business for Eskom and between 1995 and March 1996, 24 schools had been electrified using PV. Further 800 are planned to be contracted by March 1996. (Engineering News, 16 February 1996).

Generating system assets

Eskom values its generation plant at R29.6 billion (at historic cost) and R20.9 billion (depreciated) in its 1994 balance sheet. However, this is not a fair reflection of the amount invested in the assets because of the high inflation rates which have been experienced since the construction of much of the plant. If one uses the cost per MW of capacity at Eskom's latest

Majuba plant, a figure of R2.5 million/MW could be estimated as replacement cost for Eskom's generation system asset. Applying this to total capacity of 33 568 MW for Eskom's coal-fired stations would yield a replacement cost of approximately R80 billion. This exceeds Eskom's total net asset value in its current value balance sheet.

Employment in the generation industry

In 1990 a total of 20 500 people were employed in the electricity generation industry: 19 000 (Eskom 1991) at Eskom stations and 1 500 (CSS 1990) at municipal generation stations.

Electricity prices

Because of the fragmentation of the electricity distribution industry more than 2 000 tariffs are in operation in South Africa. A national tariff has been proposed as one of the necessities to achieve a more rational and equitable industry and to facilitate the achievement of the goals of the national electrification programme. Households and small businesses are largely the victims, and beneficiaries, of the current arrangement which still reflects apartheid-style allocations. For instance, it is common for households in the old white mid-to-high income local authority areas to pay less per unit for their electricity than household customers in the newly electrified old black low-income local authority areas.

Larger users are generally in a better position to negotiate electricity prices which reflect the costs of supply (or better). Because South African costs are amongst the lowest in the world, large users benefit greatly and low electricity prices are seen as often providing an important competitive advantage to South African industry. For example a recent large-scale aluminum smelting plant uses imported feedstocks and local electricity to produce aluminum for the export market. In a sense this can be seen as exporting low-cost electricity.

However, South African government regulations have not caused the internalization of environmental costs that has become mandatory in many industrialised countries. Emissions from South African power stations exceed limits that often apply in the industrialised countries, and were South Africa to apply these limits, electricity prices would be raised considerable. Figure 4.3.6 below shows South African bulk electricity prices compared to those of a number of other countries.

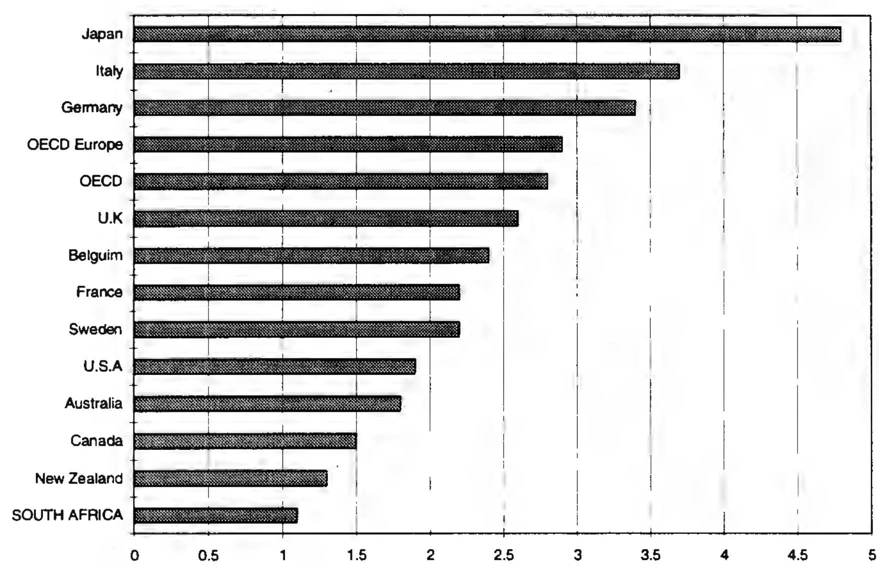

Figure 4.3.6 International comparison of South African bulk electricity prices (Dutkiewicz 1994)

As noted before, in section 4.1 on coal, the most important factor contributing to low electricity prices is the low price of South African coal. Figure 4.3.7 below shows the trend in prices of coal for Eskom power generation. After a significant rise after 1973 (also the year of the oil price shock) a variable price has changed to a low stable price. Eskom enters into long-term contracts with suppliers and is often in a strong monopsonistic position - real prices to Eskom have decreased since 1988.

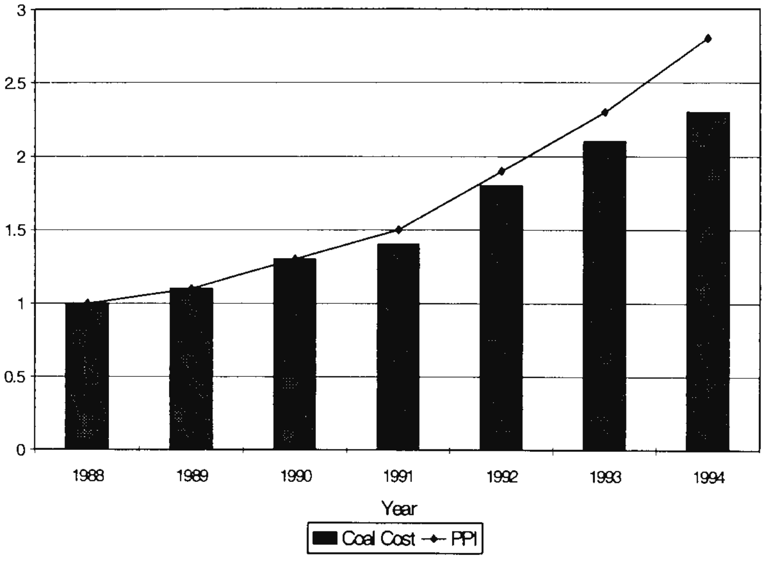

Figure 4.3.7 Eskom coal cost versus production price index (PPI) (Eskom 1994)

Figure 4.3.8 below shows very clearly the cost benefits enjoyed by South Africa electricity generation from coal.

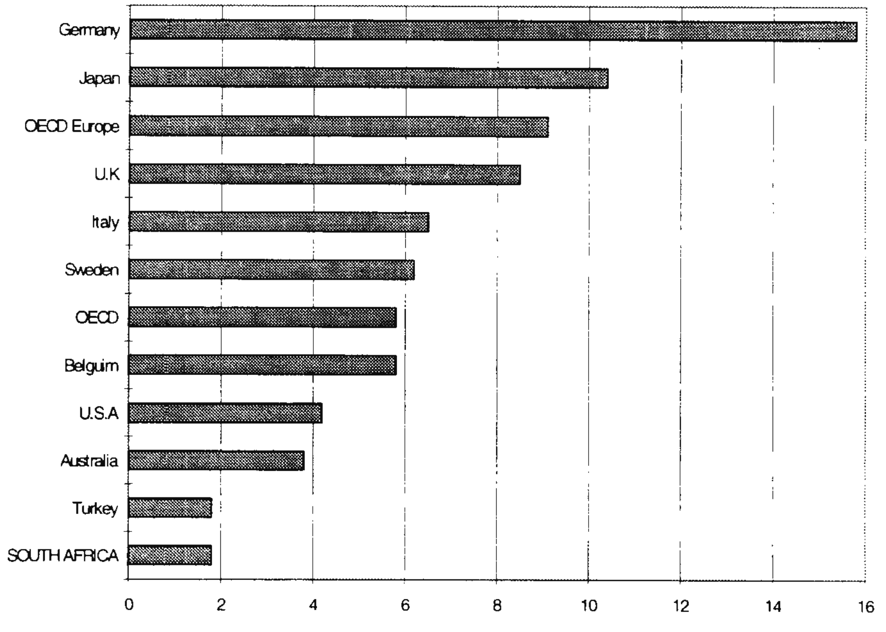

Figure 4.3.8 International comparison of coal prices for electricity generation (Dutkiewicz 1994)

4.3.3 The electricity transmission system

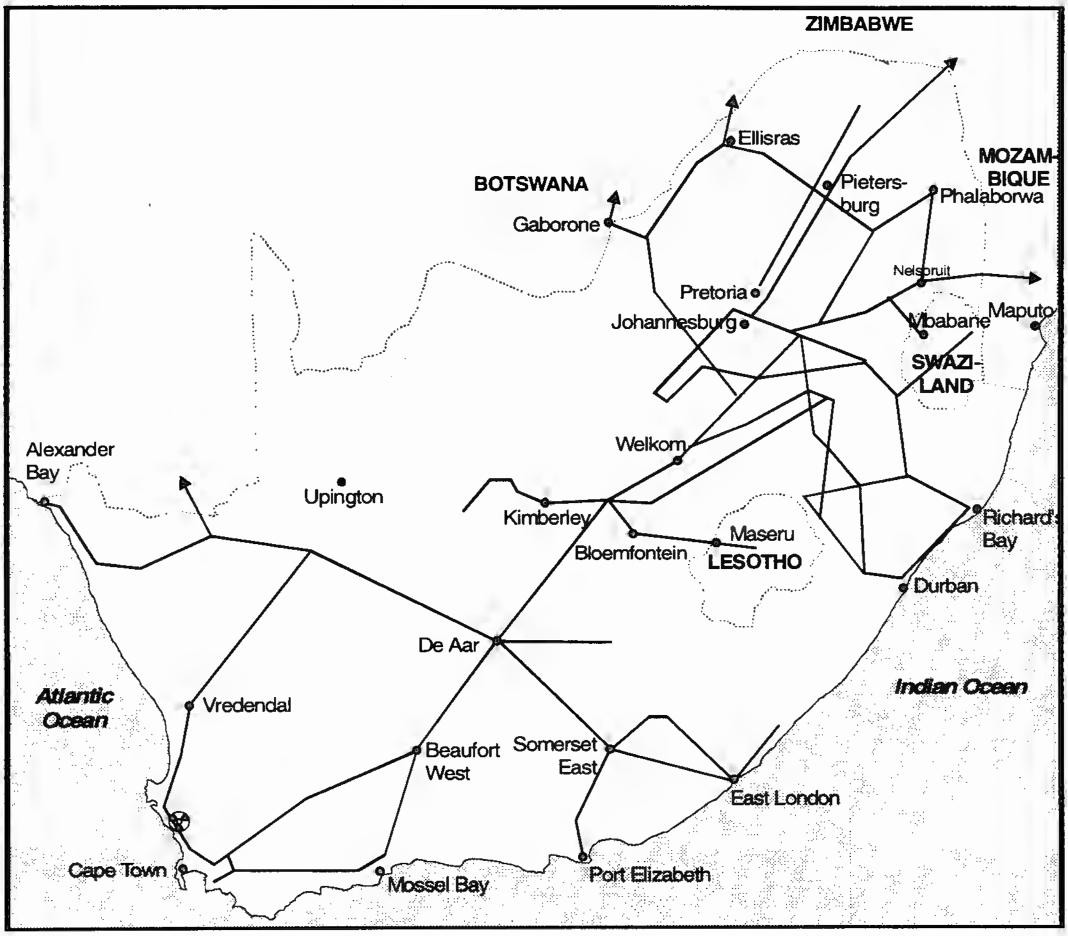

Figure 4.3.9 Map of the national electricity grid (EDRC map)

Eskom owns and operates the national electricity grid. The main transmission system which connects the power stations, large urban and industrial areas and all neighbouring states is shown in the map above. This system consists of lines operating from 132 kV to 765 kV, consists of a total of 25 181 km of transmission lines. Eskom has been the first utility in the world to successfully operate transmission lines at 765 kV at high altitudes above sea level (Eskom 1994a).

The primary distribution system operating from 33 kV to 165 kV consists of 38 122 km of lines and the reticulation system operating at 22 kV and below adds a further 176 154 km to give a total of 239 457 for the Eskom national electricity grid. Further details are given in the table below.

		1994
Main transmission system, km	765 kV	1 153[3]
	533 kV DC (monopolar)	1 031
	400 kV	13 930
	275 kV	7 220
	220 kV	1 243
	132 kV	604
Total		**25 181**
Distribution	165-132 kV	17 483
	88-33 kV	20 639
Total		**38 122**
Reticulation lines, km	Total 22 kV and lower	176 154
Total all lines, km		239 457
Cables, km .	165-132 kV	60
	88-33 kV	272
	22 kV and lower	5 509
Total all cables, km		**5 841**

Table 4.3.6 Transmission and distribution equipment in service at 31 December 1994 (Eskom 1994a)

Investment in the electricity grid

Eskom gives a value of R5.2 billion (at historic cost), R3.6 billion (depreciated) in its balance sheet for the transmission system. Data on revenues from operation of the grid, return on transmission assets and the basis for tariffs are not readily available.

The distribution system is valued at R8.9 billion (historic cost), R6.8 billion (depreciated). Assets in distribution include the investment in reticulation made as part of the national RDP electrification programme.

R billion	Historic cost	Depreciated
Transmission	5.2	3.6
Distribution[2]	8.9	6.8
TOTAL	14.1	10.4

Table 4.3.7 Summary of Eskom transmission and distribution investments and assets (Eskom 1994a)

A considerable investment has also been made in reticulation by electricity distributors other than Eskom. Accurate figures of the value of this investment are not readily available but it is possible to make estimates for this part of the electricity supply system. This will be done in dealing with the EDI later.

Operation of the transmission system

Eskom 1994a reports that the transmission system exhibited an acceptable quality of supply in 1994. Figure 4.3.9 below shows the low-frequency incidents history for the system and figure 4.3.10 the total transmission system interrupt time. Eskom also reports that supply failures cost it the equivalent of 4% of total annual sales (Business Day, November 24, 1995) .

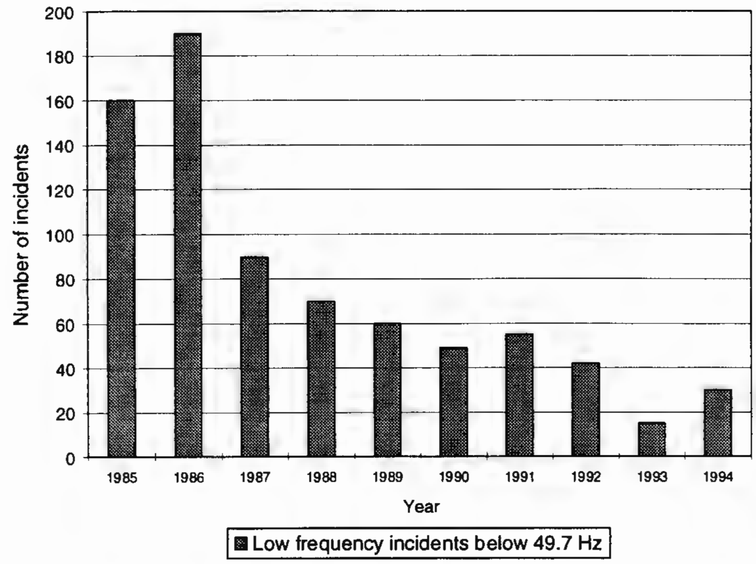

Figure 4.3.9 Low frequency incidents on Eskom grid (Eskom 1994b)

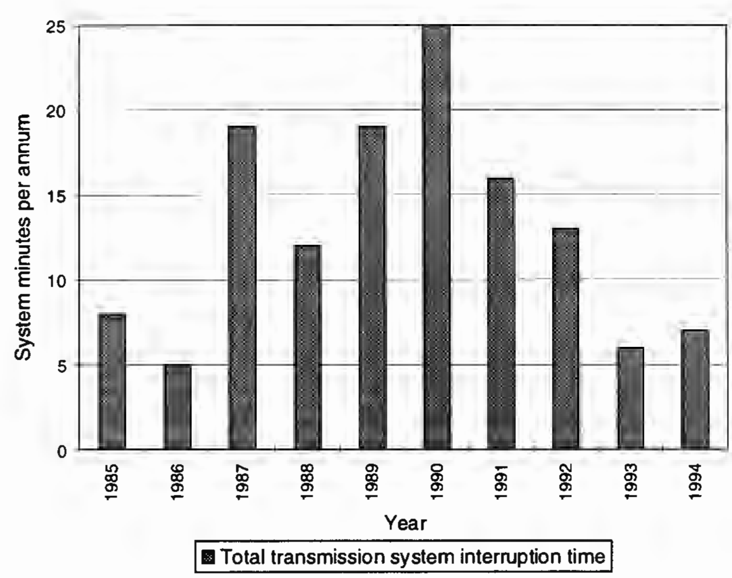

Figure 4.3.10 Total transmission interruption time (Eskom 1994b)

4.3.4 The electricity distribution industry (EDI)

The right to supply electricity

The history of electricity supply in South Africa is one of gross inequity based on race. The most important issue for the electricity distribution industry (EDI) in the post apartheid reconstruction period is the restructuring of the EDI to address this past inequity. Chapter 5, section 5.2.2 details the constitutional, legal and regulatory situation regarding this restructuring. The section concludes (repeated here):

The position with regard to the supply of electricity within local government areas is as follows:

1. Local government bodies (TMCs, TLCs, and LGCCs) have the right to supply electricity within their areas of jurisdiction provided that they acquire a license from the NER to do so. The NER is the body which determines whether local government bodies can meet the criteria to supply set out in the Constitution, the Local Government Transition Act and also comply with the NER's own licensing criteria.
2. Eskom or any other private undertaker can acquire the right to supply electricity within any local government area with the consent of such local government and provided further that they obtain a license from the NER to do so.
3. Where Eskom or any private undertaker wishes to acquire the right to supply electricity within any local government area and the local government body unreasonably withholds its consent, the NER has the power to decide the issue and has the power (on good cause) to dispossess the local government body of its rights to supply.
4. TMCs have now acquired the right to the bulk supply of electricity provided that the NER licenses the TMC accordingly. (This is necessary because the TMC is a new concept which had to be specifically catered for).

The position about the right to supply is confusing especially because conflicting rights are possible. The whole issue around rights to supply will have to be clarified in future legislation.

On 1 September 1995, 398 electricity distributors were licensed by the newly instituted National Electricity Regulator (NER 1995). The composition of this group is as follows:

Number	Institutions
1	Eskom
362	Local government
7	Joint service boards, regional councils
7	Provinces
13	Privately owned (e.g. Tongaat Hullet, Mines, Sasol, AECI - largely supply to themselves)
5	Previous homeland and self governing territory utilities - being taken over by Eskom
3	National government distribution
398	**Total**

Table 4.3.8 Electricity Distributors in South Africa (NER 1995)

The total number of customers for Eskom and the other distributors is estimated in table 4.3.9 below based on figures from (DMEA 1992) (National Electricity Regulator 1995), and (Eskom 1994b).

	Eskom	Other	Total
Domestic	1 053 725	2 177 464	3 231 189
Farming	125 864	7 000	132 864
Commercial	20 112	149 888	170 000
Industrial	5 707	19 293	25 000
Other	1 645	46 355	48 000
Total	1 207 053	2 400 000	3 607 053

Table 4.3.9 Electricity connections in South Africa (1994) (Eskom 1994b, NER 1995, DMEA 1992)

The total number of connections is expected to increase by more than six million connections between 1992 and 2012 if the RDP electrification programme succeeds. The programme will increase the number of connections by more than 100 % since before the programme started.

Distributors other than Eskom had revenues of R9.8 billion in 1994 of which R1.75 billion was profit (NER 1995). Separate figures just for the distribution component of Eskom are not available.

The asset value for the distribution industry is difficult to calculate from available data. Eskom's investments in its transmission and distribution network have been detailed earlier. If one values the non-Eskom reticulation system at the number of connections multiplied by the average cost of a connection in the 1994 electrification programme one gets R3 176 connection (Eskom 1994 b) multiplied by 2 177 464 (from the table above) to get roughly R7 billion as the replacement cost.

Non-Eskom distributors employ approximately 18 000 people and Eskom employs 18 000 people in distribution, making a total of 36 000 employees in the EDI.

Electrification programme

Electrification					
	1992	1993	1994	1995	Inception to date
Eskom	145 522	208 801	254 383	313 179	921 885
Farmworkers**	12 698	16 074	16 838	15 134	60 482
Local authorities	62 214	91 222	129 951	118 173	401 560
Other	12 121	16 074	34 584	32 281	95 060
Total	232 555	331 909	435 756	478 767	1 478 987

** 1992 figure is connections from January 1991 to December 1992

Table 4.3.10: Electrification progress (NER1996)

The national electrification programme is aimed at addressing the lack of access to electricity of most homes in areas previously defined as black. In the long term the plan aims to provide an additional 6.3 million household electricity connections between 1992 and 2012. (Engineering News, February 16, 1996). Eskom plans to provide 4.2 million of these with other distributors providing the balance.

The table above shows the progress of the electrification programme to date. Eskom has connected about 950 million houses since 1991, accounting for 75% of the total. Figure 4.3.11 below shows plans for the programme until 1999. Eskom plans to continue with a rate of 300 000 connections p.a. and other distributors are expected to step up their programmes to 150 000 p.a. as difficulties with local government re-structuring are overcome.

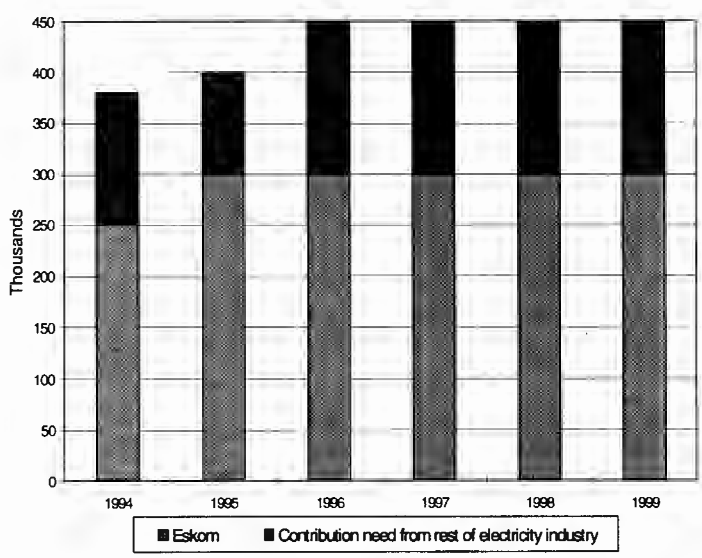

Figure 4.3.11 RDP electrification plans (Eskom 1994b)

Photovoltaic) off-grid supply to rural areas

In October the government announced the initiation of a programme to use PV systems to electrify 2.5 million rural homes by 2015. Refsa, a newly created wholly owned subsidiary of the CEF, will coordinate the project. The programme is to be financed using a revolving credit principle. Programs are also underway to use PV to electrify 16 000 rural schools and 2 000 clinics. By March 1997 plans are for another 3 200 schools to follow and then for 3 000 schools to be done yearly after that. (Engineering News, February 16, 1996)

4.4 The South Africa nuclear energy industry

In some respects the nuclear energy industry could be regarded as unimportant in South Africa. For instance nuclear energy provides less than 1 % of South Africa's primary energy consumption. In other respects the industry has drawn a lot of attention. In the apartheid era, during which South Africa's Atomic Energy Corporation (AEC) was associated with the manufacture of nuclear bombs the AEC was allocated up to 92% of the DMEA's budget. Even in 1995/1996 the AEC receives R489 million (69%) of the DMEA budget (Auf Der Heyde 1995), and representation on the AEC board of directors of nine members includes the chairperson of the Central Energy Fund, the deputy Director General of the DMEA and the CEO of Eskom, indicating its strong links with the energy sector (AEC 1995). Also the total investment in the industry since 1930 is estimated at R40 billion (Kantema 1995) with the parliamentary budget for the AEC (or its predecessors) accounting for R22 billion since 1971 (Van Horen 1995).

Thus, despite the low contribution of nuclear energy to South Africa's energy needs, huge past investments in the local industry, the current state nuclear budget, and the future of nuclear energy warrant a description of the situation in South Africa, as part of the energy sector.

The South African industry can be seen as covering three areas. The area which has received most investment involves nuclear fuels: from uranium mining through enrichment, fuels fabrication through to waste disposal. This is the area that will be focused on. The second area, associated with the supply of energy to consumers is nuclear electric power generation. This is touched on here but dealt with more specifically under the electricity section as it is seen as just one of many options for electric power generation for South Africa. The third area, namely high-technology spin-offs from the South Africa nuclear industry is not seen to be within the ambit of the energy sector, and thus the reader is referred to the AEC-2000 (AEC 1995) for information in this regard.

This section must also begin with an acknowledgment that the nuclear industry, both locally and internationally, is the subject of extremely robust debate. Views and often "facts" presented in this debate differ widely. Because information presented by exponents of opposing views in the nuclear debate is often conflicting a description of the sector, which is the aim of this document, is problematic.

This problem has been dealt with in the following way. The section essentially consists of material drawn directly from sources which could best be described as being on the one hand, critical of the arrangement of South Africa's nuclear industry and on the other hand, supportive of the existing industry arrangement. It is hoped that this provides the reader with two sets of information which compliment rather than confuse each other. The author has, however, taken the prerogative to provide a summary to conclude the section.

4.4.1 Brief history of South African nuclear fuels industry[3]

South Africa's nuclear involvement began in the 1940s, when the country was asked by the Allies to investigate uranium deposits with a view to supplying the Manhattan atomic bomb project with uranium. By 1950, South Africa agreed to supply all its uranium product to the US and UK for weapons purposes, and in 1952 the first full-scale uranium extraction plant was opened. In 1967 Nufcor was established when the state ceded all uranium resources back to the private owners. The South African nuclear industry formally came into being with the establishment of the Atomic Energy Board (AEB) on 1 January 1949, and in 1961 the AEB occupied its present site at Pelindaba. Apart from lobbying for the establishment of a local nuclear power programme, the AEB was also involved in operating the country's SAFARI research reactor, and in conducting research into enrichment techniques. In 1969 the Cabinet approved funds for a pilot enrichment plant (the so-called Y-plant). A year later the development of an indigenous new enrichment process was announced, and the Uranium Enrichment Corporation (UCOR) was formed. Construction of the Y-plant began in 1971, although it was apparently commissioned only seven years later. Apart form a halt in production between 1979 and 1981, operation continued until 1989. By 1974 the AEB's brief had been expanded into supplying military technology, when the Prime Minister's ad hoc committee decided to construct nuclear weapons using enriched uranium from the Y-plant, and in 1977 the AEB was issued with instructions to meet Eskom's future fuel requirements.

[3] The production of this section is with acknowledgment to Dr. Thomas Auf der Heyde for the supply of much of the information. Much of this section is extracted directly from his work (Auf der Heyde 1993).

The AEB commenced construction of both its present conversion plant and the "semi-commercial" enrichment (Z-) plant in 1979, and a year later also started work on the fuel fabrication (BEVA = Brandstof Element Vervaardigings Aanleg) plant. First production from the conversion plant came in 1986, while the Z and BEVA plants began production in 1988; in the case of the Z-plant problems were experienced during the commissioning process which stretched over a number of years. The last link in the chain was put in place when the Vaalputs waste repository became functional in 1986, and in the same year the AEC announced plans for a nuclear research facility near the Gouritz river mouth in the southern Cape.

The statal nuclear establishment has been restructured a number of times since its inception as the AEB. In 1982, the AEB and UCOR were converted into two companies - the Nuclear Development Corporation (NUCOR) and the Uranium Enrichment Corporation, respectively - with the Atomic Energy Corporation (AEC) as their controlling body. This year also saw the establishment of the Council for Nuclear Safety (CNS) within the AEC. The AEC was then further restructured when, in 1985, Nucor and Ucor were amalgamated into the AEC. In 1988 the CNS became fully independent of the AEC.

In 1968 a subcommittee of the AEB reported to the Minister of Mines and Planning that a 350 MW nuclear power station would be viable in the Western Cape by 1978. The decision to build the station was pre-empted by Eskom in 1967, when the utility purchased the farm Duynefontein, site of the future power station. The contracts to construct Koeberg were signed in 1976, and in 1984 - after repairs of considerable damage sustained during an ANC attack - the first reactor at Koeberg became operational, with the second following a year later.

Thus, by the end of the 1980's South Africa possessed the major stages in the nuclear fuel chain from extraction of uranium, through conversion, enrichment and fuel fabrication to a nuclear power station and a waste repository.

At present (July-1996) the AEC only supplies conversion services i.e. the conversion of UO_3 to UF_6 to NUFCOR. This increases the value of South African uranium exports. The nuclear fuel fabrication facility (BEVA) is still operational but has just completed a reload and is awaiting a government decision on its future (DMEA 1996b). Uranium mining falls under the auspices of the Nuclear Fuels Corporation of the Chamber of Mines and the Koeberg nuclear power station is owned and operated by Eskom. In the past, the AEC constituted an essential pillar in the Nationalist government's siege economy; it was considered vital to both energy security and military supremacy. As a result, the nuclear establishment received generous state subsidies that peaked at R705 million, or 92% of the Department of Mineral and Energy's Affairs budget in 1987/88.

The largest share of government funds to the AEC has been used to finance the operation of the Nuclear Fuel Production (NFP) division, which operates the conversion, enrichment and fuel fabrication plants at Pelindaba and Valindaba, as well as the Vaalputs waste repository. Of all the NFP services, only the operation at Vaalputs is breaking even, with a turnover of about R3 - 4 million/year. The AEC's Figures reveal that the average production costs at the conversion, enrichment (Z), and fabrication (BEVA) plants during the period 1988-92 were between ten and twenty times the spot market price during the same period, and this excludes the capital costs of the various plant. The most inefficient and expensive of these processes was the enrichment plant, which required operating expenditure in the order of R343 million/year with an income of only R67 million. This led to the closure of the plant in March 1995. (Author's note. Information provided by the AEC (DMEA1996b) records that: "For the 1996 finacial year virtually the whole production was exported at spot market prices. Revenue was 45% of operating costs. This implies a production cost of just two times spot market price and not 10 - 20 times." as stated previously in this paragraph.)

Since 1988, the AEC has been supplying nuclear fuel services to Eskom at prices that are between two and four times higher that the spot market prices. This has meant that Eskom has subsidised the AEC to the tune of at least R220 million over the period 1988 to 1992. The reasons for this procurement policy are not clear. The Nuclear Fuels Corporation (Nufcor) has similarly been obtaining far higher prices for uranium delivered locally, presumably to Eskom to contract with Nufcor for uranium it could have obtained at much lower prices elsewhere.

The AEC had the following comments to make on the aspects of the nuclear fuel chain described above: (DMEA 1996b)

"Enrichment:

During 1993/94 the total operating cost per SWU from the Z-Plant was R485-51. At the time world market prices were: Spot market \$68-83/SWU depending also on whether it was restricted or unrestricted-origin material; medium-term contracts \$90-110/SWU and long-term contracts \$120-170/SWU. Considering only sport-market prices and an exchange rate of R\$3-00/US, the local enrichment production did not look attractive from the economic point of view. In July 1996 with the spot market enrichment price approaching \$100/SWU and an exchange rate of R4-33/US\$ it is still not economical but the picture still looks completely different.

Fuel fabrication:

BEVA has produced 382 fuel assemblies from 1988 to 1996. This represents average production rate of approximately 48 fuel assemblies per annum, or 22t(U)/a. The 1995 price to ESKOM of an AFA2G was approximately R52 million/a at 22t(U)/a i.e. approximately R1 087 000 per AFA2G. The costs to the AEC at these rates were therefore approximately 45% higher than the price to ESKOM. The "world market" price, judged by the competitive tenders received by ESKOM, is approximately 10% below the BEVA price to ESKOM. This will have been reduced by the latest exchange rate jump.

Under current conditions, therefore, one may conclude the BEVA costs are less than 50% above world market prices. This margin was considerably less in the past, because world market prices have come down significantly in recent years.

There is no such thing as a spot market price for nuclear fuel elements although the costs represent only operating costs it must be kept in mind that all facilities were for most of the time running at only 25% of capacity. To quote numbers of ten to twenty times the spot market price excluding capital costs is wrong. It should also be kept in mind that no utility in the world will rely for its nuclear fuel requirements only on the spot market. ESKOM, like any other utility cannot rely on spot market prices. Long-term contracts are usually at higher prices in the nuclear fuel market. Although the AEC is not in economic terms a world competitor performance has not been nearly as bad as indicated (in the paragraphs before this quote - authors comment)". (From DMEA 1996b).

However, the end of the apartheid era also witnessed the beginning of the scaling down of the South African nuclear programme. State funding of the AEC, which peaked at R776 million in 1986/87 (R1.940 billion in 1995 Rands), has been cut to R489 million for 1995/96, of which R175 million is for loan repayments. AEC staff has been cut from approximately 8 200 in 1985 to 2 200. In March 1995 the uneconomic Z-plant was closed down and the Minister of Mineral and Energy Affairs has instructed the investigation of future options for the nuclear fuels industry in South Africa.

4.4.2 The nuclear fuel chain in South Africa[4]

In South Africa uranium is produced as a by-product of gold and is then marketed through Nufcor, which is part of the Chamber of Mines. Most of this uranium is exported as oxide but some is sold locally to Eskom and the AEC, and since 1992 Nufcor has also been exporting small amounts of both natural and enriched UF6. Conversion, and fabrication processes take place at the AEC's Pelindaba complex west of Pretoria, while disposal occurs at its Vaalputs site near Springbok in the north-western Cape. Eskom contracts both Nufcor and the AEC for some of Koeberg's fuel requirements. To this point, all spent fuel from Koeberg has been stored on site, and Eskom has not yet revealed its disposal plans. However, all other radioactive waste has been disposed of at Vaalputs. The Council for Nuclear Safety is responsible for licensing all nuclear transactions and processes, and for overseeing adherence to regulations governing the industry. However, the Nuclear Non-Proliferation Treaty and international safeguards agreements are administered by the AEC.

The Nuclear Fuels Corporation (Nufcor)

Nufcor is the Chamber of Mines' uranium marketing organisation. Its ownership alters from year to year, since the uranium-producing mining houses own shares in it in proportion to the amount of uranium they produce. Uranium-producing mines supply ammonium diuranate slurries to Nufcor's plant near Johannesburg, where they are blended and calcified into exportable concentrates containing U3O8. The plant employs about forty people, while the head office in Johannesburg has a staff of eight which market uranium mainly to utilities in Europe, North America, and the Far East. Nufcor has been marketing South African uranium abroad since its

[4] The production of this section is with acknowledgment to Dr. Thomas Auf der Heyde for the supply of much of the information. Much of this section is extracted directly from his work (Auf der Heyde 1993).

formation in 1967 and, according to data supplied undertook its first local delivery in 1980 (Scorer 1993). By the end of 1992 Nufcor had exported 89 956ktU out of a total production of 94 184ktU, generating an income of R6 498 million. Of the total volume produced, 855tU are unaccounted for in the data supplied, by Nufcor - possibly this amount constitutes inventory held by Nufcor.

South African uranium production has followed international trends fairly closely, peaking in 1980 at 6 082tU, constituting 13.6% of uranium produced by the world outside the centrally - planned economies (WOCA) countries during that year. Since the mid-eighties, however, South African production declined faster than WOCA production, so that in 1991 South Africa production (1 601tU) constituted just less than 6%. The figure below depicts South African uranium production as a function of WOCA production for the period 1970 - 91, while the following figure illustrates the performance of Nufcor prices for exported and locally delivered uranium in relation to the international spot market price. The data for the latter graph were calculated using averaged, annual historical ZAR:US$ exchange rates supplied by the Standard Bank of South Africa, but the rates used for the years prior to 1978 were kept constant.

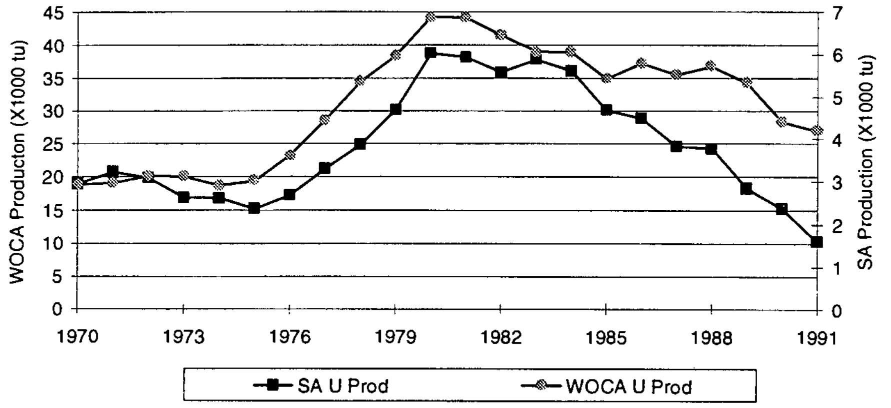

Figure 4.4.1 South Africa uranium production compared with WOCA production (Auf der Heyde 1995)

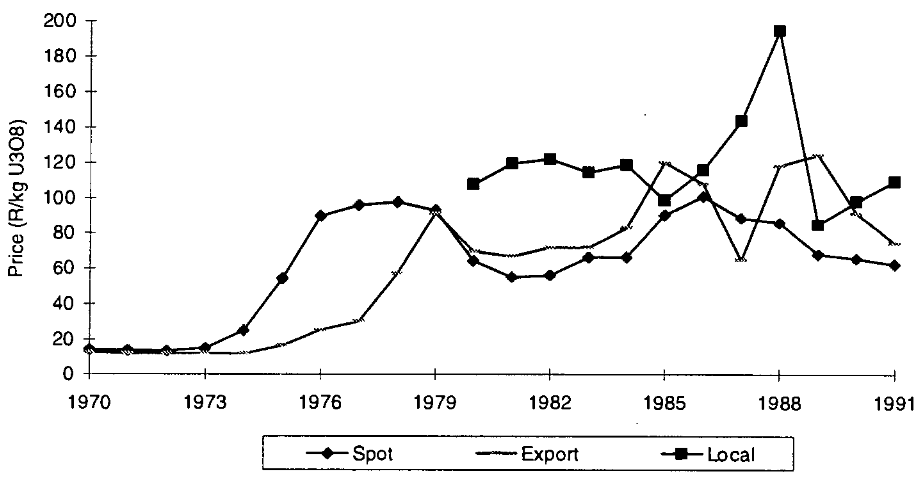

Figure 4.4.2 Local, export and spot uranium prices (Auf der Heyde 1994)

The above figure suggests that Nufcor largely failed to capitalise on the uranium boom of 1973 to 1979, its prices only reaching parity with spot in 1979. Since then, Nufcor export prices have remained marginally above spot, except for the years 1986/87, when its prices dipped below spot, perhaps as a result of an initial panic reaction to the imposition of comprehensive anti-apartheid sanctions in the US. While its performance in the export market has been fairly erratic, Nufcor has performed consistently and remarkable well on its locally delivered product, managing to persuade local consumers to pay premium prices for home-grown product.

Thus, during the years 1980 to 1992 the price of locally delivered U3O8 was on average 71% higher than spot, and 38% higher than the export price. Since there would not appear to be any local consumers of large U3O8 quantities other than Eskom and possibly the AEC, it is fair to conclude that Eskom must have been paying Nufcor at the premium rate estimated above. Bearing in mind the discounted prices offered to Nufcor by the AEC, it is furthermore fair to assume that Nufcor will have reciprocated by supplying the AEC with uranium at prices that do not approach those paid by Eskom. This means that the average 38% increment on the cost to overseas clients, or the 71% increment over the spot price, represent minimum premiums paid by Eskom, with the real prices perhaps being significantly higher than this.

Since Eskom has been extremely reticent about communicating its nuclear fuel requirements or purchases, it is impossible to estimate with any degree of accuracy the quantities that Eskom will have purchased from Nufcor over the past decade. Considering the differential between Nufcor's export prices and those obtained for local delivery, it would certainly appear, however, that Eskom overpaid not only for NFP services from the AEC, but also for uranium supplied by Nufcor. Again, it is unlikely that the real reasons for this unusual procurement policy will become public knowledge. What is certain, however, is that the privately-owned houses profited from this arrangement between one of their businesses and a statal or parastatal corporation. The costs of this arrangement were most likely borne by electricity consumers.

The nuclear fuel production programme of the AEC[5]

Transformation of the AEC's nuclear fuel activities to establish a long-term commercially viable nuclear fuel business.

The management of the AEC's nuclear fuel production portfolio over the past year included the following activities:

- a uranium conversion plant with a name plate capacity of 1 200 ton U per annum which converts uranium oxide supplied by the mining industry to uranium hexafluoride (UF_6);
- a uranium enrichment plant with a name plate capacity of 300 000 Separate Work Units per annum which produces UF6 enriched in the U235 isotope. (this plant was closed down on 31 March 1995);
- a nuclear fuel fabrication plant with a capacity of 100 ton U per annum which produces nuclear fuel assemblies for the Koeberg nuclear power station in the Western Cape as well as fuel elements for the Safari reactor at Pelindaba;
- a national radioactive waste disposal facility, Vaalputs, some 600 km north of Cape Town where low - and intermediate - level radioactive wastes are disposed of; and
- a molecular laser isotope separation programme aimed at the development of new competitive uranium enrichment technology that will, in future, add significant value to South Africa's uranium exports.

The programme to transform the AEC's nuclear fuel cycle activities into a long-term commercially viable nuclear fuel cycle business, showed progress and a number of key objectives were achieved taking cognizance of local and international market developments.

Market trends

The local market for nuclear fuel remained static as Eskom reduced its inventory of first generation fuel in preparation for the introduction of new technology in 1996.

The international conversion service market has recently stabilised to the extent that production capacity and demand are fairly evenly matched. Some sales from inventory do still occur but the spot market and contract prices are now closer matched than before.

The international market for enrichment services remains severely oversupplied.

The market for light water reactor fuel fabrication services is also severely oversupplied (demand is only about 50% of production capacity), and the trend towards higher fuel burn-ups will exacerbate this situation in future.

[5] The following is extracted from the AEC 1995 Annual report.

Notwithstanding these market conditions, the AEC succeeded in a few carefully selected cases in participating in the export market for conversion and enrichment services and as a subcontractor for the manufacture of PWR-nuclear fuel assemblies.

Conversion of natural uranium to uranium hexafluoride

The AEC's conversion plant is operated to produce the natural uranium hexafluoride (UF6) which is either required to feed the AEC's enrichment plant or exported as UF6. This plant has suffered ongoing technical problems since being commissioned in 1986. During the past financial year, a major initiative was launched to identify and rectify its shortcomings. This included plant modifications as well as organisational changes. Operational results achieved in the last quarter of the financial year show an improving trend in plant availability and throughput.

Production and sales

All export contracts were honoured, but the feed of UF6 to the enrichment plant had to be curtailed to a certain degree due to the technical problems experienced in the plant.

During the 1994/95 financial year, production of distilled UF6 amounted to 527 ton U in UF6 which is 17% less than production during the 1993/94 financial year. Total conversion sales for 1994/95 amounted to R11.8 million. Export earnings improved by 165%, leading to a marginal increase in total conversion earnings of about 1% compared to the 1993/94 financial year.

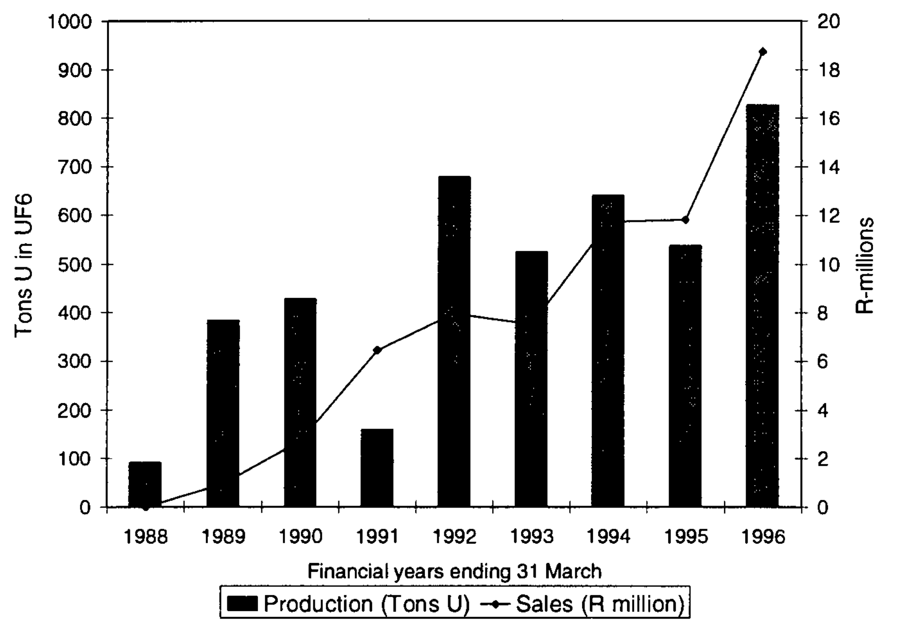

Figure 4.4.3 Conversion - production and sales revenues 1988 - 1995 (DMEA 1996b)

Uranium enrichment: Z Plant

The AEC's semi-commercial enrichment plant, known as the Z Plant, was shut down permanently on 31 March 1995 following a recommendation by the AEC to the government. This decision was the result of the high operating costs of this plant which rendered it non-competitive compared with the international market.

During the 1994/95 financial year, production amounted to 156 471 SWU. This is 20% less than production during the 1993/94 financial year. Revenue from local enrichment sales to Eskom declined by 26.9%, whilst enrichment export showed a healthy 48.5% growth over the past year, resulting in total enrichment sales of R58.5 million, an increase of 4.4% compared to the 1993/94 financial year.

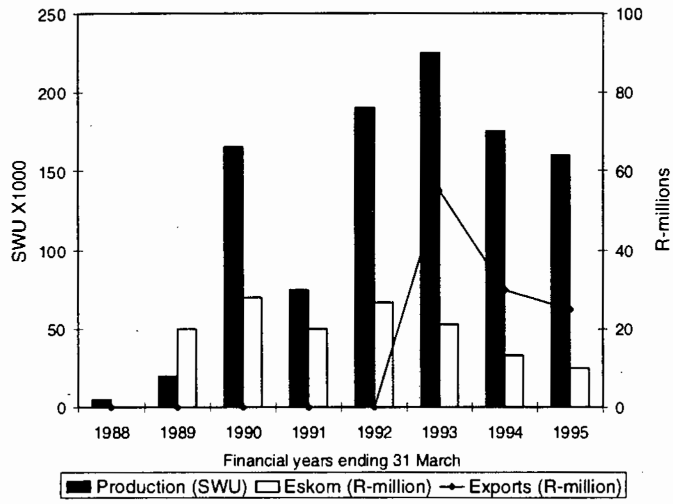

Figure 4.4.4 Enrichment - production and sales revenue 1998 - 1995 (AEC 1995)

Uranium enrichment: molecular laser isotope separation

The AEC has been involved in the investigation and development of new uranium enrichment capability in the form of the molecular laser isotope separation (MLIS) technology since 1986. In view of the limited local demand for enriched uranium in the medium term, the prime driving force behind the development work on the MLIS process is the beneficiation of South Africa's uranium concentrates for increased export earnings. An economic uranium enrichment process would enable South Africa to at least double the value of present earnings by exporting enriched uranium product instead of unenriched uranium.

Construction of the pilot MLIS plant gas loop was recently completed and licensed. The performance of this part of the plant is presently being tested with UF6. Progress with the lasers for the pilot plant is on schedule, but beam instability is causing some delay in the development of the Raman cell. Physical measurement of the cut in the laboratory facility, an important parameter for the economy of the process, is behind schedule, but first encouraging measurements have recently been successfully completed.

Due to the AEC's limited resources and the aim to internationalise this technology, it was decided to continue the programme with the support of an overseas joint venture partner. Negotiations to this effect have been successfully concluded and this development work is now 50% funded by an overseas partner (DMEA 1996b).

Fuel fabrication

The AEC's fuel fabrication plant, BEVA continued production of pressurised water reactor fuel for Eskom's Koeberg nuclear power station. In addition to fuel produced in accordance with the AEC/Eskom contract, the first subcontracted fuel was delivered to Koeberg.

BEVA's technology was also upgraded to meet international trends. This upgrade will allow the burn-up warranty of new generation fuel to be increased by 39% from 33 000 MWd/tU to 46 000 MWd/tU, yielding significant savings to Eskom. Production was started towards the end of the year on the first reload utilising the new technology.

Production and sales

During the 1994/95 financial year, the production budget was met in full and fuel assemblies containing 6,6 tons of enriched uranium were produced. This is 70% less than production during the 1993/94 financial year.

The nuclear fuel production and sales trends are summarised in the graph below.

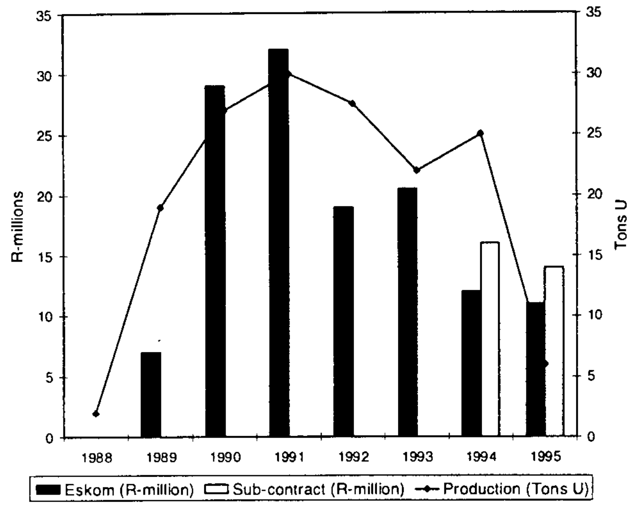

Figure 4.4.5 PWR fuel fabrication: Production and sales revenue 1988 - 1995 (AEC 1995)

(End of extract from AEC 1995 Annual Report)

The AEC 2000 PLUS PLAN

(Author's note. The *AEC 2000 PLUS PLAN* is the plan instituted by the AEC to re-orient the AEC in the "new South Africa". The following information was provided by the AEC on the plan.)

"The AEC 2000 PLUS PLAN which was initiated in 1990, provides the redirection of the Atomic Energy Corporation from a heavily state-funded strategic parastatal to a commercially driven organisation that is largely dependent on own sources of income via the sales of nuclear and industrial products and services in local and selected foreign market niches. With its vision of Wealth through Technology, the AEC has redirected its high level and very extensive technological expertise at the following four key corporate objectives:

· to enhance South Africa's industrial development and competitiveness

· to develop and maintain nuclear technologies for future commercial exploitation

· to contribute to the socio-technological development of disadvantaged communities

· to cost-effectively manage nuclear-related institutional activities and national and international relations in the nuclear and related field.

Since the implementation of the AEC 2000 PLUS PLAN in 1990, the AEC's annual state dependence for operating activities has declined, in real terms, by R621 million per annum (1996 Rand value) or 72% over this period. This has been achieved through:

- increased product sales into both local and foreign markets;
- closure of a large number of non-commercial operating plants;
- discontinuation of many scientific and research programmes;
- the contracting out of non-mission related internal services; and
- the down-sizing of support functions.

A further significant decline of state support of more than 50% for operational activities is planned through growth with new and very promising projects over the next five years. Unfortunately, above reconstruction of the AEC has also resulted in personnel numbers declining from a peak of 8 166 in 1986 to a record low of 2 227 currently. This reduction of 72% has resulted in a noticeable technology loss for the South Africa.

Of the AEC's budget allocation of R245 for 1996/97, at least R84 million (34,3%) will be channelled to institutional activities that the AEC will perform on behalf of the state as the national institution. These activities include international relations (IAEA-membership) safeguards, nuclear waste management, site maintenance, operation of national nuclear and related facilities such as Safari and the preservation of nuclear technology and related expertise.

An amount of R96 million (39% of the AEC's net operating budget) is directed to the enhancement of local industry through technology diversification.

The development of nuclear technologies for future exploitation requires R57,5 million (23%) of the net operating budget.

An amount of R7,5 million (3,2%) is allocated to social investment aimed at the technology related upliftment of developing communities.

Should the current 5-year plan be successfully completed the following benefits to South Africa's economy and society could arise:

- foreign exchange earnings of more than R500 million from product exports
- foreign exchange savings of more than R250 million
- possible investment, both local and from overseas, in new production capacity of more than R350 million
- medical radioisotope treatments of more than 1,5 million people in South Africa and a further 7 million abroad
- skills and technologically focused training of more than 7 500 South Africans
- creation of skilled direct employment opportunities for more than 3 500 persons.

The repositioned AEC is committed to the creation of wealth for all South Africa's people through the effective utilisation and application of this technology. The AEC's well developed infrastructure and breadth and depth of advanced skills and competencies are now directed towards building a new global competitive South Africa." (DMEA 1996b).

AEC as a competitor in the world market[6]

The NFP division of the AEC generates income of about R90 m/yr, R80 m of which accrues from contracts with Eskom. These agreements oblige the utility to purchase fuel from the AEC at prices that are inflated by about R40 m/yr over what Eskom would have to pay for the same products on the international spot market. An additional income of R13 m was generated in 1992/93 and 1993/94 from a contract to supply Nufcor with products for export. In order to produce this income, the NFP division requires an annual operating expenditure of about R280 m/yr.

The major reason for the NFP division's apparent economic unviability is the huge operating costs of its plants. The AEC's figures reveal that the average production costs at the conversion, enrichment, and fabrication plants during the period 1988 to 1992 were between 10 and 20 times the spot market price during the same period, and this excludes the capital costs of the various plants. In the case of the conversion and BEVA plants, it is claimed that the reason for these high operating costs is their under - utilisation.

Author's note. The AEC provided the following information on the above aspects (DMEA 1996b). "The major reason for the NFP division's apparent economic viability is the under-utilisation of the installed capacity. The NFP facilities were planned to provide fuel for four Koeberg-type units of which only two were built. In addition to this Eskom continued to import half its fuel requirements. It is not possible to operate capital-intensive high-technology facilities economically at only 25% capacity".

In part, the AEC's short-term hopes for survival in the nuclear fuel market appear to involve plans to trade in SWU on the international market. This market is over - traded at present and will continue to be so for at least the next decade, resulting in fierce competition.

The AEC states (DMEA 1996b) that "the current long term strategy of the AEC is to add value to the uranium exports of the country by converting all uranium production to UF_6 and eventually, after proving the MLIS enrichment process, to enrich local production and/or generate foreign exchange by selling technology in this regard. The AEC's process has recently been evaluated by COGEMA, a prominent French company in the international nuclear fuel business who subsequently decided to enter into a joint venture

[6] The production of this section is with acknowledgment to Dr. Thomas der Heyde for the supply of much of the information. Much of this section is extracted directly from his work (Auf der Heyde 1993).

(1:1 funding ratio) with the AEC for the further development and industrialisation of MLIS technology".

The following summarizes some basic figures for the AEC and nuclear fuels production.

Total U3o8 supplied by Nufcor (COMSTAT)	168 000 tonnes
Value of Nufcor exports by 1992	R6 498 million
AEC nuclear fuel production	
Conversion	
- production	640 tonnes of U in UF6
- sales	R11.731 million
Enrichment	
- production	266 000 SWU
- sales	R57.6 million
Fuel fabrication	
- production	21.3 tonnes of fuel
- sales	R16.5 million
TOTAL AEC nuclear fuel sales Operating expenditure	**R89.9 million** **R183.3 million**

Table 4.4.1 Summary of revenue and operating costs - 1994 (Auf der Heyde 1994, DMEA 1996b)

AEC public funding	R1 000's
Allocation in 1995/96 state budget	
Total nuclear allocation in South Africa budget rate	489 222
- support for opex and capex	273 209
- closure of Z-plant	38 000
- loan repayments	178 000
AEC public funding 1971 - 1995/96 (1995 R)*	21 000 000

* From Van Horen 1995

Table 4.4.2 Summary of funding of AEC from public funds

Year	AEC/ AEB Rm	UCOR Rm	CNS Rm	Total Rm	DMEA/ DoM Rm	% of DMEA
1971/2	6 670			6 390	39 938	16
1972/3	9 390			6 709	38 605	17
1973/4	8 762			8 762	43 992	20
1974/5	15 978			15 978	82 909	19
1975/6	17 174	51 000		68 174	123 093	55
1976/7	18 603	50 000		68 603	159 647	43
1977/8	19 987	43 000		62 987	168 001	37
1978/9	22 925	67 481		90 406	191 998	47
1979/80	32 400	99 895		132 295	404 828	33
1980/1	57 060	142 300		199 360	431 085	46
1981/2	76 835	173 400		250 235	385 634	65
1982/3	114 958	200 600		315 558	447 645	66
1983/4	352 921		75	352 996	534 967	66
1984/5	370 000		75	370 075	557 637	66
1985/6	525 878		123	526 001	627 553	84
1986/7	775 504		179	775 683	871 484	89
1987/8	705 646		183	671 329	768 462	92
1988/9	619 018		180	619 198	745 831	83
1989/90	640 000		5200	645 200	786 816	82
1990/1	712 700		6653	719 353	1 133 610	63
1991/2	685 000		6966	691 966	896 092	77
1992/3	451 958		5089	457 047	687 205	67
1993/4	469 096		5398	474 494	707 606	67
1994/5	509 725		5480	515 205	724 592	71
1995/6	489 222		5400	494 622	716 374	69

Table 4.4.3 Annual nuclear and total Department of Mines (DoM) and DMEA budget vote (Auf der Heyde 1994) (Author's note: The AEC pointed out minor differences betwen the figures in this table and their figures)

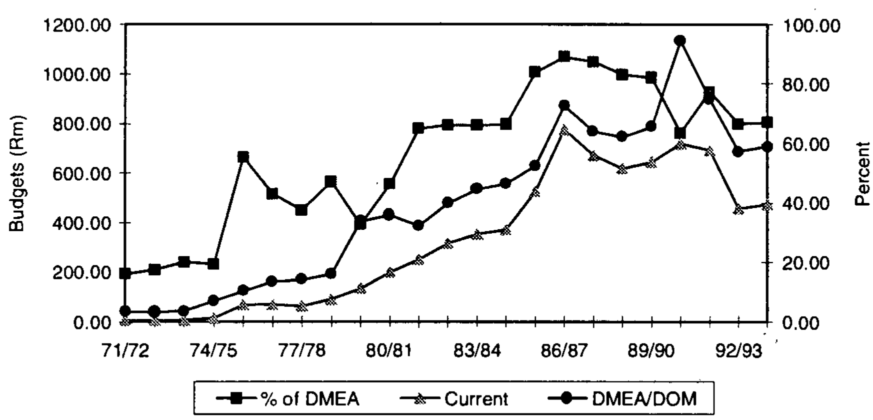

Figure 4.4.6 Annual nuclear budgets and total DoM/DMEA vote (Auf der Heyde 1994)

The data in the figure above reveal five phases. In the early years, the AEB's portion of the budget was less than 20%, but in the 1975/6 financial year it rose to 55%, remaining above 33% until 1981/2. The budget then received a second boost and hovered in the region of 66% for four years, before rising again, this time to between 85% and 90% in the years 1985/6 and 1989/90. The proportion then dropped slightly, to around 66%, where it is currently located. Figure 4.4.7 illustrates the actual budgets, in both current Rands and 1993 Rands adjusted for inflation of 12% per year for the period 1985-1993, and 10% for 1970-1993.

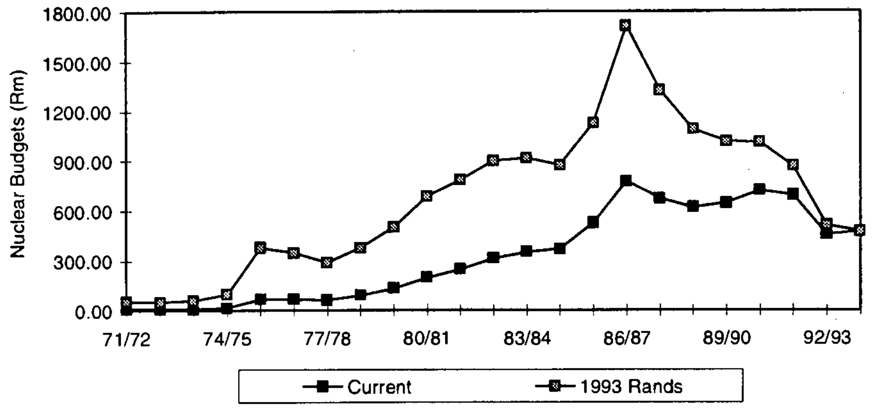

Figure 4.4.7 Annual budgets, in current Rands and adjusted for inflation (Auf der Heyde 1994)

ITEM	1994/95	1995/96	1996/97	1997/98
DMEA vote	724 592 (100)	716 374 (100)	668 386 (100)	777 727 (100)
Total nuclear Allocation	509 725 (70)	489 222 (68)	384 140 (57)	447 241 (61)
Breakdown of Nuclear				
Support for Opex and Capex	308 252	273 209	273 442	223 506
Closure of Z-Plant	-	38 000	29 408	21 673
TOTAL AEC SUBSIDY	308 252 (42)	311 209 (43)	302 850 (45)	245 179 (32)
[Projected subsidy ('93s Rs)]	[335 870]	[285 528]	[184 895]	[173 908]
Actual loan repayments	201 473 (28)	178 013 (25)	81 290 (12)	232 062 (30)
[Projected loans ('93 data)]	[201 173]	[175 240]	[76 338]	[226 039]
Nuclear Safety	5 480	5 400	5 771	7 398

Table 4.4.4 Future funding of the AEC (Auf der Heyde 1995)

(End of extract from Auf der Heyde)

Future funding for the AEC

The table above shows that as a proportion of the DMEA budget the nuclear energy budget is reduced very slightly (2%) from 1994/1995 to 1995/1996. The sharper drop of (11%) in 1996/1997 is due mainly to the reduced loan repayments.

As stated at the beginning of this section, detailed information on the nuclear budget has been presented not because of its importance to South Africa's energy economy (where it contributes less than 1% of primary energy), but because of the huge state outlays of public funds on the nuclear budget, and the ongoing, and planned future support using public funds. This final table shows that for the 1997/1998 budget, the total nuclear allocation will remain over half the DMEA budget at a figure of R477 million.

(Author's note. The AEC has pointed out (DMEA 1996b) that it is possible that a skewed perception of the AEC funding in terms of the DMEA budget could be created by comparing the AEC funding with the DMEA budget and that instead, all DMEA related activities, including the activities of state organisations such as Central Energy Fund Pty Ltd, should be considered in terms of ***turnover*** to produce a more balanced impression.) The following updated budget for the AEC was also provided.

		Budget 1997				
Detail	Budget 1995-96 R'000	1996-97 R'000	1997-98 R'000	1998-99 R'000	1999-2000 R'000	2000-2001 R'000
Activities	273,209	245,399	220,860	168,729	154,374	122,415
Loan redemption	14,783	24,206	178,033	10,174	29,637	4,850
Bridging	103,300	0	0	0	0	0
Loans interest	59,930	57,084	53,206	36,287	35,393	32,769
Z Closure	3,800	29,408	21,673	21,673	0	0
Total (Government Grant)	**455,022**	**356,097**	**473,772**	**236,863**	**219,404**	**160,034**

Table 4.4.5 AEC budget - 1997
(DMEA 1996b)

4.5 Biomass[7]

In the context of energy supply, biomass in South Africa refers mainly to woodfuel supplied to households. Dung and crop wastes play a minor role in household energy supply. Bagasse plays an important role in energy supply to the sugar-refining industry.

Woodfuel supply to households

Section 3.4.3, *Energy demand by household and community facilities*, explains the importance of woodfuel to a large proportion of South Africa's population. The main point made is that woodfuel is a basic fuel for most of the 3.2 million rural households comprised of 0.9 million farmworker households and 2.3 million rural households in previously defined homeland areas. These people in rural areas make up about half of the total population of South Africa.

Worldwide, experience has shown that conventional supply-demand economic analysis is often inappropriate and unuseful in considering woodfuel supply. This is due to a number of factors. The most important are:

1. On the supply side, besides providing woodfuel, trees provide a multitude of goods and services in rural economies, ranging from wood for fencing and building, fruit and medicine, through to the role trees play in protecting soil and water. Woodfuel is most often seen as a by-product of other functions trees play. As such, direct supply-side measures such as tree planting to provide fuelwood are often unsuccessful because the participants in rural economies do not perceive sufficient utility in this.
2. On the demand side, poor rural households operate a complex array of interlinked coping mechanisms to survive their poverty. The time spent by women collecting wood does not carry any direct cash cost but plays an important role in the household economy. Also, commercialised and semi-commercialised fuelwood collection by poor rural inhabitants on communally owned land has complex links to the rural economy. Because of the complexity of both of these links it is almost impossible to provide a useful, conventional economic supply model to these two main sources of fuel wood supply.
3. The status of communal natural woodland varies widely even within otherwise homogenous areas. Shortages and surpluses occur in specific localities and thus aggregated supply and demand statistics are not appropriate to considering interventions.
4. Analyses of fuelwood supply from energy-economic perspectives have often been in disagreement with rural people's perspectives or in disagreement with decision-makers' perceptions. As fuel wood collection is traditionally, and in current practice, a woman's task, the fuelwood problem is essentially a problem faced by women and their opinions on the matter have seldom been drawn out let alone their voices heard. Thus incorporation of the technical aspects of an economic analysis of the fuelwood situation into local political and cultural arrangements is problematic.

Because of the factors above and a number of additional issues related to rural development in impoverished areas, the best that can be said in describing the fuelwood situation, in the context of considering policy for effective interventions, is that the work needs to be situated in a holistic rural development strategy. Fuelwood supply issues are best placed in a component of this strategy which has recently gained the name of *Rural Development Forestry*. Fuelwood issues would be one of a number of considerations in this component.

Even though the utility of supply-demand figures is questionable, the following data is presented for information. Gandar (1994) estimated national fuel wood use at 11 million tonnes per year, of which 6.6 million tonnes is used by rural households in former homelands, 3.5 million tonnes by farmworker households and 0.7 million tonnes in urban areas. Aaron *et al* (1991) estimated the total sustainable supply of *wood* from natural woodlands for all the former homelands to be 11.6 million tonnes per year. Williams (1996) estimates that no more than half of the 11.6 million tonnes can be regarded as *fuelwood*. Williams concludes that these figures indicate a significant shortfall in woodfuel production. This is corroborated in energy consumption surveys which provide evidence of shortages experienced by rural households and woodland denudation in many areas of South Africa.

[7] All data on biomass supplied by Anthony Williams of the Energy and Development Research Centre at the University of Cape Town.

Programmes have been activated to attempt to begin to deal with the woodfuel problem. The *Biomass Initiative* is an ongoing South African government programme. The first phase of this programme, largely concerned with gauging the woodfuel problem and considering various options for dealing with it, is nearing completion. Some of these options are presented in the *South African Energy Policy Discussion Document* (DMEA 1995a). Projects have also been established to augment the fuel wood supply and over the last 10 years about 6 000 subsistence-level farmers have established timber plantations with the assistance of commercial timber companies (Williams, 1996). However, considering that South African has about 3 million rural households, the size of these programmes could be considered to be only at pilot level.

Bagasse

Bagasse is a waste product of sugar refining and all consumption is by the sugar-refining industry. The DMEA (DMEA & Eskom 1995) reports that bagasse use accounted for 47 PJ in South Africa in 1993. This is significant as it represents more than five per cent of total industrial energy consumption. At 7 MJ/kg, 47 PJ is equivalent to 6.7 million tonnes of bagasse.

4.6 Renewables[8]

Although the theoretical potential renewable energy resource in South Africa is huge, as in most other countries of the world technological developments and economic and political pressures have not yet progressed to the point where renewable energies make a significant impact on the national energy supply. Thus this description of the component of the energy supply system driven by renewable sources of energy is limited to a brief description of the potential resource and of the limited application of the resource to date.

Solar energy

South Africa experiences one of the highest solar radiation levels in the world with daily solar radiation levels in the range between 4.5 and 6.5 kWh/m^2. Only a very tiny part of the potential offered by this resource has been realised. However, South Africa's photovoltaic equipment industry is developing: PV panel assembly totals about 6MW per annum and the solar water heater industry has fourteen manufacturers. The table below indicates solar powered installations currently in operation.

Telecommunications photovoltaic generation	2.6MWp
Domestic photovoltaic generation	1.8MWp
Water pumping photovoltaic generation	0.7MWp
Total photovoltaic	**5.1MWp**
Domestic solar water heating	220 000m^2
Commercial and industrial solar water heating	34 000m^2
Agricultural solar water heating	2 600m^2
Solar swimming pool heating	227 000m^2
Total solar water heating (collecting area)	**483 600 m^2**

Table 4.6.1 Installed solar capacity

Wind Energy

Wind power potential is good along the coast with mean annual speeds greater than 4 m/s and localised areas where the value of 6 m/s is exceeded. About 400 kW of small wind turbines for power generation have been installed. Windpumps for water supply in rural areas are very common in South Africa and about 300 000 such machines are in operation.

Hydro power

South Africa is generally a dry country with low rainfall and few large rivers. Estimated hydro potential is 8 360 MW. South Africa has a total of 600MW of hydro power plants greater than 10 MW in operation, pumped storage schemes of 1 400MW, and 65 MW of hydro plants smaller than 10 MW.

[8] All data on renewables supplied by Anthony Williams of the Energy and Development Research Centre at the University of Cape Town.

Chapter five

Governance and policy institutions

This chapter on governance and policy is included to provide background information on energy governance in general and aspects of the South African governance system and institutions in particular. Vol. 1, the Energy Policy Discussion Document (EPDD), ***focuses*** on policy and governance issues. This chapter can be seen as an appendix to the EPDD giving information that may be of relevance to the discussions on policy and governance. The debate on governance in South Africa is extensive at this time of transformation, and, this chapter does not attempt to be complete or definitive. It provides complimentary information to that given in the Energy Policy Discussion Document and is thus aimed at being an aid to assessing some of the policies proposed in the Energy Policy Discussion Document.

Firstly, a review of international energy governance issues that may be applicable to South Africa is provided as a context for energy governance and policy in general. Then information on energy policy institutions and legislation is given specifically for the electricity and liquid fuels supply sectors. The electricity section includes a summary of important outputs from the National Electrification Forum. This is followed by information on the Central Energy Fund (CEF) group of companies, which has played a key role in the upstream oil industry and liquid fuels industry in the past and is beginning to act as home of the National Electricity Regulator and Renewable Energy for South Africa (Refsa) institutions. The last section provides information on South African state expenditure in the energy sector, in terms of both the parliamentary budget and other transfers such as the equalisation fund appropriation. This information provides one of the key indicators of state involvement in the energy sector.

5.1 International review of energy governance

Energy governance is not a uncontentious issue, particularly in South Africa. During initial work on development of the process to develop a new energy policy for South Africa the response from many parties was that the "market should be left to do its work" and that the government should keep away. This was unsurprising in an environment where the energy sector had over the years become the *de facto* policy maker. However, whilst South Africa had provided an energy supply system which provided large industrial users and mines with amongst the cheapest energy in the world, the preceding chapter shows that there were costs associated with other sectors - for example, low-income households were poorly catered for. Also, the resulting system is not a good example of an efficient market with easy access to new entrants, strong competition or low levels of government involvement. Rather, in most cases, a careful consideration of the information in chapter 4 especially reveals that the opposite is more often the case - namely large barriers to entry, monopolistic, monopsonistic or oligopolistic market conditions, and pervasive government involvement and control.

This section on international energy sector governance briefly looks at how the state is involved in the energy sector internationally. It describes *why* various governments are, or are not involved, *how* they are involved and how the state makes policy for the energy sector in terms of institutional arrangements. Lastly it looks at various forms of ownership and regulation in energy industries internationally. This international review provides a comparative background for the rest of the chapter that deals with the South African situation.

The role of the state in the energy sector[1]

Given the high level of interlinkages between the energy sector and other economic sectors, its size and its strategic significance, it is inevitable that the sector is influenced by national economic, social and political goals. Consequently, it is almost impossible to conceive of a situation in which the state does not have an impact on the energy sector since, ultimately, the state must retain "its central role as director of the economy and the development process. Economic policy management and the fight against poverty and underdevelopment are responsibilities that governments must assume, regardless of the prevailing political system." (Olade 1992).

[1]Much of section 5.1. was extracted from material submitted by Mark Pickering of the Minerals and Energy Policy Centre as input to the South African Energy Policy Discussion Document (DMEA 1995a). Mr Pickering's analysis draws heavily on two recent publications (Olade 1992) and (IEA 1992) on governance of the energy sector of countries of the OECD and South America (see footnotes 2 & 3).

International approaches to the role of the State in the energy sector

Accepting that the state has a legitimate role to play in the governance of the energy sector it is useful to examine international variations on the approach to this task. A cautious view should be adopted, however, in that while these lessons may be instructive they cannot be conclusive. As Olade, the Latin American Energy Organisation, recently observed after an extensive investigation into the role of the State in the Latin American and Caribbean energy sectors: [2]

> "Which economic, legal and institutional scheme is most appropriate for a given country will depend to a great extent on its particular political, social and economic situation. There are no blanket models or recipes since what is applicable in one country may not be to another."

On the matter of competition Olade goes on to suggest that:

> "It would be advisable to introduce competition into energy markets provided it would enable economic benefits to be maximised from a social standpoint. In doing this, the basic economic characteristics of energy markets must be kept in mind: in some cases, they are natural monopolies and, in others, competitive markets that are generally oligopolistic."

The IEA (1992), came to a similar conclusion after surveying the roles played by its member states in their energy sectors:[3]

> "The challenge for policy makers is to find a proper balance between relying on free and competitive markets, where they can exist, and taking appropriate, cost-effective action to ensure the nation's economic health and national security. This is a sensitive and difficult task, but it can be accomplished." (United States' Department of Energy, Energy security: A report to the President of the United State, 1987, quoted in IEA 1992)."

Arguments for state involvement in energy sector governance

The IEA (1992) identifies the following:

1. interventions which affect the economy as a whole: for example commercial law or general taxation;
2. interventions which arise from the fact that the production and use of energy have special characteristics: in particular they are perceived as more dangerous than most economic activities and are therefore subjected to special safety regulation;
3. interventions specific to the energy sector but arising from policy requirements: for example the bans on trade in energy which have been enforced against some countries which have repressive regimes or fail to comply with international law;
4. interventions which arise from sectoral policies other than energy policy: currently environmental, fiscal and transport policy have a particularly significant impact on the energy sector and vice versa; and
5. interventions for reasons of energy policy: particularly the need to maintain energy security.

Olade concludes that the roles of the state in the energy sector are inherent, regardless of the politico-economic situation, and include:

1. indicative planning;
2. regulation of natural monopolies;
3. supervision of competitive markets;

[2] Olade investigated Argentina, Barbados, Bolivia, Brazil, Chile, Columbia, Costa Rica, Cuba, the Dominican Republic, Equador, El Salvador, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Surinam, Trinidad and Tobago, Uruguay and Venezuela:

[3] The International Energy Agency is an autonomous body operating within the framework of the Organisation for Economic Cooperation and Development (OECD). Participating members of the OECD include Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United kingdom and the United States.

4. and, in many cases, company owner, depending on the prevailing institutional, technical, economic and financial conditions. This role should be clearly differentiated from the state's other roles and should be performed under conditions of economic efficiency." (Olade 1992)

Mechanisms for state intervention in the energy sector

Olade (1992), commenting on need to address the prolonged economic crisis in Latin American, within the historical context of a great deal of State intervention in the energy sector, proposes a number of broad reforms for Latin American energy subsectors:

1. restructuring of energy subsectors: which should aim for the most efficient structure. Monopolies over infrastructure ownership and management should be eliminated and, where advisable from an economic point of view, market forces should be allowed to dominate;
2. deregulation of competitive markets: for markets dealing in tradeable commodities;
3. re-regulation of monopolies whether natural or legally protected: in order to achieve regulation as a market substitute and to replicate the conditions that foster the efficiency of natural monopolies;
4. private sector participation: which need not mean total privatisation of State assets. The characteristics and scope of private sector involvement should be examined case by case as a function of prevailing economic and financial conditions and political and social considerations; and
5. corporatisation of public enterprises: public companies should be autonomously managed and subject to managerial accountability criteria. They should apply sound business practices and be subject to similar laws and the same conditions that apply to private sector companies.

By contrast the more stable IEA community avoids pondering the more principled questions on state involvement and comments on the specifics. Current practice and trends in IEA governments in this regard are listed as the following:

1. control of national resources, particularly oil and gas;
2. regulation of the grid based industries against the abuse of monopoly power with increasing emphasis on regulation to promote competition;
3. strict control on nuclear energy, and in some cases support for these industries;
4. involvement in large scale contracts for the import of natural gas;
5. consumer prices and taxes, with a growing use of taxes as an instrument of energy and environmental policy;
6. promotion of efficiency in energy use and of new technologies for both production and use of energy;
7. a growing framework of environmental regulation related to the energy industries; and
8. emergency response measures (IEA 1992).

The marked difference between the Latin American and OECD energy institutions in their descriptions of potential State interventions in energy markets is no doubt due to the significant variances between their economic conditions. Many developing countries face the challenge of implementing fairly radical structural adjustments to their economies, energy sectors included, while the more developed Western nations appear to be more concerned with the maintenance and refinement of their energy systems.

Trends in the role of the State in the energy sector

In conclusion then, the international trend in both OECD and Latin American countries is away from direct State involvement and towards a greater reliance on market forces to achieve energy policy goals. This trend is not absolute, however, as in some areas, particularly around environmental issues, there are signs of more government involvement than in the past (IEA 1992). Furthermore, the nature of the energy sector, its strategic significance and the historical role that most governments have played in it, all ensure a significant role for the State in the energy sector that cannot be avoided.

Government policy making for the energy sector - international experience
The IEA documents energy policy making arrangements within its 24 member states with such clarity that the section of the report dealing with these activities is reproduced in full below:

The IEA (1992) states:

> "Governmental institutions for formulating and implementing energy policy vary widely. The arrangements are determined by the administrative traditions of the country, by the structure of the energy sector, by political considerations and even by fashions well as by the more objective requirements of energy policy. Arrangements have varied over time as well as between countries. In all IEA countries, however, there has been found to be a need for a group within government which has the responsibility for formulating energy policy. In the majority of IEA countries Austria, Belgium, Finland, France, Germany, Greece, Italy, Japan, Netherlands, New Zealand, Portugal, Spain and Sweden.] this group is located under a Minister and in a Department with wide responsibilities for economic and industrial policy. In some cases (e.g. New Zealand, Portugal and Spain) there is a junior Minister or State Secretary responsible for energy within a larger Department. In others the energy group is headed by a Director General who is one of the top officials in the Department. (None of these countries have a similar arrangement to South Africa with an official at the level of Chief Director as head - authors comment.)
>
> Seven countries [Canada, Denmark, Ireland, Luxembourg, Norway, Turkey and the United States] have separate Departments of Energy. ... These separate Departments were usually created in response to the need to control development of indigenous resources of coal and gas or in response to the energy crisis of the 1970s. A separate Energy Department was abolished in New Zealand in 1990 and in the United Kingdom in 1992.
>
> Many other Departments are concerned with energy policy, particularly those responsible for finance, external affairs and science and technology. ... Departments or Agencies responsible for environmental policy take a close interest in energy policy and particularly efficiency in energy use. Coordination between the various Departments with an interest in energy policy is in most cases sought under the general arrangements for coordination within government. The effectiveness of coordination naturally varies between countries.
>
> The extent to which national governments delegate responsibility for implementing energy policy to non-Ministerial organisations varies with the general practice and tradition of Member countries. In all cases, state activities of a commercial character are normally entrusted to state companies or public corporations to some extent at arms length from the government. ... In most countries some aspects of implementation are handled by the central departments and others by non-Ministerial organisations. The latter are used most frequently for research and development, energy conservation programmes and regulation of the electricity and gas industries. Parliaments play a role in energy policy in all IEA countries. They alone can adopt new legislation. Beyond that the role of the Parliament is determined by the established framework of accountability of the government to Parliament. In some countries, such as Finland, Norway and Sweden, the final decisions on energy policy are taken specifically by the Parliament. In others, such as France and the United Kingdom, the government determines policy and answers for it as part of the general accountability to parliament. In the United States, where there is a sharp division between the executive and legislative arms of government, powerful committees on energy in both the Houses of Congress hold the Administration to account." (IEA 1992:15,16)
>
> Unfortunately the IEA study only examines the role of national or federal governments and has little to say about the other tiers of government. It does, however, mention that local governments' involvement in the energy sector is not normally motivated by reasons of energy policy but it can be relevant to the way in which energy industries are regulated. In some countries local government is involved in the provision of energy to small consumers"

With regard to the process of policy development the following findings were made (IEA 1992):

> "There is a plethora of advisory committees to government covering all aspects of energy policy. The influence of these committees varies. They are most effective in countries where there is a tradition of cooperation between government and the social partners - for example, Australia, Japan and some of the smaller countries such as Austria, Belgium and the Netherlands. In other countries their influence is more limited but depends on the personality of the ministers concerned and the committee chairmen (sic) and members.
>
> Nearly all IEA governments issue energy policy documents from time to time. New energy policy documents have recently been defined, or are in the process of being prepared, in Australia, Austria, Belgium, Denmark, Finland, Germany, Italy, Portugal, Spain, Sweden, Switzerland and the United States. The European Community has adopted a series of energy policy objectives. These policies are designed to achieve an acceptable trade off between conflicting objectives, notably energy security, a clean environment and low cost supplies. The weight given to these factors varies over time. In the 1970s and early 1980s energy security was the dominant consideration. Economic growth and protection of the environment bulk large in the recent energy policy documents. In some countries, such as Canada and the Netherlands, new statements of environmental policy include an important energy policy component.
>
> These documents range from fairly general policy statements, as in Germany, to lengthy documents based on a mass of underlying analysis, as with the Australian "Issues in Energy policy: An agenda for the 1990s" and the United States' National Energy Strategy published in 1992. ... all these policies rely in the first instance on market forces to bring about a satisfactory level and pattern of energy production and use. They all envisage a measure of government intervention to set the framework within which the market operates. The extent of intervention varies with national circumstances and the economic and political approach of the government concerned."

Structure, ownership and regulation

In the foreword to a recent IEA review (IEA 1994) of the structure, ownership and regulation of the electricity supply industries in OECD countries, Helga Steeg, the IEA executive director, commented that:

> "Changing market structures are affecting every major sector of economic activity world wide, and the ESI is no exception. Driven by a desire for improved economic efficiency, many countries are reforming and restructuring their industries to reap the benefits of a more competitive electricity market. While recognising the significance of other important policy goals, such as energy security, efficiency and environmental protection, Governments are also re examining their involvement in energy industries generally and the ESI in particular and ceasing to use the sector as a social policy tool.
>
> The perception of the ESI as a public utility with the obligation of maintaining a reliable power supply is changing rapidly to that of a business providing a multitude of electricity services in order to satisfy customer requirements profitably. This fundamental shift in philosophy has led to new structures, ownership patterns, and forms of regulation that allow power companies to respond to the needs of a more competitive international market."

The IEA's opinion is informed by the fact that so many OECD ESIs are undergoing a period of dramatic change as OECD countries reform their industry structures, ownership's and regulatory regimes.

Underlying these developments are the old debates about the economic role of the sector. Some continue to view electricity as a pubic good which deserves special treatment and protection. They argue that because electricity is essential for modern life the ESI must serve all its customers reliably and without discrimination. Electricity supply cannot be put at risk or denied to the poor or remote rural customers. In exchange for the obligation to serve, electricity utilities are granted exclusive rights to serve a region, often known as the franchise area. Competition is not, in this view, an overriding consideration. This view closely represents the de facto South African situation. Others argue, however, that electricity should be treated like any other commodity and be subject to competitive markets. Competing suppliers provide other essentials, such as food. Although the technical problems associated with competition in the ESI may be more complex there are means to ensure system reliability and-security of supply in competitive electricity markets.

Within the OECD at least six countries have already introduced extensive reforms aimed at moving from the first to the second philosophy and other countries are examining their position or restructuring in different ways. Ownership of the ESI in IEA countries ranges from integrated state monopolies to multiple private companies. No IEA government has totally relinquished ownership or some form of control over the ESI. Governments are generally involved at local, regional, national and supra national levels. Even in countries with a largely privately held ESI a government presence can be found in the form of partial ownership or control through regulation.

There are potential advantages in public ownership of the ESI, but there is also evidence of inefficiency in some countries in the areas of investment, construction, operation, pricing and staffing of state owned electricity utilities. While criticism of Eskom's massive over capacity problem may be considered as evidence of such inefficiency locally, this is a complex issue which has not received adequate study to date.

Some IEA countries consider that the best way to make the ESI more efficient is through corporatisation or privatisation. Corporatisation is the process of re organisation and transfer of responsibility from a government ministry to a separate commercially oriented entity. Eskom has successfully undergone such a process since its redefinition in 1987 under the Eskom Act. Corporatisation generally involves introducing managerial and accounting structures that prepare the ground for privatisation and may be a transitional step to ultimate privatisation.

Privatisation is pursued by governments not only for reasons of economic efficiency but also for the reason that the ESI is very capital - intensive and some governments have become reluctant to finance electricity investments from state budgets. Whilst this has not been the case in South Africa in the past with most of the ESI being self -funding, the financial realities of electrification may push government in this direction. Also, governments may wish to gain a once - off cash infusion for public coffers through sales of state assets. This has certainly been considered in South Africa by past governments and may well be considered by present and future governments. Further significant benefits of privatisation are that it imposes market discipline on utilities, it places them at arms - length from the government and reduces the possibility of government intervention for non - economic reasons.

Ownership itself does not, however, affect the utility's market power private monopolies can behave in the same way as government owned monopolies. Currently South Africa's entire ESI is in the hands of the public sector, either under the Ministry of Public Enterprises (Eskom) or local government (municipal undertakings). NELF has recommended to Cabinet that the industry should remain under public ownership, a position which was accepted by Cabinet at the time.

A further important determinant of the success of a particular approach to controlling the monopoly aspects of the industry is the form of the regulatory regime and its independence from government and the industry. Governments of countries with state - owned utilities sometimes fail to make a distinction between the role of the state as owner and the broader public interest, although in recent years there has been a tendency to establish more transparent procedures such as social contracting whereby the utility undertakes to achieve a certain level of technical and financial performance (IEA 1994). In South Africa this tendency has been evidenced by Eskom's pricing compact with its stockholders whereby it has undertaken to reduce the real price of electricity by a certain percentage over a five - year period, given a set of reasonable macro - economic parameters and envisaged internal efficiency gains. Another related aspect of social compacting has been Eskom's publicly stated commitment to achieving a significant proportion of the RDP electrification target. Whilst these are encouraging developments they do not, however, represent a complete social compact between the utility and the state, nor have efforts been made to formalise the social compact concept into a regular and monitored process.

In large part, the role of the regulator must depend on the nature and structure of the ESI. This follows from the fact that very different forms of regulation apply for different ESI conditions.

The 1994 IEA review identified the following options:

"State-owned utilities may be regulated by:

- social contract; of which the contract de plan agreement between the French government and Eledicite de France is a good example; or
- direct regulation; accomplished by direct government intervention in the planning and pricing affairs of the utility.

Investor owned utilities may be regulated through:

- detailed/structured or institutional regulation conducted within a given legal and institutional framework that grants the regulator powers to prescribe rules to which the utility has to adhere. A variant on this theme is the concept of performance regulation whereby the regulator establishes strict financial and other objectives to which the utility must adhere. The two main types are rate of return regulation and incentive regulation. A further variant on this theme is conduct regulation which takes its main form in integrated resource planning which is a planning process that explicitly provides an opportunity for the consideration of supply and demand - side resources using a consistent evaluation method and set of financial criteria; or
- light - handed regulation which, in its simplest form, does not require a regulatory framework specific to the energy or electricity sector. Instead it involves monitoring the behaviour of the monopoly or dominant firm on the basis of principles established by competition legislation in general. The monitoring agency may not be a regulatory agency per se, it may be an authority established by competition or anti trust law" (IEA 1994).

(End of extract from Pickering 1995)

5.2 Governance of the South African energy sector

5.2.1 Central government governance structures

The Department of Mineral and Energy Affairs (DMEA)

The Minister of Mineral and Energy Affairs and the Chief Directorate: Energy of the DMEA currently have responsibility for developing energy policy, framing legislation, administration of regulatory controls, funding and management of national energy policy-oriented research, and overall control of the CEF and the National Electricity Regulator (NER).

The DMEA is responsible for administering the following energy acts:

- Central Energy Fund Act (Act 38 of 1977)
- Petroleum Products Act (Act 120 of 1977)
- Nuclear Energy Act (Act 131 of 1993)
- Electricity Act (Act 41 of 1987 as amended)

In terms of these acts the DMEA performs certain regulatory functions, particularly in relation to the liquid fuels subsector and, more recently, oversight of the NER (formerly the Electricity Control Board) and the Council for Nuclear Safety.

Current functions of the DMEA

In order to fulfill its role of promoting effective integrated and balanced energy use the Chief Directorate: Energy considers itself to be performing the following functions:

- advising the Minister and others;
- administration of energy acts;
- environmental scanning and analysis;
- policy development, including management of energy policy research;
- integration with socio-economic activities; and
- action programmes where appropriate.

Structure and staffing

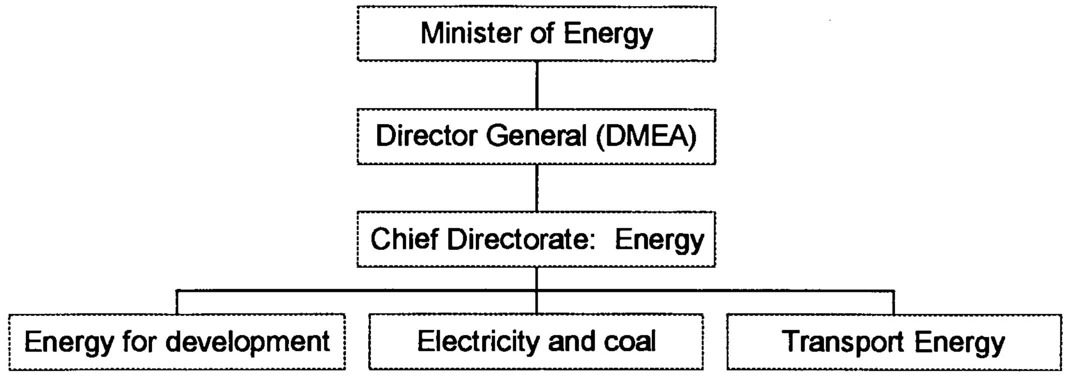

Figure 5.2.1 Structure of the DMEA

The chief directorate has a very small staff, indicated in the table below, considering its responsibilities and is currently reviewing its structure and capacity.

Designation of post	Authorised posts	Posts filled	Posts vacant
Chief director	1	1	0
Director	3	2	1
Deputy Director	9	8	1
Energy Specialist	15	10	5
Administrative, clerical and other staff	14	13	1
Total	42	34	8

Table 5.2.1 Chief Directorate: energy posts and staffing (end 1995)

A number of other national departments play some role in the governance of the energy sector. For example whilst the DMEA is responsible for energy policy Eskom and Transnet report to the Department of Public Enterprises.

While the DMEA, in a structural sense, has the clear administrative and policy making responsibility and lines of reporting, a strong *de facto* role in policy development is played by other government organisations operated at a central level. The CEF, owners of the Strategic Fuel Fund (SFF), Mossgas and Soekor, the Atomic Energy Corporation (AEC) and Eskom are the most important. Many of the operations of both these organisations were clouded in secrecy during the era that the CEF was responsible for procuring oil in the face of sanctions, and setting up Mossgas and Sasol, and when South Africa was developing a nuclear weapons capability. These conditions have only very recently changed and it is not surprising that under the new dispensation the roles of these organisations and the relationships between them and various lines of reporting in government are not clear. For example, the CEF chairperson's 1994-1995 annual review states that "CEF has shed the cloak of secrecy essential to its operations under the old dispensation."; and in March 1996 the chairperson of CEF resigned amongst reports of difficulties in relationships between CEF and the new parliament.

Thus, at central level, South Africa has a history of a small administrative and policy making organisation, namely the Chief Directorate: Energy. Other players at the central level, on the other hand, have operated in secrecy, have had extraordinary powers, and have, with extensive public funding (tens of billions of Rands) built up powerful organisations.

The Central Energy Fund Pty Ltd.

The CEF is the holding company for the state's strategic oil storage and trading arm (Strategic Fuel Fund) (SFF), oil and gas promotion and exploration (Soekor) and oil and gas production and downstream beneficiation of natural gas (Mossgas). It has also lately become responsible for a large rural electrification programme using photo-voltanics via subsidiary Refsa, houses the NER and has technology development subsidiaries involved with catalyst development and coal development.

CEF was established in 1964 as the SFF to procure and store crude oil. Since then it has been centrally involved in South Africa's strategic operations in the oil and gas industries. CEF, through SOF (Pty) Ltd. was used to initially finance the Sasol Secunda plants. It was then involved in facilitating the privatisation of Sasol. CEF provided loan funds for this purpose and carried the financial risk for loss of income to Sasol in the case of the Sasol subsidy not being met.

CEF states in its annual report that its expertise in the management, hedging and accounting of foreign loans is widely acknowledged. It plays an active role in oil and financial trading. The SFF subsidiary reported *R2 504 420 000 as cash and short term deposits* in its 1994/1995 balance sheet.

CEF/SFF has 340 employees at a central level (excluding employees in other subsidiaries). In an exploratory memorandum to the 1995/1996 budget CEF summarises its main purpose as follows:

> CEF was created by statute to manage the state's commercial and technical activities in the broad energy field, and in particular, liquid fuels.
>
> The specific aims and objectives served by CEF are:
>
> - Energy policy development and implementation.
> - Value-addition to Republic of South Africa's minerals

There is potential conflict, or lack of clarity at least, in the roles of CEF and the DMEA in that both have a principle objective of *energy policy development*. However, CEF/SFF, with 340 employees being paid market-related salaries to manage huge assets and perform daily transactions in international financial markets with sums of money equivalent to the entire Chief Directorate: Energy's annual budget, is clearly in a different league to the Chief Directorate. (Section 5.3, below, provides further details on the DMEA, Chief Directorate: Energy and CEF finances).

In summary, the governance of the South African energy sector is accomplished by a range of institutions each with defined, but often overlapping, roles and functions, which in many cases are not entirely clear.

5.2.2 Electricity governance[4]

This electricity governance section first looks at current arrangements in terms of legislation and institutions involved in electricity governance in South Africa. This is followed by a detailed analysis of one of the problematic cornerstones of theory informing both legislation and institutions involved with electricity supply namely the *right to supply electricity*. The next component of this section is a summarised record of some of the key outputs of the National Electricity Forum which has had a strong influence on attempting to transform the apartheid electricity supply industry. This is followed by a brief description of the newly established Electricity Working Group (EWG).

Current governance arrangements for the ESI

Currently the following bodies, laws and functions play an important role in governing the South African ESI:

The Constitution of South Africa

The Constitution provides a framework for electricity governance in that it creates and enables a range of bodies to legislate, execute and adjudicate on electricity matters. The Constitution also makes specific reference to electricity insofar as it provides that local government bodies shall "make provision for access to electricity", but does not go so far as to state that local government bodies necessarily have to undertake supply themselves. Rather, the obligation to ensure access is determined by applicable law, as discussed below.

The Constitutional Court and the judiciary

Disputes concerning the position of the constitution on electricity may be referred to the Constitutional Court or the Supreme Court, depending on the nature of the dispute.

The legislature

Parliament, combined with the Senate, forms the legislature where laws dealing with electricity are passed or amended. Two of the parliamentary committees in particular are concerned with electricity related matters: the Committee on Mineral and Energy Affairs and the committee on Public Enterprises.

[4] Section 5.2.2 was extracted from material submitted by Mark Pickering of the Minerals and Energy Policy Centre as input to the South African Energy Policy Discussion Document (DMEA 1995a).

Existing legislation concerned with electricity

Important legislation affecting electricity supply includes:

- the Electricity Act, No. 41 of 1987, as amended, which creates and empowers the NER;
- the Eskom Act, No. 40 of 1987, which creates Eskom and its supervisory body the Electricity Council; and
- the Local Government Transition Act, No. 209, 1993, as amended, which provides for the restructuring of local government and various matters relating to electricity provision.

The executive

Composed of the President, Vice-Presidents and cabinet Ministers, the executive has the responsibility to interpret the constitution and laws of the land into policies which are implemented through the various government departments. Three of these departments in particular have important roles to play in the governance of the ESI:

- the DMEA, which is responsible for administering the Electricity Act;
- the Department of Public Enterprises, which is responsible for administering the Eskom Act; and
- the Department of Constitutional Development and Provincial Affairs, who are responsible for administering the Local Government Transition Act.

In terms of the Electricity Act the Minister of Mineral and Energy Affairs appoints the NER and approves its budget. In practice the NER reports to government via the Chief Directorate: Energy in the DMEA.

In terms of the Eskom Act the Minister of Public Enterprises is empowered to issue certain directives to the utility concerning its operation and, in practice, is central to approving annual price increases and significant shifts in Electricity Council policies.

The National Electricity Regulator

Created in terms of the Electricity Act, the NER is a crucial component of the governance framework for the ESI. The role of the NER is to implement government policy on the ESI through the mechanism of issuing electricity licences. Any utility wishing to generate, transmit or distribute electricity in South Africa has to obtain a licence to do so. This mechanism therefore creates the opportunity for government to exercise considerable influence over the development of the industry. For instance, government may direct the regulator to establish strict licencing criteria as a means of ensuring the rapid rationalisation of the distribution industry structure. The empowerment of the NER to regulate the entire ESI has created a policy implementation instrument for government that did not previously exist. Along with this has come a policy gap that has still to be adequately addressed.

The Electricity Council

The Electricity Council is appointed by the Minister of Public Enterprises. Various positions on the Council are reserved for government officials, and other seats are reserved for specific stockholder (consumer) organisations who may each nominate a list of up to four individuals, from whom the Minister selects one person. Further seats are reserved for the Chief Executive of Eskom and up to seven "experts" who are appointed at the minister's discretion. Although the Electricity Council is usually described as a "stockholder body" the individuals nominated on to it are not legally accountable to their nominating organisations for positions taken within the Council and cannot be recalled. The role of the Council, which is clearly defined in the Eskom Act, is to supervise the operation of the parastatal.

Eskom Management Board

The Management Board of Eskom, including the Chief Executive Officer, is appointed by the Electricity Council and also has its duties clearly defined in the Eskom Act. The role of the Management Board is to manage the day - to - day activities of Eskom.

Eskom

Eskom is a state - owned, or parastatal, organisation which generates, transmits and distributes electricity. It is not subject to company tax and has no shareholders. Eskom has a virtual monopoly on generation in South Africa and owns the national transmission grid. Following its electrification related activities in recent years it has become the largest single distributor in the country (in terms of both number of customers and kWh sales).

Provinces

In terms of the Constitution provinces have no legislative competence with regard to electricity. This creates a somewhat anomalous situation in that the Constitution also provides that local government is one of the competencies of provinces and, further, that local government has certain constitutional rights and obligations with regard to electricity. Prior to the coming into operation of the Constitution, provinces regulated the electricity affairs of local government by issuing ordinances. The Constitution provides that these existing ordinances remain in force until amended or repealed by a competent authority which, in this case, cannot be the provinces. It should be noted that in terms of the Constitution provinces are granted the power to plan and coordinate the process of development within their boundaries and that aspects of the electrification process would fall into this category.

Local governments

An important consequence of the Local Government Transition Act (LGTA) is that local government's obligation to supply electricity is now subject to the crucial qualification that the supply of electricity can be rendered in a sustainable manner and is financially and physically practicable. In other words, for the first time local governments rights to supply electricity are subject to a means test (Morgan 1995b). A further important consequence of the LGTA has been the creation of the anomalous situation whereby although the Provinces have legislative competency over local government affairs they do not have legislature competency over electricity matters. Despite this, local governments are, in terms of the Constitution, automatically granted certain powers in relation to electricity supply.

An interpretation of the applicable legislation reveals that local government bodies have the (non-exclusive) right to supply electricity within their areas provided that they satisfy the criteria for supply as set out in the Constitution and comply with (applicable) national law (that is they comply with the licensing requirements in the amended Electricity Act). The effect of the Constitution is thus to make electricity supply a national matter, take it out of the powers of the provinces and to make the obligation to ensure access to electricity the responsibility of local government bodies.

In terms of past electricity legislation and provincial ordinances, many local governments have established their own municipal electricity undertakings.

Management of municipal electricity undertakings

The management of municipal electricity undertakings is generally appointed by and accountable to the local authority which owns the undertaking. Unlike Eskom's Electricity Council, there are generally no transparent mechanisms for stockholders, other than local voters, to influence the decisions of the local authority in directing the operation of the municipal undertaking.

Municipal electricity undertakings

Although a few of the major cities have electricity generation plants, most municipal electricity undertakings are solely concerned with electricity distribution. Not all local authorities have established electricity undertakings, however, and many have chosen to let Eskom or neighbouring municipalities distribute within their boundaries. In the past this practice has required a license from the Electricity Control Board (the forerunner of the NER).

Although most individual municipal undertakings are small compared with the scale of Eskom's distribution activities altogether the majority of electricity consumers in South Africa are currently supplied by municipal undertakings.

Customers and other stakeholders

Customers and other stockholders participate in the governance of the electricity industry through a variety of indirect and direct mechanisms. Through parliamentary elections and related party political processes individuals are able to influence electricity policy goals. A clear example of this is the Reconstruction and Development Programme electrification target which has been adopted by the Government of National Unity as a national goal.

Local government elections also offer individuals an opportunity to influence the electricity - related policies of those municipalities which own and operate electricity undertakings.

Electricity consumers, and particularly the organised interests of large consumers, are able to influence Eskom's affairs directly through their positions on the Electricity Council. This situation does not, however, apply to municipal undertakings, where councillors have historically tended to favour the interests of the voting public, to the cost of non-voting commercial and industrial concerns.

The rights of local government bodies to supply electricity[5]

Historical overview

The position in South Africa was that anyone who generates, transmits or supplies electricity required a license to do so from the Electricity Control Board (the electricity regulatory authority). However, successive Electricity Acts have exempted various suppliers from such mandatory licensing requirements. Local government bodies and departments of state have always enjoyed exemption. Eskom has been exempt since 1987.

The position in terms of the Electricity Act, 1987

The Electricity Act, No. 41 of 1987 provides that "no person shall carry on or engage in any manner in any undertaking for the generation of electricity or for the supply thereof except under the authority of a license issued by the Electricity Control Board" (Section 6(1)). However, the Act exempted departments of state, local government bodies, Eskom and certain other categories of supplies from the mandatory licensing requirements (Section 6(1) (a) (f)). The result was that local government bodies did not require a licence from the Electricity Control Board to supply electricity within their areas of jurisdiction. This has been the position since (at least) the initial Electricity Act, 1922 came into operation.

Local government bodies were authorised to supply electricity in terms of various provincial ordinances, which gave local government bodies the power to establish works for the supply of light, heat and power (for example, see Section 83 of the Transvaal Local Government Ordinance, No. 17 of 1939). In the case of *Eskom versus the Chairman of the Electricity Control Board and Others* (discussed later) the Court held that local government bodies were vested with rights to supply electricity in terms of the provisions of the Electricity Act, and not just in terms of provincial ordinances.

Insofar as the supply of electricity in local government areas is concerned, the Electricity Act made the following provisions:

Section 15 (1) "The sale and supply of electricity within the jurisdiction of local government authority shall be under the control of that authority, except insofar as any other undertaker has lawfully acquired the right to supply within that area or any potion thereof, whether under a license of by agreement with the local authority or otherwise."

Section 17: "The right to supply electricity within the area of jurisdiction of a local authority or to construct transmission of distribution lines shall be subject to the consent of that authority: Provided that if it is alleged that such consent is unreasonably withheld, the manner shall be decided by the Electricity Control Board after a public hearing at time and place of which not less than 14 days notice shall be given to the parties by the Board."

The following electricity supply options were accordingly possible within local government areas:

1. the local government body had the right to supply electricity within its areas of jurisdiction and did not require a licence from the Electricity Control Board to do so;
2. Eskom, or any private undertaker, could acquire the right to supply electricity within any local government area by entering into an agreement with the local government body to do so; and
3. Eskom, or any private undertaker, could acquire the right to supply electricity within any local government area from the Electricity Control Board where the Board decided that the local government body was unreasonably withholding its consent to such supply being undertaken by Eskom or the private undertaker.

It is important to make the point that local government bodies have never enjoyed the exclusive right to supply electricity within their areas of jurisdiction. Any other supplier (including private suppliers and Eskom) could acquire the right to supply

[5] This extract is reproduced with acknowledgment that it is drawn from a document produced for the NELF working group on legal issues affecting the regulation of electricity (Morgan 1995a).

by consent (of the local government body) or, if such consent was unreasonably withheld, by ruling of the Electricity Control Board. Competing claims to supply electricity were accordingly possible and the Electricity Control Board would be the final adjudicator (subject to the right a litigant would have to appeal the decision of the Board to the relevant Minister in terms of the Electricity Act, 1987).

The question arises as to whether section 17 of the Electricity Act (which provides that a local government body cannot unreasonably withhold its consent to supply by another party) applied only to the case where the local government body was not already supplying electricity itself or whether the Section could be used to dispossess a local government body of its supply rights. (To do this the Electricity Control Board would have had to be satisfied that the local government body had already withheld its consent, and to come to this conclusion the Board would presumably have had to be convinced that the applicant (to supply) could provide a superior service to customers at lower cost). It is submitted that the only reasonable interpretation of the section is that a person wanting to supply electricity at any time within the area of a local government was obliged to obtain the consent of such body, which consent could not be unreasonably withheld. This section could therefore be used to dispossess local government bodies of their supply rights.

Implications of the decision in the case of:

Eskom versus the Chairman of the Electricity Control Board and the Local Affairs Board

This is one of very few cases which appear to have come before our courts concerning conflicting rights to supply electricity. The facts were as follows: the Local Affairs Board became the local government body in the township of Dainfern. Eskom was supplying electricity to (all) consumers in the township. The Local Affairs Board applied to the Electricity Control Board to take over the supply of electricity from Eskom. Eskom resisted on the basis of its existing right to supply. All the parties agreed to approach the courts for a decision. One of the difficulties faced by Eskom was that it did not have an agreement with the local government body to supply within the area (as is required in terms of the Electricity Act). The court held that Eskom's right to supply electricity in the area terminated immediately the area fell within the jurisdiction of the local government body. Eskom elected not to appeal the decision. Eskom could, however, have relied on the provisions of Section 17 of the Electricity Act, applied to the local government body for consent to supply and, if such consent was refused, appealed to the Electricity Control Board. In any event, the provisions of later legislation have fundamentally changed the position.

The impact of the coming into operation of the Constitution of the Republic of South Africa

The coming into operation of the Constitution of the Republic of South Africa, 1993 (the Constitution); the Local Government Transition Act, No 46 of 1994 and the future coming into operation of the Electricity Amendment Act, No. 46 of 1994 (the Electricity Amendment Act) has fundamentally effected the rights of local government bodies to supply electricity.

The supply of electricity is not a matter over which Provinces have legislative competency (Section 126 (1) and Schedule 6 of the Constitution). The Provincial Ordinances authorising local government bodies to supply electricity are now, except for the transitional arrangements in the Constitution, ultra vires the powers of the Provinces. However, the Constitution provides that all laws which were in force immediately before the commencement of the Constitution shall continue in force subject to any repeal or amendment of such laws by a competent authority (Section 229 of the Constitution). The Provincial Ordinances authorising local government bodies to supply electricity accordingly remain valid until they are repealed of amended by a competent authority which, in the case of electricity, cannot be the Provinces.

The Constitution also established local government (Section 174 (1) of the Constitution) and provides that the powers, functions and structures of local government shall be determined by law of competent authority (Section 175 (1)). The "competent authority" is the Province because local government falls within the legislative competency of the Provinces (Section 126 (1) and Schedule 6 of the Constitution).

Insofar as the supply of electricity is concerned, the Constitution provides as follows:

" Section 175 (3). A local government shall, to the extent determined in any applicable law, make provision for access by all persons residing within its area of jurisdiction to ... electricity provided that such services and amenities can be rendered in a sustainable manner and are financially and physically practicable." (Constitution 1993)

It is important to note the following:

1. the Constitution does not give local government bodies the exclusive right to supply electricity, rather it provides that they shall "make provision for access to electricity" (i.e. local government bodies do not necessarily have to undertake the supply themselves);
2. the obligation to ensure access is determined by applicable law (i.e. in this case the Local Government Transition Act and the Electricity Act); and
3. local government's obligations are subject to the critical qualification that the supply of electricity can be rendered in a sustainable manner and is financially and physically practicable.

For the first time local governments' rights to supply electricity are now subject to a means test.

It is also important to highlight an anomalous situation which has resulted. In terms of the Constitution, the Provinces have legislative competency over local government affairs, but they do not have legislature competency over electricity matters; yet local government is given certain powers in relation to electricity supply.

Local government bodies accordingly have the (non - exclusive) right to supply electricity within their areas provided that they satisfy the criteria for supply as set out in the Constitution and comply with (applicable) national law (i.e. comply with the licensing requirements in the (amended) Electricity Act).

The effect of the Constitution is to make electricity supply a national matter, take it out of the powers of the provinces and make the obligation to ensure access to electricity the responsibility of local government bodies.

The effect of the Local Government Transition Act, 1993

The Local Government Transition Act promotes the restructuring of local government by providing for the amalgamation of previously racially separate local governments. The Act provides for the establishment of three types of urban local government bodies, namely transitional metropolitan councils (TMCs); transitional local councils (TLCs) and local government coordinating committees (LGCCs) and for different types of rural local governments, namely services councils, sub regional councils or district councils.

Insofar as the supply of electricity is concerned, the Local Government Transition Act provides that:

1. the powers of a TMC shall be at least the powers and duties listed in Schedule 2 (Section (1)(b)(a)). The bulk supply of electricity is included in the said schedule. The Act provides further that the TMC may, it its discretion, decide not to exercise such power or perform such duty (section 7(1) (b) (aa) (bbb));
2. no specific mention is made of electricity powers in relation to TLCs. (The Act is silent here); and
3. the powers and duties of any LGCC shall be at least the power to ensure access by all persons residing within the areas of jurisdiction of the individual local government bodies to electricity if so agreed by all the individual local government bodies (Section & (1)(c)(i)(aa)). The section includes the proviso that if the individual local government bodies do no have the ability, jointly or severally, to ensure access to electricity themselves, the LGCC shall negotiate for such access

thereto to be provided on its behalf by any other competent body (Section 7 (1)(c)(i)(aa)).

The above provisions relate to transition council during the pre interim period. The same provisions apply during the interim phase except that the option of the LGCC falls away.

The Local Government Transition Act does not deal with electricity supply powers of rural local governments.

Of course the rights and powers of local government bodies to supply electricity in terms of the other legislation mentioned earlier continue in force. It is submitted that the Local Government Transition Act has effected the following changes to the previous positions, namely:

1. TMC's have acquired the power to the bulk supply of electricity (which term is not defined); and
2. The supply of electricity by LGCCs is now also subject to a means test.

The effect of the Electricity Amendment Act, 1994

The Electricity Amendment Act, 1994 came into operation on the 1 March 1995. The Act changes the name of the ECB to the National Electricity Regulator (NER) and removes the exemption which Eskom and local government bodies enjoy from the mandatory licensing requirement. The result is that all suppliers of electricity have had to be licensed by the NER.

Conclusion

Taking the above developments into account it is submitted that the position with regard to the supply of electricity within local government areas is as follows:

1. local government bodies (TMCs, TLCs, and LGCCs) have the right to supply electricity within their areas of jurisdiction provided that they acquire a license from the NER to do so. The NER is the body which determines whether local government bodies can meet the criteria to supply set out in the Constitution, the Local Government Transition Act and also comply with the NER's own licensing criteria;
2. Eskom or any other private undertaker can acquire the right to supply electricity within any local government area with the consent of such local government and provided further that they obtain a licence from the NER to do so;
3. where Eskom or any private undertaker wishes to acquire the right to supply electricity within any local government area and the local government body unreasonably withholds its consent, the NER has the power to decide the issue and has the power (on good cause) to dispossess the local government body of its rights to supply;
4. TMC's have now acquired the right to the bulk supply of electricity provided that the NER licenses the TMC accordingly. (This is necessary because the TMC is a new concept which had to be specifically catered for).

The position about the right to supply is confusing especially because conflicting rights are possible. The whole issue around rights to supply will have to be clarified in future legislation.

(End of extract from (Morgan 1995a)

National Electricity Forum (NELF) proposals

1994 Cabinet resolution on NELF proposals

The Cabinet approved that:

- Eskom's generation and transmission business should be retained in its present form;
- local government authorities which presently operate their own power stations should be allowed to continue to do so subject to regulation by a National Electricity Regulator (NER);
- the Electricity Control Board (ECB) should be utilised as the independent NER and new members should be selected and nominated by the NELF through a transparent process for consideration by the appropriate minister;

- the main role of the National Regulator will be inter alia to issue licences, regulate price and tariff structures, regulate service standards, regulate the achievement of electrification targets and settle disputes;
- there should be a rationalisation phase for the restructuring of the ESI, during which

    - local government undertakings that are efficient, can comply with the requirements of the National Regulator and elect to do so, should continue to supply electricity in their agreed areas of jurisdiction;

    - Eskom should take over the electricity supply of the previously independent (TBVC) and self-governing territories. Legislation through a Presidential Proclamation should be prepared to this end; and

    - local government undertakings who elect not to supply directly or those who cannot satisfy the Regulator's criteria for supply, will be obliged to transfer their supply rights to another supplier (Eskom or another local government supplier);
- a national domestic tariff system be developed and implemented as soon as possible by the Regulator; and
- the ring - fencing (managerially and financially) of local government electricity undertakings and running them as separate business units as well as the taxation of electricity be referred to an ad hoc committee of ministers consisting of the Minister without Portfolio and the Ministers of Finance and of Local Government (Convenor).

The Cabinet also noted the probable financial implications for the electricity account of the relevant local authorities which would result from the merging of fragmented local authorities as well as the probable need for external sources of funding for specific parts of the electrification programme. Proposals on how to deal with these and related matters will be considered at a later stage.

Criteria to be used by the NER when adjudicating on retention or transfer of supply rights
The NELF proposal is for the NER to use the following criteria when ruling on the right to supply:

(i) Capability of supplier to provide an acceptable service to all customers, including large customers:

- technical capability;
- acceptable pricing policy (i.e. fair cost allocation);
- price stability;
- long-term viability of supplier (i.e. infrastructure, human resources and financial capacity);
- reliability of service;
- quality of supply; and
- safety of supply system.

i. Ability to meet Government's electrification targets for the area.

ii. Market responsiveness and customer focus of supplier.

iii. Management competency of supplier.

iv. Economic viability of supply area:

- common economic system;
- customer consumption patterns;
- affordability levels;
- acceptable financial returns; and
- opportunity for cost pooling.

v. Impact on existing or future supply network configurations.

vi. Transfer of supply rights must promote the technical, operational and financial viability of a particular area of supply, must balance geographic and economic factors to maximise operational efficiency, and must also take into consideration the technical characteristics or constraints of an interconnected power system at various voltage levels.

vii. Transfer of rights must not impede progress towards the realisation of the evolving end state model.

Ring-fencing

NELF recommends that local government electricity undertakings should be ring - fenced managerially and financially. By ring fencing is meant that an undertaking is run as a separate business unit at arm's length and according to specific criteria, making it possible to identify costs, revenue, resources, performance, etc. The criteria could include the following:

- all transfers from the undertaking to non-electricity services must be visible;
- undertakings must operate separately under normal business conditions and follow a business culture;
- generally accepted accounting practices (GAAP) must be followed;
- interdepartmental cost allocations must be done based on fair cost of service; and
- the structure should provide for a separate, dedicated financial function to enable sound management practice and financial discipline (AMEU 1994).

Obviously, ring - fencing would have to be applied to all distributors of electricity.

The Cabinet referred NELF's ring - fencing proposal to an ad hoc committee of the Cabinet consisting of the Ministers for the RDP, Finance and Local Government for further study.

NELF's recommendations on the financing of electrification are as follows:

1. Loans from loan sources should be expanded to include provision for electrification.
2. The Development Bank of South Africa. should increase and fast track electrification support, with NELF's assistance, where necessary.
3. Electricity undertakings should make maximum use of their own financial abilities.
4. Fiscal transfers should be channeled to local authorities through Government structures, and to Eskom as direct transfers.
5. An independent national electrification financing agency should only be formed if an electrification levy is introduced.

NELF recommends that the following principles should apply to the re-employment of staff:

1. In respect of staff take-overs

- No loss of employment should take place;
- employees of distributors being taken over should be absorbed into the organisation responsible for the re-employment;
- re-employment of staff should be negotiated between all relevant parties, with inclusion of trade unions; and
- re-employment should be carried out in accordance with the provisions of the Constitution of the Republic of South Africa Act of 1994, the Labour Relations Act of 1956 and other applicable legislation, industrial agreements and procedures.

2. In respect of salaries and conditions of service

- Existing salaries and conditions of service should initially be retained;
- disparities should be systematically addressed through negotiations; and
- although human resource management policies exist, basic standards should be reviewed to ensure standardisation.

3. In respect of training, re-training, development and affirmative action

Attention should be given to

- general re-training, training and upliftment of the skills base with special emphasis on adult basic development;
- affirmative action;
- capacity development in communities; and
- development of managerial skills.

(End of extract from NELF proposals).

The Electricity Working Group

One of the first tasks of the NER, after its establishment on 1 March 1995, was to require all electricity generators, transmitters and distributors of electricity to apply for licences. After considerable problems in evaluating applications submitted by many distributors, owing largely to lack of clarity on policies which determined the conditions under which licences were to be granted, during August 1995 the NER decided to issue *permanent* licences to generators and transmitters but to only issue *temporary* licences to distributors of electricity.

The NER then called on government to set up a working group to make recommendations on the future structure of the electricity distribution industry (EDI). The establishment of the Electricity Working Group (EWG) in September 1995 was the result. By March 1996 the EWG had not yet reached a point of making recommendations. However, a document ***for discussion purposes only*** was produced by the end of November 1995. The document included a framework for evaluation of recommendations on the industry, an identification of structure options and came to a conclusion that, at that stage, the most appropriate structure for the EDI would be a ***Single Decentralised Distributor.*** In this structure electricity would be supplied by autonomous, decentralised regional distributors supply geographically distinct areas of the country. These distributors would collectively own and control the Single Decentralised Distributor which would be responsible for setting common policy, funding the business, allocating subsidies etc.

However, the above conclusion has clearly been noted by the EWG as being for discussion purposes only and the EWG is still busy with the task of unraveling the legacy of the connection between funding and organisation of highly inequitable race-based local authorities and the EDI.

5.2.3 Liquid fuels governance[6]

The relationship between the government and the oil industry in South Africa over the past several decades is characterised by a considerable degree of state involvement, intervention and control of many aspects of the industry's business activities including refining, marketing, pricing, technical issues and future planning.

Prior to 1979, the Department of Trade and Industry handled the administration of state/oil industry matters while the Department of Environmental Planning and Energy was responsible for planning. The Minister was advised by the Energy Policy Committee, with a Secretariat provided by this department. Many decisions involving state spending, such as the construction of Sasol, were taken by the Cabinet on the recommendation of this committee. The Department of Mineral and Energy Affairs was formed in 1980 as a result of a major rationalisation of the public service in 1979/80. All major oil industry matters involving the government were then handled by this department.

State energy planning and administration was delegated to the National Energy Council (NEC) in 1987. This parastatal body was instituted in terms of the Energy Act, 1987 (Act 42 of 1987) in order to establish a more market-related and economically sound energy industry, a better balance between economic and strategic issues, and goal-oriented state-financed energy research, by close interaction between the public and private sectors. The Council thus provided a forum in which the oil industry could assist in energy planning. The Council was abolished in 1993 due to a reassignment of national financial priorities by the government, in which the earmarking of funds acquired through levies for spending outside the national budget, as in the case of the NEC, was no longer acceptable. The functions of the NEC were subsequently rationalised and transferred to the DMEA.

In recent years the state has moved marginally away from regulation, but still retains tight control in many areas of the oil industry, while participating in on going debates on the advantages and disadvantages of deregulation. The profitability of refining operations is no longer controlled, but wholesale marketing

[6] Much of section 5.2.3 was was extracted from material submitted by Dr Robert Scott as input to the South African Energy Policy Discussion Document (DMEA 1995a).

operations are monitored on an industry-wide basis and margins are adjusted when minimum or maximum permitted profits are exceeded; retail margins are controlled by means of a formula based on the performance of a sample of service stations, retail price maintenance on petrol is still rigidly enforced and controls on the wholesale price of diesel and paraffin still exist. The State has also been involved, but in more of a coordinating role, in technical matters such as the octane structure and lead content of petrol.

In the past year there has been a complete relaxation in the strict secrecy pertaining to virtually all oil industry matters, such as crude oil acquisition, storage, refinery capacities, production volumes and national fuel demand. This followed the lifting of the United Nations oil embargo against South Africa in 1994.

The following legislation governs state involvement in the oil industry:

- Central Energy Fund Act, 1977 (Act No. 38 of 1977), as amended.

- Petroleum Products Act, 1977 (Act No. 120 of 1977), as amended.

The DMEA, assisted by its parastatal institution CEF (Pty) Ltd., is responsible for the administration of these laws. In addition to the above, there are several agreements in place, often at the insistence of the state, which tend to regulate the oil industry in one way or another to protect national, industry or consumer interests, and various organisations such as the oil companies, Sasol, Mossgas, Central Energy Fund Pty Ltd , Strategic Fuel Fund and Motor Industries Federation are involved.

(End of contribution by Dr Robert Scott)

5.3 State funding of the energy sector

This section does not attempt to give a complete description of all state expenditure in the energy sector but, instead, identifies some key areas in which the state funds energy sector activities. Although not all state transfers are strictly within the area of governance they are the *concern* of governance structures because these structures need to account for both the planning and implementation of the expenditure of significant amounts of public funds.

5.3.1 The energy-related budget of the DMEA

	1995/96	1996/97	1997/98
PROGRAMME 5 - Chief Directorate: Energy			
- Energy management	5 812 000	6 112 000	6 258 000
- Electrical energy	7 520 000	9 037 000	12 405 000
- Energy for development	5 625 000	9 610 000	13 700 000
- Transport energy	1 578 000	1 362 000	1 245 000
Programme 5 total	**20 535 000**	**26 121 000**	**33 608 000**
Atomic Energy Corporation			
Z-plant closure	273 209 000	273 442 000	223 506 000
AEC - strategic loans	38 000 000	29 408 000	21 673 000
Strategic loan re-payment	178 013 000	81 290 000	232 062 000
AEC total	**489 222 000**	**384 140 000**	**477 241 000**
Council for Nuclear Safety	**5 400 000**	**5 771 000**	**7 398 000**
Central Energy Fund Pty Ltd	**1 000**	**0**	**0**
Total energy - related	**515 158 000**	**668 386 000**	**777 727 000**

Table 5.3.1 DMEA energy-related budget summary (DMEA 1995b)

The 1995/6 energy-related budget for the DMEA is R716 374 000. Programme 5 indicated in the table above is the budget for the Chief Directorate Energy which is responsible for developing and administering energy related policies of the South African government. The Chief Directorate: Energy enjoys about 4% of the energy related expenditure. It has to be pointed out that these are very small percentages in terms of the Department's budget and that the amounts are small considering the size of the sector detailed in the rest of this document and the problems being experienced in the sector. Many commentators, including the International Energy Agency, which carried out an in-depth analysis of the South African energy sector in 1995, have made a direct link between the on-going problems in the energy sector and a lack of capacity in the DMEA. One of the obstacles to developing the required capacity is small amount budgeted for the Chief Directorate: Energy.

Explanation of individual items in the table

The amount allocated to "strategic loan repayment" refers to obligations entered into before the change of government for repayment of loans by the AEC and cannot easily be changed although it does not necessarily have to be administered through the DMEA budget. The Z-plant closure is also part of the unavoidable inheritance from the previous government. However, other amounts are budgeted for yearly and in terms of directives of the new government should be done on a "zero- based" principle.

In terms of understanding budget priorities it is useful to simplify the figures in table 5.3.1. above.

percent*		
1.8	5 812 000	Energy management
2.4	7 520 000	Electrical energy
1.8	5 625 000	Energy for development
0.5	1 578 000	Transport
6.4	**20 535 000**	**Total: Chief Directorate: Energy**
85.5	**273 209 000**	**Atomic Energy Corporation ****
1.7	**5 400 000**	**Council for Nuclear Safety**
0.0	**1 000**	**Central Energy Fund Pty Ltd**
100.0	**319 680 000**	**Total energy related****

* Of total energy - related less Z-plant closure and strategic loan repayment

** Less Z-plant closure and strategic loan repayment

Table 5.3.2 Energy-related DMEA budget for 1995/96**

The AEC budget of R273 209 000 accounts for more than 85.5% of the energy-related budget (less Z-plant closure and strategic loan repayment) that could be fairly said to be set by zero-based budgeting. The Chief Directorate: Energy accounts for 6.4% and the Council for Nuclear Safety for 1.7%.

The energy management budget comprises mainly staff costs in the Chief Directorate: Energy. Electrical Energy, energy for development and transport energy correspond to the three Energy Directorates, and the budget is mainly for professional services (mainly research and pilot projects).

Energy management and transport energy remain relatively unchanged from 1995/1996 to 1996/1997. Changes in the Energy for Development and Electrical Energy budgets can be in part attributed to increased activity in energy efficiency, low-smoke coal, biomass and off-grid electricity pilot projects. These increases result in an overall increase of 27% in the programme 5 (non-nuclear) budget.

The AEC budget

The AEC budget (excluding loan repayments and costs of closure of the Z-Plant) for 1995/96 was R 273 209 000 for 1995/96 compared with R 308 252 000 for 1994/95, a decrease of 11 percent. This then *rises* slightly in 1996/97 before dropping by 18 percent in 1997/98. More details on this budget are provided in section *4.4 - Nuclear energy.*

Period	Annual average (Nominal Rm)	% of DMEA budget	Annual average (1995 Rm)
1971/72 to 1975/76	21.2	32.0	250.6
1976/77 to 1980/81	110.7	40.8	740.6
1981/82 to 1985/86	363.0	70.3	1 336.5
1986/87 to 1990/91	686.2	79.9	1 403.5
1991/92 to 1995/96	524.5	70.3	619.3
Total 1971/72 to 1995/96	**8 528.0**	**69.3**	**21 753.3**

Table 5.3.3 Subsidies to the South African nuclear industry (Van Horen 1995)

Other state expenditure in the energy sector

CEF group companies

The budget presented to parliament described above does not give a complete picture of state-controlled expenditure in the energy sector. In the 1994/1995 years other amounts considerably larger than the parliamentary budget were disbursed by the CEF. Also, CEF, and companies in the CEF group posted large provisions for past or expected future losses in their balance sheets which can be seen as public funds which have been expended.

Over the years Soekor has spent about R1.24 billion of public funds exploring the Bredasdorp Basin off Mossel Bay for example, expenditure on Soekor by CEF for 1994/1995 was accounted for as follows: Soekor's balance sheet reflects an amount of R1 315 839 000 which is a long term loan from parent company CEF. CEF's balance sheet reflects this loan. In 1994/1995 CEF advanced an additional loan of R113 892 million to Soekor and increased provision for non-payment of Soekor's loan from R1 115 900 000 to R1 229 773 000 an amount of R113 873 million. In effect this amount was expended - a fact presented in CEF's income statement under an item named *Provision against loans to subsidiaries.* (This amount advanced to Soekor exceeds the Chief Directorate: Energy's budget by five times). The following were accounted for in a similar way in 1995 CEF annual report.

	Rands
Loans to Soekor	113 273 000
Loans to Enerkom [1]	4 648 000
Loans to Mossgas [2]	7 139 145 000
Total	**7 257 666 000**

(1) A grant of R5 155 000 was made to CEF by the DMEA to finance phase II of the Enerkom Oxicoal project.
(2) The provision for non-payment of Mossgas's debt to CEF follows on a report by the Auditor General which was critical of the carrying value of the investment previously shown in CEF's balance sheet.

Table 5.3.4 Increases in provision for non-payment of loans to CEF group companies by the CEF holding company (CEF 1995)

CEF income

Whilst most other government expenditure is funded from taxes, which, in conjunction with expenditure, are subject to the government budget presented to parliament, CEF funds its activities from its own revenues. Whilst Mossgas has not generated sufficient income to even service its debt obligations and Soekor's exploration costs have yet to be adequately rewarded by a large oil or gas find, SFF manages to produce a large operating surplus. Whilst the figures given in the 1994/95 annual financial statements are not sufficiently detailed to provide a breakdown of SFF's revenue sources the control of about R2.5 billion in cash and short term deposits at 31 March 1995 represents a considerable asset for generating funds. The other main asset for generating income is SFF's control of about 40 million barrels of oil (at US$ 17/barrel = 680 million US$) with an approximate value of R2.7 billion. This oil, combined with storage facilities represents a considerable state-owned asset in terms of South Africa's energy supply system.

Synfuel subsidies

Although these have been mentioned in more detail in section 4.2 on liquid fuels a summary is repeated here to complete the picture of large transfers of public funds in the energy sector. These are financed by the imposition of the *equalisation levy* on liquid fuel sales and administered by CEF.

	Rands
Subsidy to Mossgas	413 000 000
Subsidy to Sasol	1 100 000 000
Total	**1 513 000 000**

Table 5.3.5 Synfuel subsidies 1994-95

Chapter Six

Conclusion

6.1 Conclusions drawn from previous chapters

The main conclusion drawn from chapter 1 is that the previous orientation of policy in South Africa and the way that policy was made had a strong negative effect on the development of information for public policy making in the energy sector. In the post-1994-election period an attempt has been made to improve this situation but the availability of information formulated to facilitate good policy making is still inadequate.

From chapter 3 on energy demand it is clear that the arrangement of the energy sector reflects the historical structure of both the economy and society and that over the past fifty years these structures have changed fundamentally. Future planned changes in the economy, as indicated by the extract from a Department of Trade and Industry (DTI) document and changes in society, as exemplified by the national electrification programme and the rapid growth in demand for petrol caused by motor vehicle use, have important implications for changes in energy demand patterns. Government social and economic policies play an active role in shaping these changes and it is important that energy policy that is developed by government is well coordinated with other policies.

The first conclusion from chapter 4 on the energy supply system is that in terms of resources, primary production and the supply of energy to industry, commerce, households in the previously defined white local authority areas and transport fuels, South Africa has a well-functioning energy supply industry that provides good quality products country-wide at amongst the lowest prices in the world. However, there is also significant room and a need for improvements:

- firstly, in developing energy supplies that are more appropriately orientated towards the majority of the population who still remain without electricity - these people also often pay needlessly high prices for other fuels and suffer severe health and environmental problems associated with the household energy use;
- secondly, to address the role of state enterprises such as the Central Energy Fund, the Strategic Fuel Fund, Soekor, Mossgas, and the Atomic Energy Corporation which were essentially developed to serve the economy and society of the previous era but whose usefulness now needs to be re-evaluated, and;
- thirdly, to re-examine the structure and regulation of the energy supply subsectors, which are clearly the result of past national economic and social policy, in the light of the social and economic policies of the new dispensation.

The second conclusion that emerges from chapter 4 on energy supply subsectors is that there is pervasive intervention by the state, both historically, in developing the energy supply system, and currently, in ownership, intervention and regulation. While the coal production system is privately owned its main customers are either parastatals or previously state-owned synfuels plants which are still strongly influenced by government regulation. State-controlled transport infrastructure and tariffs have a strong influence on other coal prices. All phases of the electricity industry namely generation, transmission and distribution, are almost entirely publicly owned. The liquid fuels industry has a history of state involvement through development of a large synfuels industry and regulation of product imports and regulatin of prices and the industry remains tightly regulated.

An overwhelming conclusion ***emerges from chapter 5 on governance.*** The energy governance structures and budgets inherited from the previous government, which had very different needs from the present, are still in place. The DMEA Chief Directorate: Energy is struggling to carry out its responsibilities with inadequate staffing of 35 civil servants of whom only 21 are professionals, and a budget of about R26 million. However, parallel to this, the CEF/SFF organisation with assets such as R2.5 billion in cash and short term deposits to generate operating funds and a staff of 340 who are paid market related salaries, is also involved in policy development. Also, while the DMEA's activity, specially its budget and expenditure, is under close scrutiny of the new government, decision on expenditures of amounts an order of magnitude greater than the entire Chief Directorate: Energy's budget are made by CEF/SFF outside of this type of public scrutiny. Within the parliamentary budget, the AEC continues to receive about

85% of the energy related budget of the DMEA (excluding provisions for past commitments such as strategic loans and the Z-plant closure).

An additional conclusion from chapter 5 on governance is that the size of flows of public funds in terms of revenue and appropriations in the energy sector *outside* of the parliamentary budget are orders of magnitude larger than the flows within the budget. This raises questions of integrated economic planning and accountability which are unequivocally stated policies of the new democratically elected government.

In summary the Chief Directorate: Energy does not have the capacity to develop adequate policy for these large organisations under its responsibility or to provide the necessary independent evaluation of their performance.

6.2 Gaps in information

As stated in the preface and introduction, the production of this document has been largely in response to the lack of an overall description of the South African energy sector to be used in conjunction with the Energy Policy Discussion Document. Prior to the publication of Energy Statistics No 2 (DMEA & Eskom 1995) in late 1995, the most comprehensive set of official published government statistics on the energy sector was Energy Statistics No 1 (DMEA 1989) which excluded all information on liquid fuels, including for example, the amount of coal used to manufacture liquid fuels. South Africa Energy Statistics No 2 does include liquid fuels but important quantities, such as imports and exports of refined products are excluded. Also, the document was published at the end of 1995 but statistics are only given up until 1993. The collection and collation of data needs to be streamlined so that more current data are available.

To produce a current description of the energy sector in South Africa requires the assembly of information from a wide variety of sources. In many cases the only sources are the large energy suppliers who are under no legal obligation to provide data and in many cases are very reluctant to do so. In other important cases, particularly for data on consumption of energy, data have not been collected.

The International Energy Agency produced a report on the South Africa energy sector (IEA 1996) which was released in May 1996. In that report it states:

> "The lack of good data is a major weakness in the energy policy making process in South Africa. It also hinders transparency in the energy sector."

In the same report the IEA also states:

> "The energy policy making capacity of the Department of Mineral and Energy Affairs is currently weak, in part due to the fact that historically most energy policy making has *de facto* been performed by the energy industry itself."

While the situation in South Africa has improved vastly since the repeal of, for example, the provisions of the Petroleum Products Act which prohibited the publication of information on liquid fuels, the situation is far from satisfactory in terms of information on the energy sector. This makes it impossible for government to produce policies for the sector in the inclusive, accountable and transparent manner which it has committed itself to and also. makes it very difficult for the public and civil society to engage effectively in the policy process and to monitor the results of the policies which are implemented.

In theory, new South African legislation pertaining to freedom of information would oblige the state to make information that it collected on the energy sector available to any party that requested the information. Also, the government does not have a legal right to compel energy suppliers , or users, to provide energy data. Paradoxically, the combination of these legal conditions makes it even less likely that many parties will divulge statistics than they were in the past.

At present, the large energy suppliers have arguably the best data available on their particular subsectors. Some suppliers publish good statistics. However, information is generally not available in a coherent form across the whole energy sector. Government will only be able to change the practice of making energy policy when it provides both itself, the public and civil society with the information necessary for making an input to policy decisions and monitoring the implementation and results of those policies. This can only be achieved if the structures and processes for collection, analysis and dissemination of information on the energy sector undergo major improvements.

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South African Energy Policy Discussion Document - Vol II Overview of the South African energy sector

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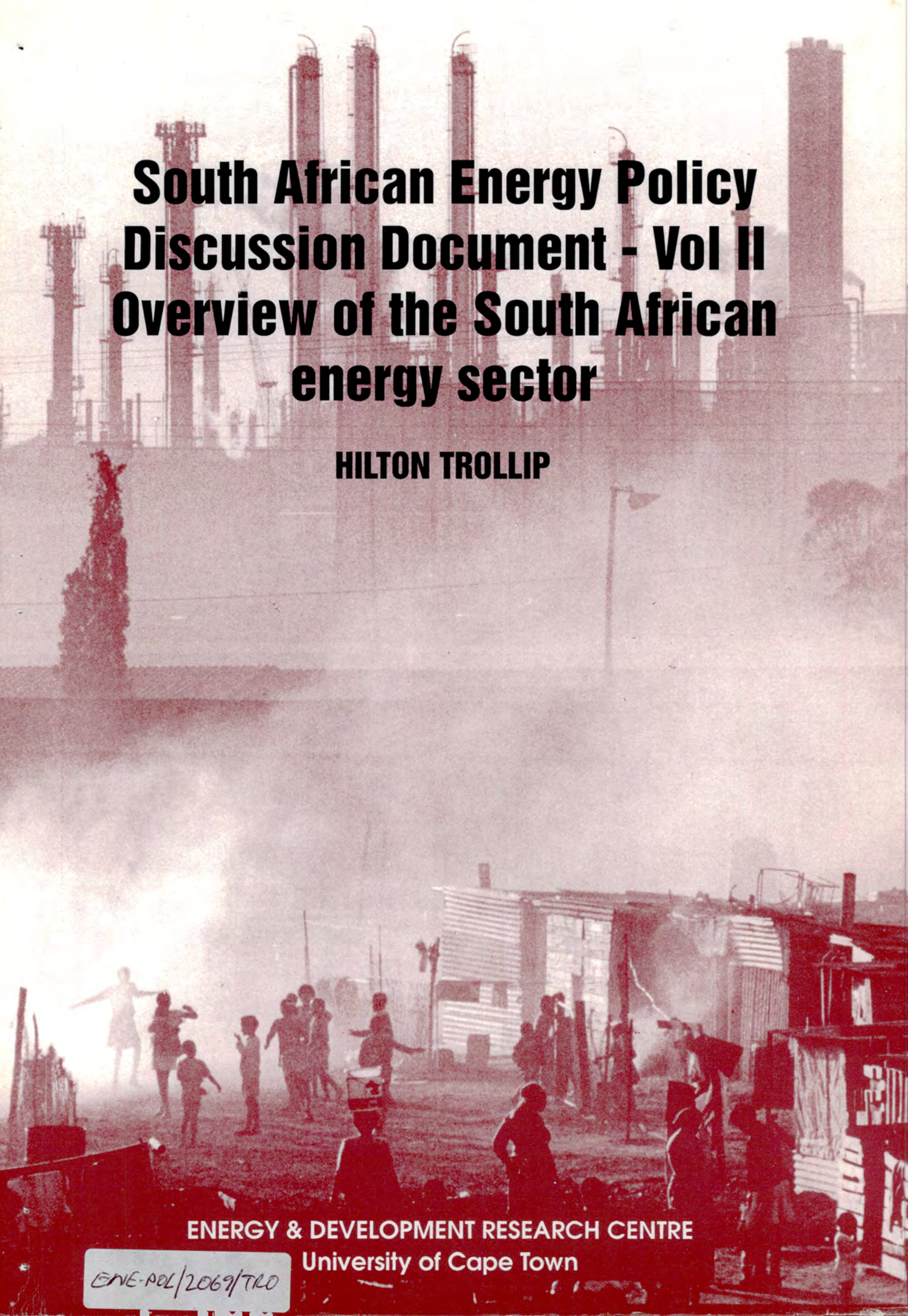

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