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Natural resource accounts

Energy accounts for South Africa, 1995–2001

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Natural resource accounts: Energy accounts for South Africa, 1995–2000: Discussion document

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Preface

This report contains the natural resource accounts for energy in South Africa from 1995 to 2001. The report has been compiled in accordance with the recommendations of the System of Integrated Environmental and Economic Accounting 2003 (SEEA 2003).

The SEEA 2003 defines natural resource accounting as 'an accounting system that deals with stocks and stocks changes of natural assets, comprising biota (produced or wild), subsoil assets (proven reserves), water and land with their aquatic and terrestrial ecosystems. It is frequently used in the sense of physical accounting as distinguished from monetary (environmental) accounting.'

This document is for discussion and to obtain comments and/or suggestions from all the relevant stakeholders and users. It will only be made available on the Statistics South Africa website[1].

[1] www.statssa.gov.za

List of abbreviations

CO_2	Carbon dioxide
DME	Department of Minerals and Energy
GDP	Gross Domestic Product
GW	Giga watt
IAEA	International Atomic Energy Agency
IEA	International Energy Agency
IMF	International Monetary Fund
LPG	Liquefied petroleum gas
Mmt	Million metric tons
NEA	National Energy Agency
NOX	Nitrogen oxide
OECD	Organization for Economic Cooperation and Development
PBMR	Pebble bed modular reactor
PJ	Petajoule
SEEA	System of Integrated Environmental and Economic Accounting
UN	United Nations
TWh	Terawatt hour
TJ	Terajoules
PV	Photovoltaic
SNA	System of National Accounts
SOX	Sulphur oxide

Contents

1. Introduction

Natural resource and environmental accounts aim at collecting qualitative and quantitative information on both the state of natural resources and their evolution, within a consistent framework. The general purpose of natural resource accounts is to provide policy-makers with an information base on natural resources and to contribute to the general awareness of the environmental issues at each level of decision-making, and of the general public.

Energy accounts are of considerable interest in their own right, especially for countries heavily involved in oil mining and processing. Also, every economy in the world depends on the availability of oil and other energy sources. The use of energy is critical to the economy, because almost all economic activities are connected either directly or indirectly to the consumption of energy.

Energy accounts provide information about the levels of direct energy consumption of industries regarding their production process and private households. These accounts can also provide information on changes in the energy requirements of particular industries in relation to their output. This shows the macro level impacts of new technologies and eco-efficiency measures and behavioural changes. They are also an indispensable prerequisite for reliable estimates of air emissions related to energy consumption.

The South African economy can be considered as energy intensive. This is because it is still based on primary extraction and the processing of coal and uranium. South Africa's indigenous energy resource base is dominated by coal, primarily because it is relatively cheap and plentiful. Many of the deposits can be exploited at extremely favourable costs and, as a result, a large coal mining industry has developed[2]. In addition to the extensive use of coal in the domestic economy, large amounts are exported, mainly through the Richards Bay Coal Terminal to European countries and the Far East. Apart from coal, South Africa sources energy locally from biomass (such

[2] According to the Mineral Accounts for South Africa (Report no.04-05-02; 1980 – 2001) in 2001 there were 246 years left before coal will be depleted at the current rate of extraction of 223,5 tons a year.

as wood and dung)[3], natural gas, hydropower, nuclear power, solar power and wind power. South Africa has very little oil reserves and therefore, the majority of our crude oil is imported. South Africa also has fairly small gas fields, off her south coast, which supply Mossgas. Renewable energy sources, other than biomass, have not yet been exploited to the full in South Africa.

South Africa has very large coal and uranium reserves (coal reserves were estimated at 55 billion tons in 2002 and the estimate of reasonably assured uranium resources was 205 000 tons)[4]; limited reserves of hydropower; a large potential for solar power, especially in the Northern Cape; and considerable potential for wind power in the coastal regions.

The aim of this discussion document is to present and discuss the energy accounts for South Africa from 1995 to 2001.

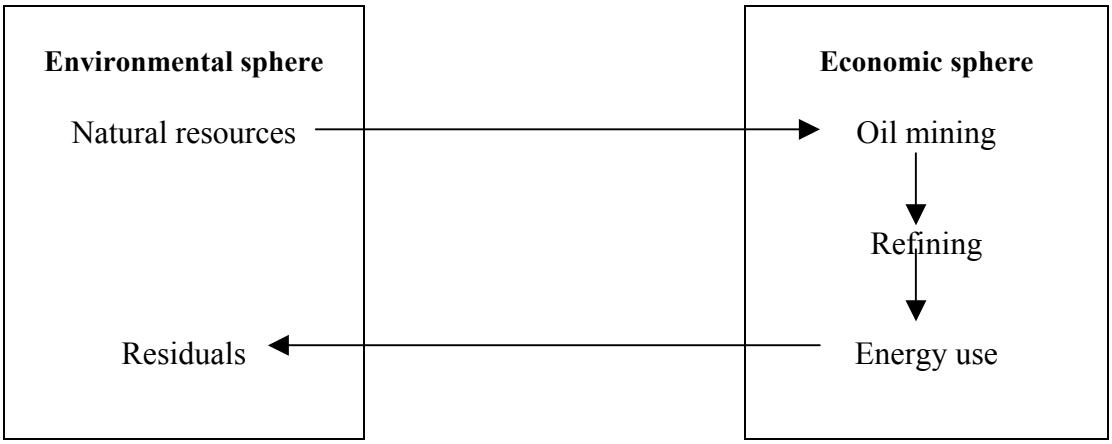
[3] See Residential Sector (3.2.4) for more information on this.
[4] Energy Outlook for South Africa: 2002

2. International guidelines

Energy accounts usually embrace all four types of physical flows: natural resource extraction (coal, crude oil, natural gas), ecosystem inputs (oxygen combustion), products (energy fuels such as petrol, diesel etc.) and residuals generated by the use of fossil fuels. (Emissions to air and other residuals such as ashes are dealt with separately in the emission accounts).

Figure 1 summarises the scope of the energy accounts.

Figure 1: Scope of energy accounts in the case of oil



Source*: Integrated Environmental and Economic Accounting: 2003*

Physical energy accounts should be constructed in extended supply and use tables. Usually the energy supply and use accounts will include both the monetary as well as the physical units. In the South African energy accounts, we however only used the physical units, which are converted to terajoules (TJ) to give total energy use and total energy supply, since the monetary values are not easily available.

2.1 Energy supply table

Supply of products is defined as domestic production plus import of the various energy commodities. The two main sources used to obtain data on the supply of energy are production statistics and foreign trade statistics. It is important that the nomenclatures of these two sources be absolutely compatible. Both the production

and the foreign trade statistics will normally provide data on the monetary value as measured in basic prices of the energy commodities both produced domestically and imported as well as the corresponding physical quantities thereof.

If only monetary values are available, the data can be supplemented with data from the sort of energy balances of the country and made compliant by the International Energy Agency (IEA). However some energy types are not commodities in the narrow sense of the word, for example many renewable resources are not tradable, like for example wind. The physical supply of such renewables is thus determined by the total use, while the supply in monetary terms is determined either by the unit value of relevant substitutes (or some other 'rule of thumb') or set to zero, depending on the corresponding market prices. Foreign trade statistics are used as a source of information for imports and exports of the different energy commodities.

Table 1 shows an example of the energy supply table used by Denmark, which was published in SEEA 2003.

Table 1: Sample supply table for energy

	Crude oil	**Natural gas**	**Coal and lignite**	**Petroleum products**	**Gas to users**	**Electricity**	**Steam and hot water**	**Wood, straw and waste**	**Total energy use**	
	1000 tons	*Million m^3*	*1000 tons*	*1000 tons*	*Million m^3*	*TWh*	*PJ*	*1000 tons*	*PJ*	*Billion DKK*
a. Domestic production										
b. Imports										
c. Total supply (a+b)										

Source*: SEEA 2003*

2.2 Energy use table

Total product use is defined by the intermediate use by industries, household consumption, inventory changes and exports. The use table shows the use of natural resources, for example; the use of coal, gas and oil extracted by the mining industries.

An important distinction has to be made between primary energy sources, separated into fossil fuels and renewable energy sources (such as water power and solar energy), and secondary energy sources such as electricity and refined petroleum products which have been produced from the transformation of a primary energy source.

The level of disaggregation of the table depends both on the number of energy commodities and the number of industries published in the national accounts. Naturally, the usefulness of the system increases with disaggregation as does the complexity of establishing the system. Compiling a comprehensive view of the energy use table therefore typically involves combining all sorts of data together with assumptions (for example estimating private transport to be equal to 75% of total transport) and well-defined calculation procedures. Often definitive information is available at an aggregate or semi-aggregate level and this data is used as control totals in determining entries at a lower level of aggregation.

When determining the use of the different energy commodities by industries and households, the first group of data consists of information from surveys explicitly concerned with energy consumption. In many countries, including South Africa, these are conducted regularly (in South Africa, normally every three years) for manufacturing, hereby providing industry specific data on the use of a number of energy products. Surveys on service industries and households are also conducted in some countries, including South Africa. If not conducted yearly, the data must be projected or estimated using various indices and other supporting data[5].

In some cases the survey data includes information in both physical quantities and monetary values. If not, accounting data may give more or less detailed information on the amount spent on energy by industry, measured in monetary terms, thus providing important information on the value dimension of the industry-specific control totals. This, together with information on price statistics can help to determine a control total in physical terms also. Best use of both physical and monetary data should be made in populating the use table, typically making use of the one dimension in determining the other in a supplementary way.

[5] SEEA 2003

Table 2 shows an example of the energy use table used by Denmark, which was published in SEEA 2003.

Table 2: Sample use table for energy

	Crude oil	Natural gas	Coal and lignite	Petroleum products	Gas to users	Electricity	Steam and hot water	Wood, straw and waste	Total energy use	
	1000 tons	*Million m^3*	*1000 tons*	*1000 tons*	*Million m^3*	*TWh*	*PJ*	*1000 tons*	*PJ*	*Billion DKK*
a. Intermediate consumption by industries										
Agriculture, fishing and quarrying										
Manufacturing										
Electricity, gas and water supply										
Construction										
Wholesale and retail traders										
Transport, storage and communication										
Financial intermediation										
Public and personal services										
b. Inventory changes										
c. Total private consumption										
Own account transportation by cars										
Heating, use of electricity etc.										
d. Exports										
e. Losses in distribution										
f. Total use (a+b+c+d+e)										

Source*: SEEA 2003*

Bringing the system into balance means that for any commodity the total supply must equal the total use, and for any industry the sum of its uses of each of the energy commodities must equal some given level (which might be one of the control totals).

As the whole system tends to be rather large, it often pays to balance smaller blocks of the system separately before putting the whole system together. The balancing has to be done by first filling out the parts, which are known with a fair degree of certainty and then determining the remainder of the system using progressively less hard data and more assumptions.

All of the resources used are expressed in their own specific physical units. These units are then all converted to petajoules (PJ) in order to calculate total energy use. In the Energy Balances – RSA, which is the main data source, terajoules (TJ) are used instead of petajoules, so the energy account for South Africa will also be expressed in terajoules. A distinction is made between primary and secondary energy sources. Primary sources are in the form in which they appear in the environment and thus synonymous with natural resources; secondary sources are in the form in which they are finally consumed in the economy and are thus products. Crude oil, natural gas, coal, wood and straw could be shown as natural resources flowing from the environment to the extraction industries of the economy but for the purpose of this account are shown as products; that is, as outputs of the economy.

For petroleum products, gas to users, electricity, and steam and hot water, the domestic production is a result of the conversion of primary energy types into final energy types. Thus, there is a double counting in the sense that both primary energy (for example, coal) and the secondary energy (for example, electricity produced by coal) are included. This, however, is not different from other monetary and physical supply tables for products in which both raw materials and finished products appear.

The use table for energy has exactly the same headings as the supply table. For each group the total use is equal to the total supply. However, one additional entry, 'losses in distribution, etc.', is included in the use table in order to take explicit account for the losses that take place when the energy is distributed from supplier to user by pipe, wire, ship, truck or other means of transportation. As an alternative to the explicit accounting, the physical losses in distribution should be allocated to the users of the energy.

3. South African classifications

The following changes were made to the framework recommended in the SEEA 2003 to adapt it to South African circumstances:

- The following columns were excluded: natural gas; steam and hot water; wood, straw and waste.
- The following columns were included: nuclear power; hydropower; renewables and waste.

The following rows were changed: Electricity, gas and water supply; wholesale and retail traders; financial intermediation; and public services were all included under 'commercial sector' in the South African tables because the data for South Africa does not allow the breakdown of the commercial sector according to categories.

The above changes were made in order for the framework to better apply to the resources and sectors used in South Africa. All the data used in the account are from the Department of Minerals and Energy.

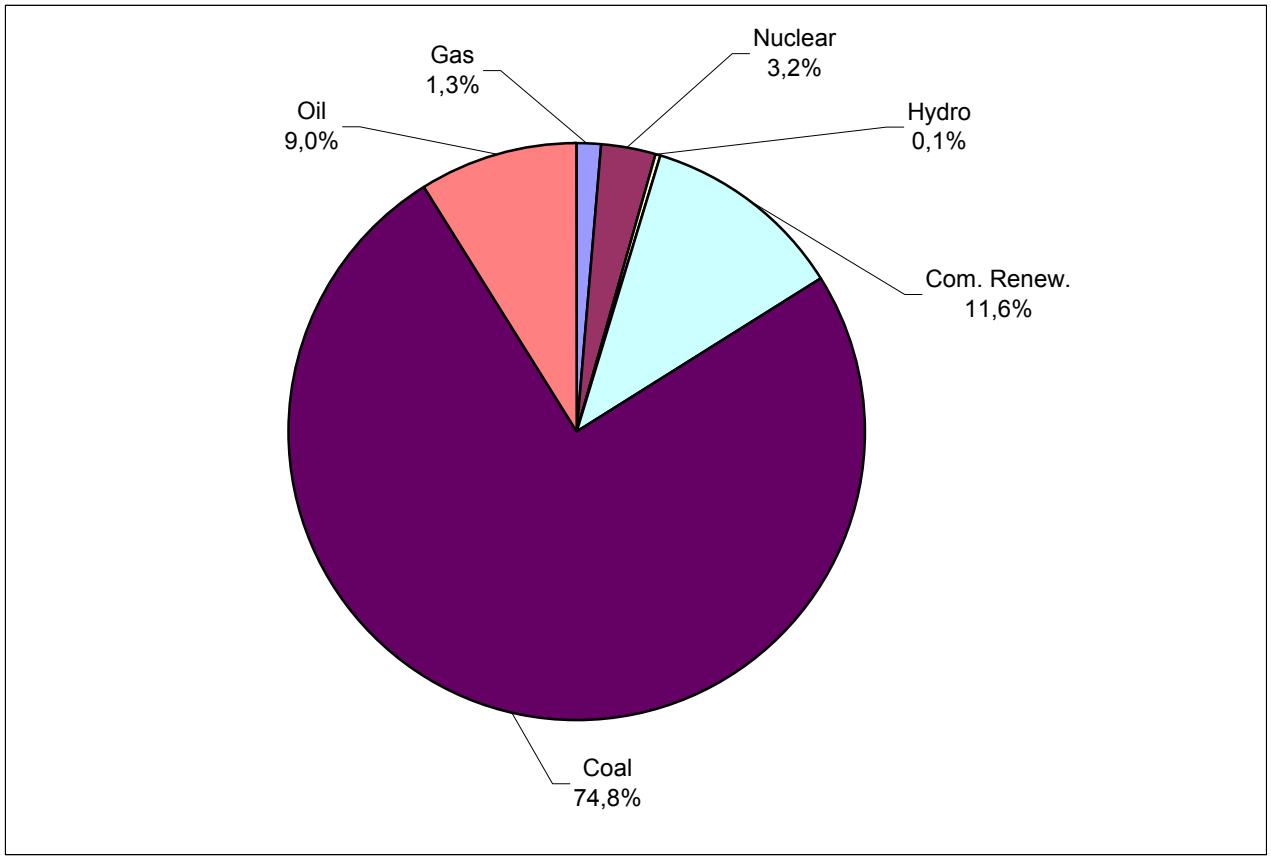
In South Africa's case road transport users were separated into passengers and freight based on the assumption that passengers constituted 75% of transport used on roads, and freight the remaining 25% in 2000[6]. This 'ratio' was used as the basis for the energy use accounts.

3.1 Energy resources

The main energy resources in the South African economy are coal, oil, gas, nuclear power, hydropower and renewable sources such as wind, solar, biomass and wave power. Figure 2, gives the percentage distribution of energy to total primary energy supply in South Africa during 2000[7].

[6] Based on data from the Energy Outlook for South Africa: 2002
[7] Based on data from the Energy Outlook for South Africa: 2002

Figure 2: Percentage distribution of energy to total primary energy supply in South Africa, 2000



Source*: International Energy Agency*

The abbreviation Com. Renew. refers to renewable resources such as biomass, wind and solar power. Figure 2 shows that the main energy source supplied in 2000 was coal (74,8%), followed by commercial renewables (11,6%), oil (9,0%) and nuclear power (3,2%).

3.1.1 Coal

Internationally, during 2002, coal was the most widely used primary fuel, accounting for approximately 36% of the world's electricity production. This situation is likely to remain until at least 2020[8].

[8] According to Eskom, South Africa

In South Africa, for the year 2002, about 77% of the primary energy needs were provided for by coal. This is unlikely to change significantly in the next decade, due to the relative lack of suitable alternatives to coal as an energy source. South Africa's coal production feeds the various local industries, with 53% used for electricity generation. In 2002, South Africa's coal reserves were estimated at 53 billion tonnes, and with the present production rate there should be almost 200 years of coal supply left[9]. According to the latest natural resource accounts report for minerals, published by Statistics South Africa in 2004 (Report no. 04-05-02; 1980 to 2001), in 2001 there was 246 years left to depletion, given current rates of extraction and proven resources.

Producing electricity from coal starts when coal is pulverized in huge mills into a fine powder before it is blown into boilers. Due to the heat in the boiler, the coal particles combust and burn to generate heat to turn water into steam. The steam from the boilers is used to turn the blades of a turbine. The turbine turns the generator. The generator then produces an electric current, which is sent to the homes and factories of consumers via power lines.

- The ***advantages*** of coal power for South Africa are that our country has abundant coal reserves, coal-fired power stations are reliable, our infrastructure to generate electricity from coal is well established and burning coal is the most cost-effective and energy efficient way of generating electricity.

- The ***disadvantages*** are that coal has the most waste problems of all energy sources, building coal-fired power stations is a long and expensive process and South Africa's coal fields are concentrated in Mpumalanga, which limits the location options for power stations.

3.1.2 Wind power

For centuries, the energy created by wind has been caught and used for milling, pumping and other things. Only in the past 50 years or so has South Africa started to use wind energy to generate electricity on a small and large scale.

[9] According to Eskom, South Africa: www.eskom.co.za

- The ***advantages*** of using wind power to generate electricity are that it is freely available, it is renewable, clean and does not give off harmful gases. South Africa's coastal regions are ideal for use of this technology.

- The ***disadvantages*** are that wind doesn't always blow, and wind generators create noise and are expensive to build, which means the electricity will be expensive for consumers.

3.1.3 Solar power

Photovoltaic (PV) or solar modules are made up of solar cells that are connected in series. The most common commercial cells are made from purified silicon. The silicon cell is essentially a p-n junction that utilises the energy from the sunlight to generate electron flow from the p-type Silicon to the n-type Silicon. A typical solar module comprises of 36 cells connected in series to produce an operating voltage of 12V.

PV systems often include a battery bank for energy storage, and a charge controller that regulates the power flow into and out of the battery bank. Battery banks are typically sized in order to provide energy during days of no or limited sunshine.

The main benefit of using solar energy is access to inexpensive electric power in remote areas that are not connected to the national supply network. Schools in remote areas in particular can make use of electronic media as a result of this technology.

- The ***advantages*** of solar power are that it is renewable, clean and has no direct emissions. Solar panels can be used almost anywhere in South Africa and are suitable for low energy use such as lights and television.

- The ***disadvantage*** is that without battery storage, the energy is not available all the time and the equipment is expensive.

3.1.4 Wave power

Waves are a free and sustainable energy source created as wind blows over the ocean surface. Energy is stored in these waves until it reaches the shallows and beaches of South Africa's coasts where it is released.

Wave power technology involves two basic elements; a collector to capture the wave energy and a turbo generator to transform the wave power into electricity.

Eskom is currently looking into the resource availability of wave power along the east and west coastlines of South Africa. The process is to capture wave data and manipulate the data to determine the possibility of investing money into similar projects. Once the resource assessment has been completed and if the results are positive, then Eskom will begin doing laboratory tests on different ocean energy conversion technologies. These tests will enable us to choose the best technology to be used on our coastlines. No time has yet been set as to when these tests will be conducted.

3.1.5 Biomass power

Biomass is raw or processed plant material and includes agricultural residues, wood waste, paper trash, municipal solid waste, energy crops and methane captured from landfill sites. Unlike fossil fuels, biomass is renewable in the sense that only a short period of time is needed to replace what is used as an energy source. This biomass can be used to generate electricity, heat or liquid fuels.

- The ***advantages*** are that the energy source is renewable, it reduces the emissions of nitrogen oxide (NOX) and sulphur oxide (SOX) in power generation and if waste is used, the cost of fuel can be close to zero and in some cases negative.

- The ***disadvantages*** are that the capital cost of building a biomass power plant is high and if dedicated fast-growing crops are used it must compete with other agricultural activities for land. It can

therefore be an expensive type of fuel. Fast-growing crops need substantial land area and transport of fuel can be expensive, even if it is free. Proximity of the power plant to the fuel source is therefore an important consideration in terms of location.

3.1.6 Nuclear power

Nuclear energy is used widely to produce electricity. Simply put, nuclear power generation is the harnessing of the energy created by a nuclear reaction. To produce electricity an energy source is needed to drive the turbines in a power station. In a nuclear power station, that energy comes from the splitting of atoms of uranium – a process known as fission. Considerable heat is generated from this fission reaction, and it becomes the energy source that boils water to steam. The steam ultimately drives the power station's turbines.

- The ***advantage*** of nuclear power generation is that it is safe. Generating electricity from nuclear power does not lead to carbon dioxide emissions and other 'greenhouse' gases that can damage the environment. The process produces small volumes of waste to dispose of.

- The ***disadvantages*** are that nuclear energy is often associated with nuclear weapons and there are concerns about nuclear waste safety. Nuclear stations with engineering safety systems are expensive, mainly because of the systems needed to ensure their safety. Waste disposal is also expensive. The Pebble Bed Modular Reactor (PBMR) technology, however, is inherently safe and therefore more affordable.

3.1.7 Hydropower

Hydro electricity can be divided into two sections, namely, conventional hydropower and micro hydropower. These are discussed further below.

3.1.7.1 Conventional hydropower

In a hydroelectric scheme, water is stored in a dam and passed through a turbine and generator set before being released back into the river downstream. It is important to note that the power station does not consume any water in this process; it only uses the energy contained in running water to turn its turbines.

- The ***advantage*** of using hydropower is that water is a renewable source of energy. The process of electricity generation has no emissions.

- The problem in South Africa though is that it is a dry country with few rivers suitable for hydroelectric plants.

3.1.7.2 Micro hydropower

Micro hydropower is a technically and economically feasible remote area power supply technology option at suitable sites. A typical micro-hydropower scheme diverts water from a river using a dam or weir. The intake is protected using a screen. The water is transported to the forebay using a canal or pipeline. From the forebay the water is taken to the turbine by the penstock. The turbines drive a generator either directly or by means of a mechanical transmission. Electricity can be transmitted by means of an underground cable or overhead line.

Micro hydropower is highly site specific. The site needs to have a constant supply of water falling through a specific height. The amount of water and the height it falls through will determine the amount of power available. Maintenance on the turbine and generating plant is minimal, although civil works, such as the dam, require periodic maintenance.

- The ***advantages*** of using micro hydropower are that power is continuous and available on demand, the process is environmentally friendly, limited maintenance is required, running costs are low and the technology is long-lasting and robust.

- The ***disadvantage*** is that Eskom has concluded that micro hydropower is not a feasible option for South African circumstances. It is not economically viable at this stage.

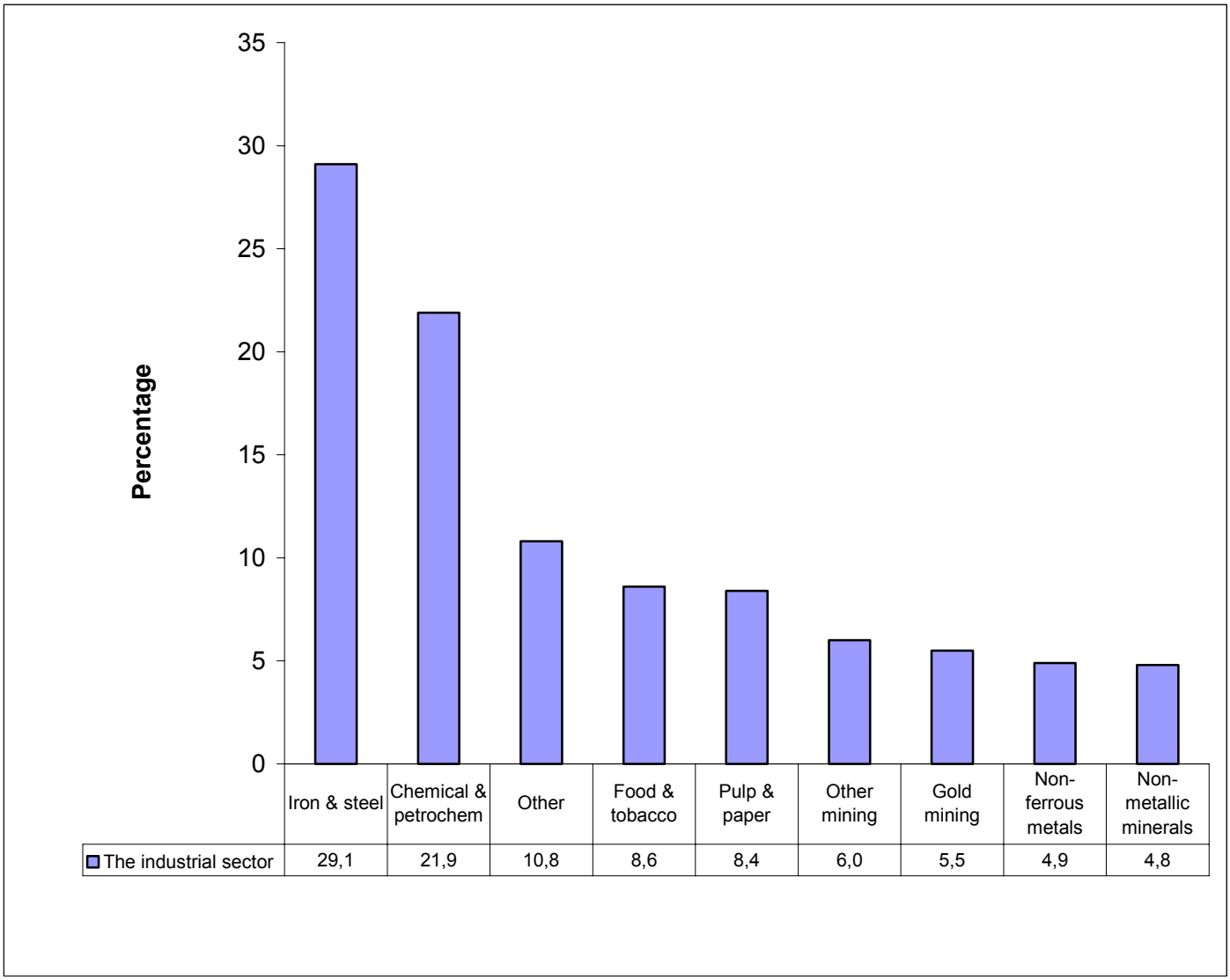
3.2 Sectors concerned with energy use

For the purpose of energy use the South African economy can be divided into the following sectors: industrial, commercial, agricultural, residential and transport. Each of these sectors is discussed in more detail below.

3.2.1 The industrial sector

The industrial sector uses the largest amount of energy and electricity in South Africa. The sector is divided into eight sub-sectors: mining, iron and steel, non-ferrous metals, chemicals and petrochemicals, non-metallic minerals, pulp and paper, food and tobacco, and other. Figure 3 shows the percentage of energy used in each of the above-mentioned industrial sub-sectors.

Figure 3: Percentage distribution of energy used in each of the industrial sub-sectors for South Africa, 2000

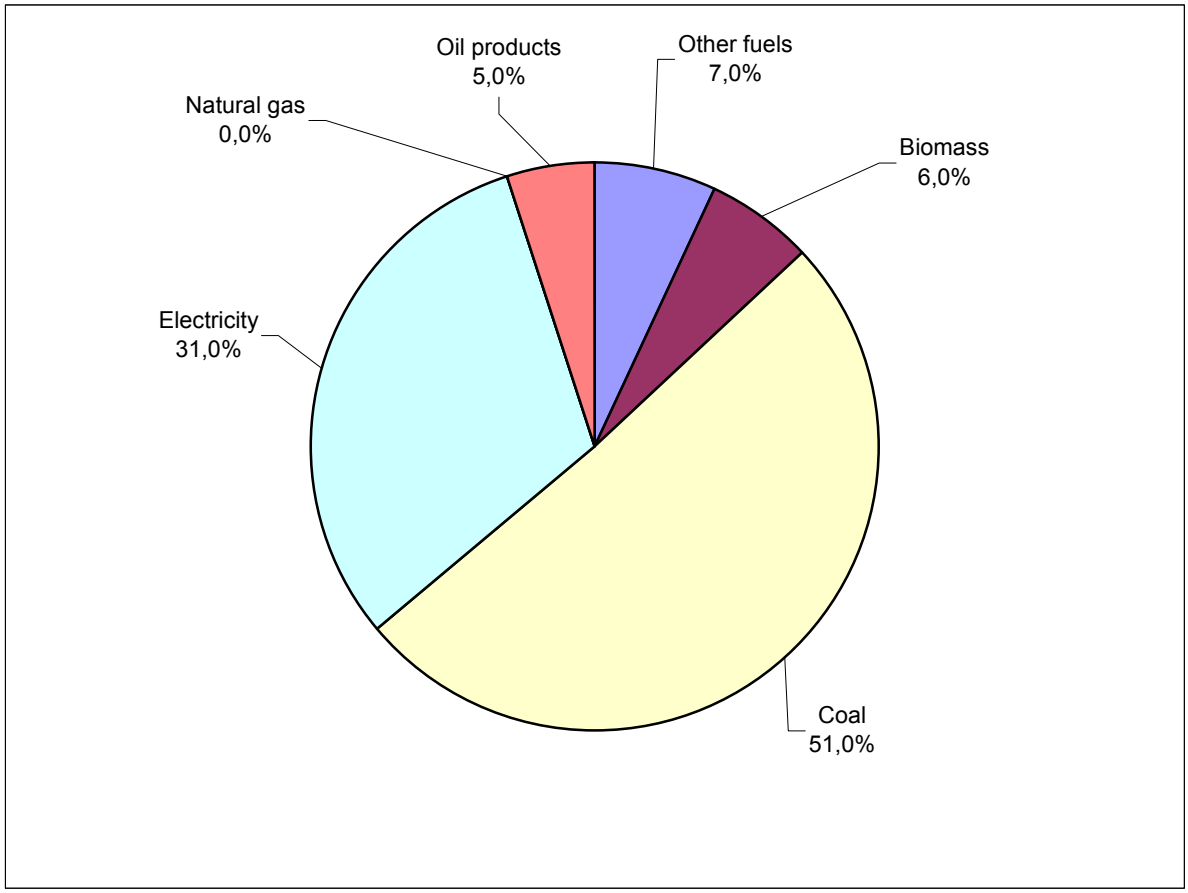


Source: *Energy Outlook for South Africa: 2002*

It can be seen in Figure 3 that the iron and steel sector used the highest percentage of energy in the industrial sector (29,1%) in 2000 followed by the chemical and petroleum sector (21,9%). Non-metallic minerals used the lowest percentage of energy at 4,8%.

Figure 4 below shows the percentage distribution of energy types used in the industrial sector in South Africa during 2000.

Figure 4: Percentage distribution of energy types used in the industrial sector in South Africa, 2000



Source*: Energy Outlook for South Africa: 2002*

From Figure 4, we can see that coal (51,0%) was the biggest resource used in the industrial sector in 2000, followed by electricity (31,0%), other fuels (7,0%) and biomass (6,0%).

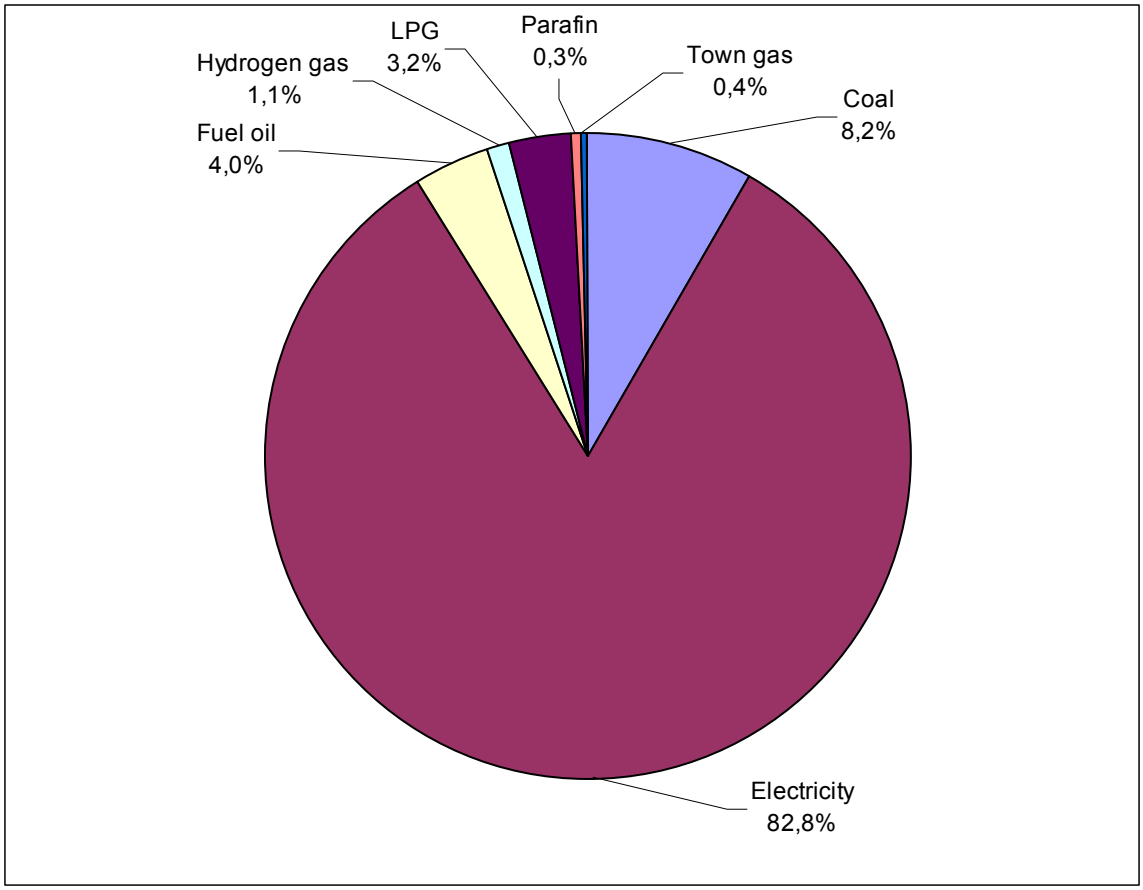
3.2.2 The commercial sector

The commercial sector consists of government, office buildings, financial institutions, shops, recreation and education, as classified by the Department of Minerals and Energy (DME).

Energy in this sector is used mainly for lighting, heating and air-conditioning but, office machines such as computers, fax machines and printers are starting to play a

bigger role as energy users. Electricity contributes the most to the commercial sector's energy use. According to the DME [10] it is believed that electricity is likely to take an even bigger share of energy for this sector. Figure 5 shows the percentage distribution of energy types used in the commercial sector in South Africa during 2000.

Figure 5: Percentage distribution of energy types used in the commercial sector in South Africa, 2000



Source: *Energy Outlook for South Africa: 2002*

Figure 5 shows that electricity is the largest contributor (82,8%) to the commercial sector, followed by coal (8,2%) and fuel oil (4,0%). This can be attributed to the fact that the commercial sector consists mainly of office buildings, which are largely dependent on electricity as an energy resource.

[10] Energy Outlook for South Africa, 2002

3.2.3 The agricultural sector

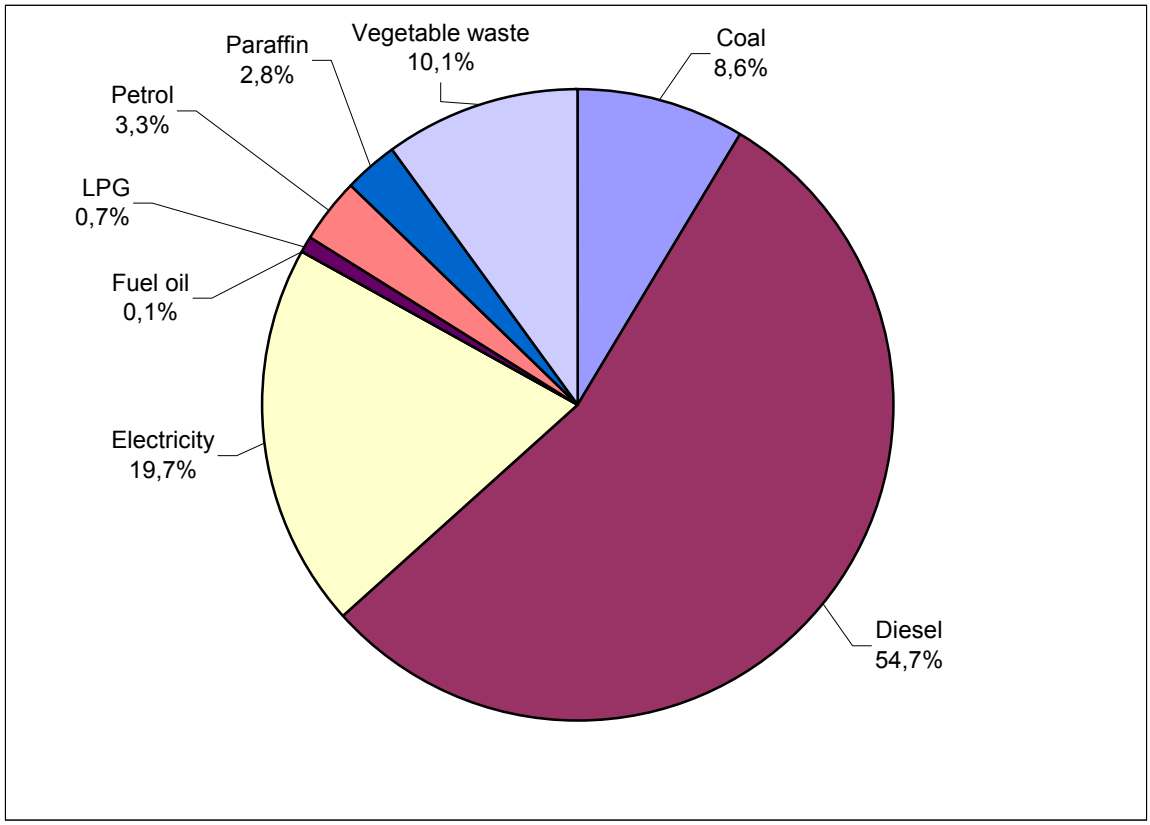
As economies mature, agriculture forms a smaller share of the national employment, large farms replace smaller ones and agriculture produces a smaller fraction of GDP[11].

With land reform, many new small farms are likely to arise, and these will almost certainly use traditional farming methods on small plots, including the use of vegetable wastes for energy. On the other hand, globalisation and commercialisation of farming is likely to lead to fewer commercial farmers with bigger farms and increased exports and imports. This will lead to a search for more energy efficiency.

The latter trend is almost certain to prevail for agricultural energy demand and it is expected that the importance of diesel and electricity will increase, while that of vegetable wastes will decline. Figure 6 shows the percentage distribution of energy types used in the agricultural sector in South Africa during 2000.

[11] Energy Outlook for South Africa: 2002

Figure 6: Percentage distribution of energy types used in the agricultural sector in South Africa, 2000



Source*: Energy Outlook for South Africa: 2002*

Figure 6 shows that diesel (54,7%) was the major energy resource used in the agricultural sector. This is mainly because farm equipment, such as tractors, operates on diesel. Electricity (19,7%) was the second highest contributor followed by vegetable waste (10,1%).

3.2.4 The residential sector

The residential sector can be sub-divided into urban and rural areas. Rural areas can be defined as squatter camps or informal settlements, where people live in shacks made of tin and wood, according to the Energy Outlook, 2001. Whereas most people in urban areas rely on the use of electricity, residents in rural areas, however, might use mainly wood for their energy source.

Residential energy falls into three categories:

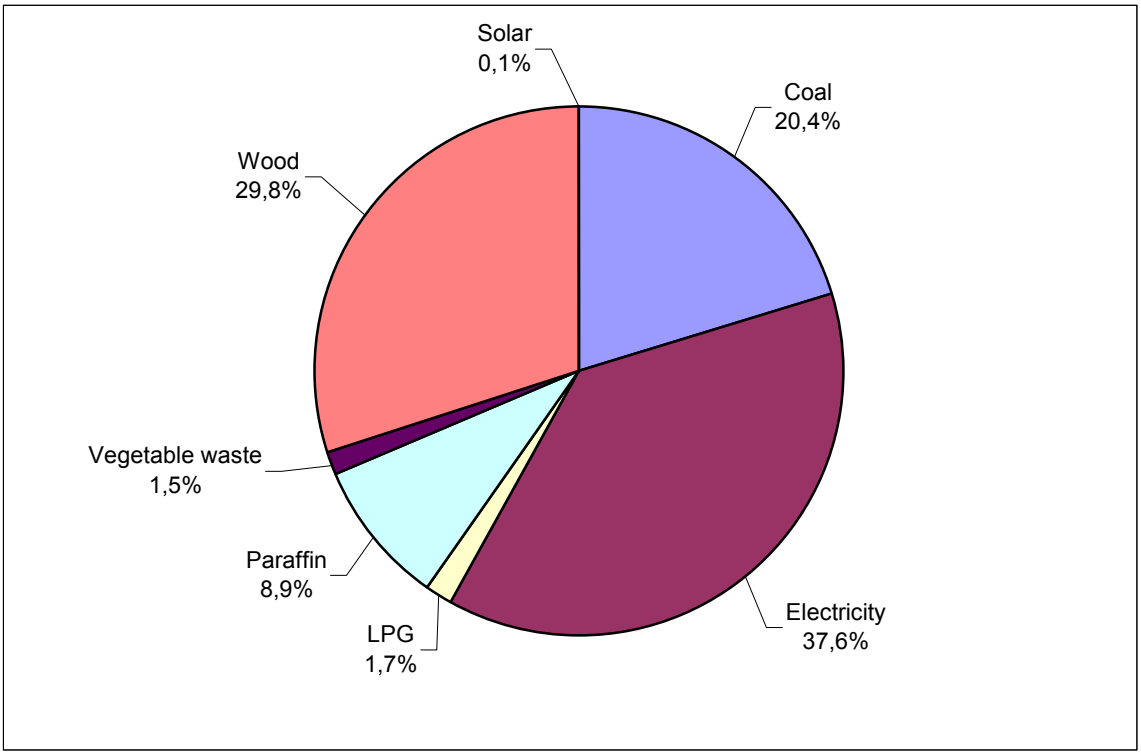
- Traditional fuels, consisting of wood, dung and bagasse;

- Transitional fuels, consisting of coal, paraffin and liquefied petroleum gas (LPG); and
- Modern fuels, consisting of electricity.

Figure 7 shows the percentage distribution of energy types used in the residential sector in South Africa during 2000. It shows that electricity (37,6%) was the major energy resource used in the residential sector, followed by wood (29,8%) and coal (20,4%).

When compared to Figures 8, 9 and 10, which contain Census 2001 data, it seems that the percentage of electricity used by households increased in 2001. This could be attributed to better basic service delivery. According to the Census 2001 data, 63,8% of households stayed in formal settlements during 2001, compared to 16,4% of households in the informal settlements. The remainder of households were grouped under 'traditional', 'backyard' or 'other' settlements.

Figure 7: Percentage distribution of energy types used in the residential sector in South Africa, 2000



Source*: Energy Outlook for South Africa: 2002*

There are five main uses of residential energy, namely:

- Space heating;
- Water heating;
- Cooking;
- Lighting; and
- Other (such as refrigerators, radios and TVs).

Table 3 shows the percentage distribution of use of residential energy in South Africa for the year 2000.

Table 3: Percentage of use of residential energy for South Africa, 2000

Residential energy use	**%**
Cooking	39,9
Lighting	5,4
Space heating	12,4
Water heating	31,9
Other	10,4
Total	**100,0**

Source: *Energy Outlook for South Africa: 2002*

From Table 3 it can be seen that cooking (39,9%) used the highest percentage of energy, followed by water heating (31,9%) and space heating (12,4%). It can also be seen that lighting (5,4%) used less energy.

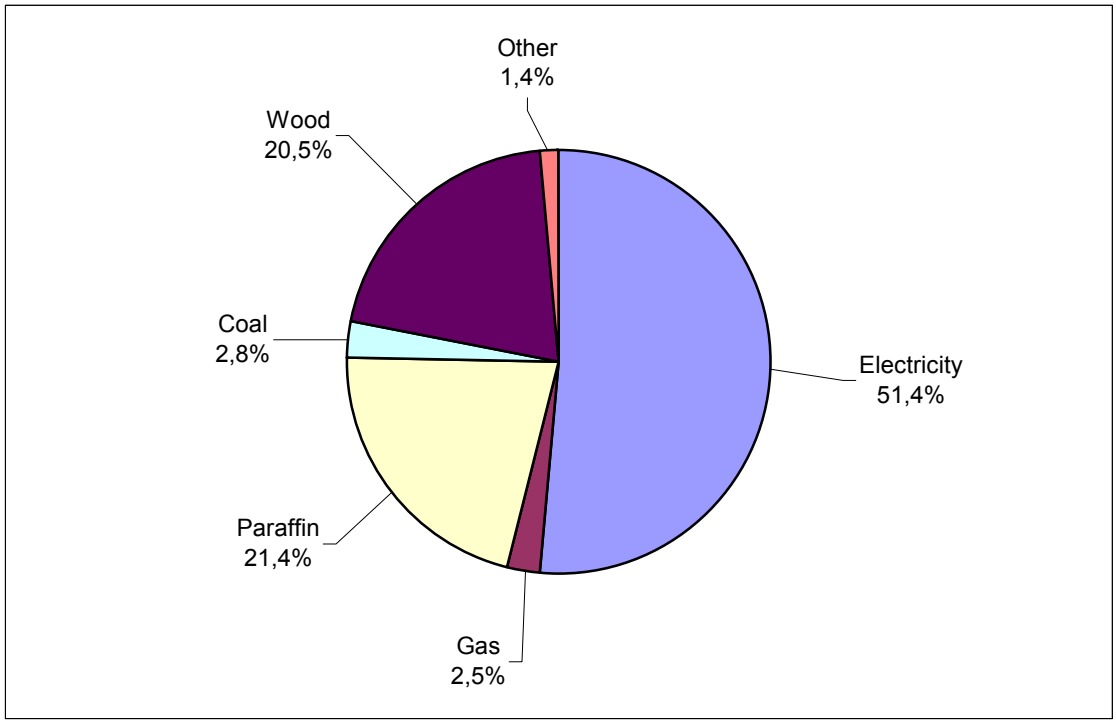
It is expected that in the future the trend from traditional fuels through transitional fuels to electricity is likely to continue, based on previous experiences. Electricity allows for more efficient energy use than coal, wood and paraffin although more energy can get consumed for water heating. It is also expected that there will be a growth in demand for energy for non-essential appliances such as TVs.

Residential energy use is expected to grow at the same rate as the population[12].

Figure 8 shows the distribution of households by main energy source used for cooking, as indicated in the 2001 Population Census.

[12] According to the Energy Outlook for South Africa: 2002.

Figure 8: Distribution of households by main energy source used for cooking, 2001

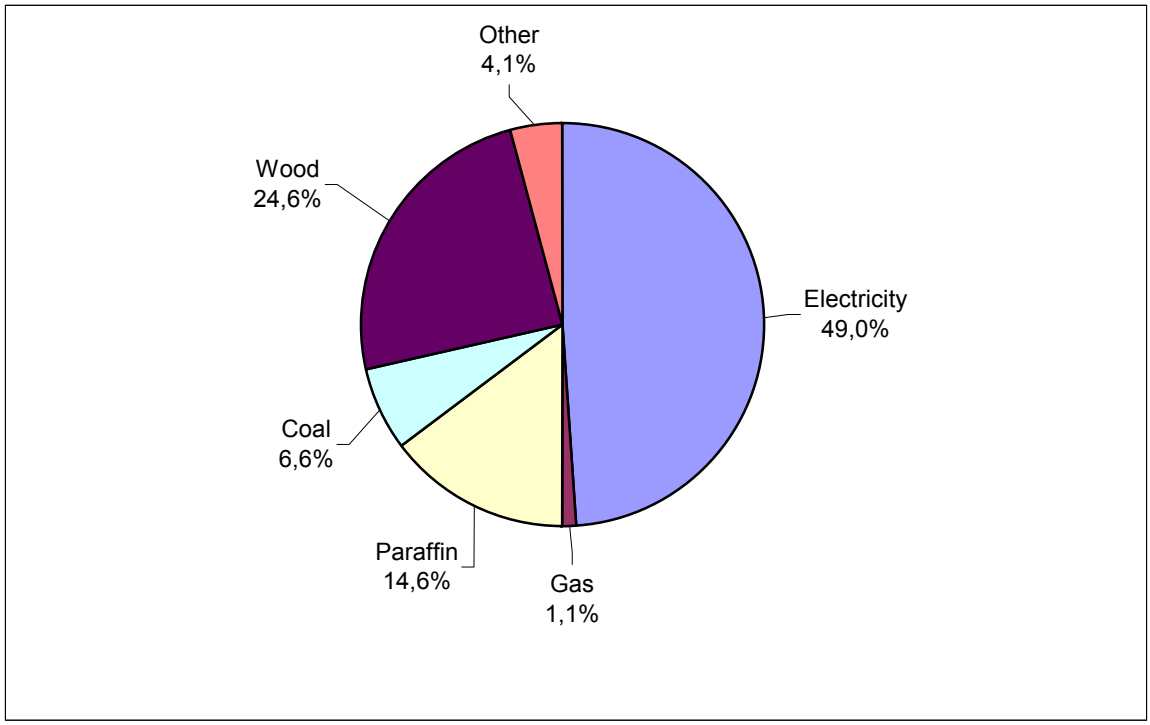


Source: *Statistics South Africa: Census 2001*

Figure 8 shows that the major energy sources used by households for cooking in 2001 were electricity (51,4%), paraffin (21,4%) and wood (20,5%).

Figure 9 shows the distribution of households by main energy source used for heating, as indicated in the 2001 Population Census.

Figure 9: Distribution of households by main energy source used for heating, 2001

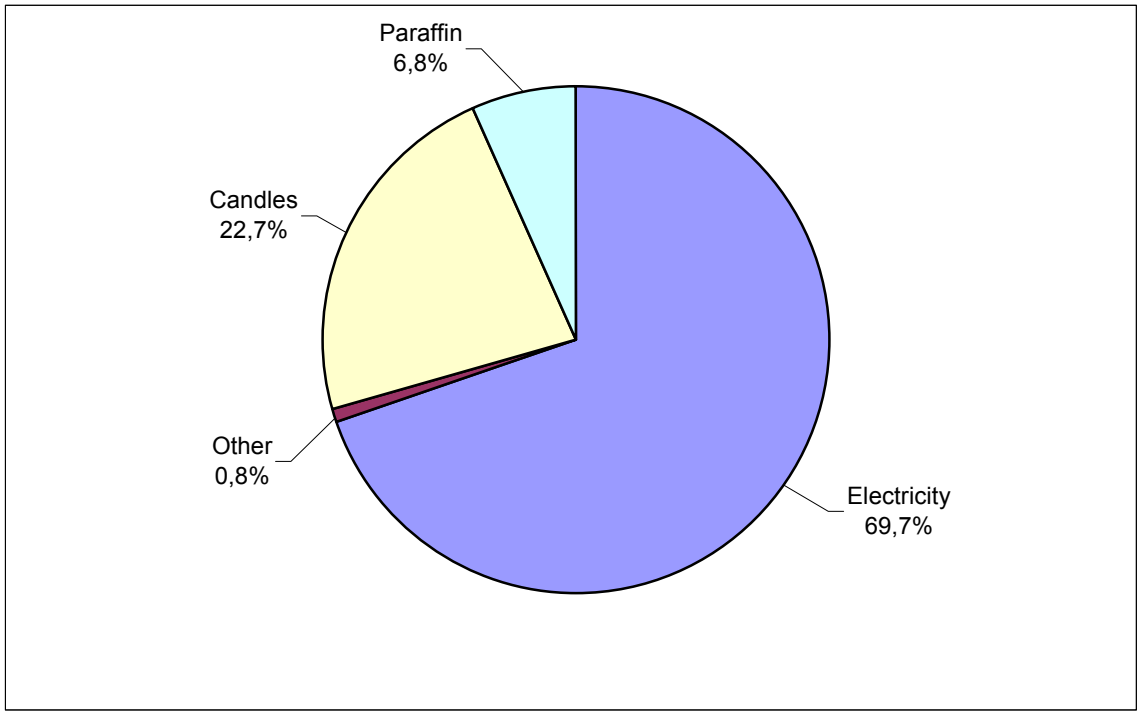


Source*: Statistics South Africa: Census 2001*

Figure 9 shows that the main energy sources used by households for heating in 2001 were electricity (49,0%), followed by wood (24,6%) and paraffin (14,6%).

The distribution of households by main energy source used for lighting, as indicated in the 2001 Population Census, is shown in Figure 10.

Figure 10: Distribution of households by main energy source used for lighting, 2001



Source: *Statistics South Africa: Census 2001*

Figure 10 indicates that the main energy sources used for lighting in 2001 were electricity (69,7%), followed by candles (22,7%) and paraffin (6,8%).

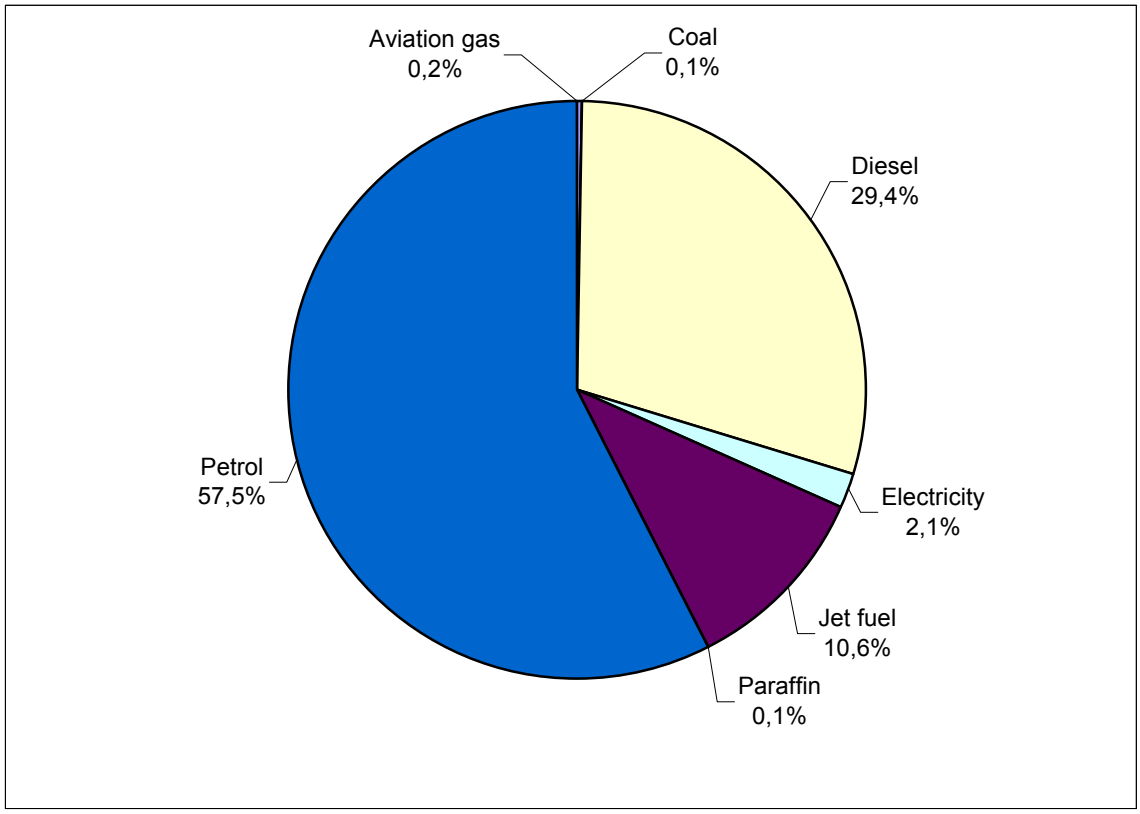
3.2.5 The transport sector

The transport sector deals with transport of people and goods by land, sea and air. Energy for transport is completely dominated by liquid fuels, such as petrol, diesel and jet fuel. It is very difficult to switch from fossil fuels to other sources of energy in this sector.

Land transport is dominated by petrol and diesel with some electricity used by trains. Air transport uses jet fuel for gas turbine engines and aviation gas for piston engines. There are however, very few piston engines in the air these days and marine engines are nearly entirely diesel.

Figure 11 shows the percentage distribution of energy types used in the transport sector in South Africa during 2000.

Figure 11: Percentage distribution of energy types used in the transport sector in South Africa, 2000



Source*: Energy Outlook for South Africa: 2002*

Figure 11 shows that petrol (57,5%) was the major energy source used in the transport sector in 2000, followed by diesel (29,4%) and jet fuel (10,6%).

Table 4 shows the percentage distribution of energy used by land, air, and other transport in South Africa during 2000.

Table 4: Percentage distribution of energy used by land, air and other transport in South Africa, 2000

Transport energy by mode	**%**
Air transport	10,8
Land passenger	66,7
Land freight	22,4
Other transport	0,1
Total	**100,0**

Source*: Energy Outlook for South Africa: 2002*

From Table 4 above it can be seen that land passenger transport was the major user of energy (66,7%), followed by land freight (22,4%) and air transport (10,8%).

4. Supply and use tables for energy for South Africa

Physical energy accounts should be constructed as extended supply and use tables. Usually the energy supply and use accounts will include both the monetary as well as the physical units. In the South African energy account we, however, only used the physical units. This section gives the physical accounts for South Africa's energy supply and use from 1995 to 2001.

The main energy resources used in South Africa are listed in the columns and the sectors are given in the rows of the tables. Energy supply has to equal energy use in the column totals in order for the accounts to balance. For example, total crude oil supplied in 1995 has to equal total crude oil used in 1995. All of the resources used are expressed in terajoules (TJ).

Supply of products is defined as domestic production plus import of the various energy commodities, whereas total product use is defined by the intermediate use by industries, household consumption, inventory changes and exports. The use table shows the use of natural resources, for example the use of coal, gas and oil extracted by the mining industries.

An important distinction has to be made between primary energy sources, classified into fossil fuels and renewable energy sources (such as water power and solar energy), and secondary energy sources such as electricity and refined petroleum products which have been produced from the transformation of a primary energy source. Use of a product refers to the consumption of the product by various industries and households. Exports, losses in distribution and statistical differences are included in the use table.

One should keep in mind that the energy accounts should include both primary and secondary energy sources. There is thus double counting in the sense that both primary energy (e.g. coal) and the converted energy (e.g. electricity produced by coal) are included. This is not different from other monetary and physical supply and use tables for products in which both raw materials and finished product appear. Because

of this, the energy consumption on the Energy Balances – RSA, will be different from the total energy used on the energy account. The exports category will also make a difference in this regard, since it is included in the use table of the energy account, but it appears under the supply side of the Energy Balances- RSA.

Table 5: Energy supply table for South Africa, 1995

	Crude oil	Nuclear	Coal	Petroleum products	Gas to users	Electricity	Hydro	Renewables and waste	**Total energy supply**
	TJ	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*
a. Domestic production	304 196,69	123 283,64	4 895 135,20	999 334,35	98 343,78	672 541,20	1 904,40	408 739,00	**7 503 478,26**
b. Imports	669 378,02	0,00	11 169,30	16 502,05	0,00	536,40	0,00	0,00	**697 585,77**
c. Total supply (a+b)	**973 574,71**	**123 283,64**	**4 906 304,50**	**1 015 836,40**	**98 343,78**	**673 077,60**	**1 904,40**	**408 739,00**	**8 201 064,03**

Table 6: Energy use table for South Africa, 1995

	Crude oil	Nuclear	Coal	Petroleum products	Gas to users	Electricity	Hydro	Renewables and waste	**Total energy use**
	TJ	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	***TJ***
a. Intermediate consumption by industries	**1 029 536,18**	**123 283,64**	**3 218 855,16**	**334 482,02**	**97 877,70**	**517 627,90**	**1 904,40**	**8 739,00**	**5 332 306,00**
Agriculture & fishing	0,00	0,00	7 994,86	58 300,71	0,00	19 084,22	0,00	0,00	85 379,79
Mining & Quarrying	0,00	0,00	16 269,61	17 861,82	478,14	119 433,78	0,00	0,00	154 043,35
Manufacturing	1 029 536,18	0,00	1 250 387,40	61 104,58	96 559,33	287 814,30	0,00	0,00	2 725 401,79
Electricity, gas & steam production	0,00	123 283,64	1 895 259,72	4 246,15	0,00	0,00	1 904,40	8 739,00	2 033 432,91
Construction	0,00	0,00	0,00	12 237,00	0,00	49,70	0,00	0,00	12 286,70
Transport, storage and communication	0,00	0,00	1 471,45	180 549,38	7,77	15 452,14	0,00	0,00	197 480,74
Commercial sector	0,00	0,00	47 472,12	182,38	832,46	75 793,76	0,00	0,00	124 280,72
b. Inventory changes	**-59 689,87**	**0,00**	**-8 362,60**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**-68 052,47**
c. Private consumption, total	**0,00**	**0,00**	**58 050,00**	**399 492,55**	**466,09**	**101 236,03**	**0,00**	**400 000,00**	**959 244,67**
Own account transportation by cars	0,00	0,00	0,00	365 867,78	0,00	18,35	0,00	0,00	365 886,13
Heating, use of electricity etc.	0,00	0,00	58 050,00	33 624,77	466,09	101 217,68	0,00	400 000,00	593 358,54
d. Exports	**3 728,40**	**0,00**	**1 670 929,62**	**281 861,87**	**0,00**	**10 800,00**	**0,00**	**0,00**	**1 967 319,89**
e. Losses in distribution (Incl. Stat. Diff.)	**0,00**	**0,00**	**-33 167,68**	**-0,04**	**-0,01**	**43 413,67**	**0,00**	**0,00**	**10 245,94**
f. Total use (a+b+c+d+e)	**973 574,71**	**123 283,64**	**4 906 304,50**	**1 015 836,40**	**98 343,78**	**673 077,60**	**1 904,40**	**408 739,00**	**8 201 064,03**

Table 7: Energy supply table for South Africa, 1996

	Crude oil	Nuclear	Coal	Petroleum products	Gas to users	Electricity	Hydro	Renewables and waste	**Total energy supply**
	TJ	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*
a. Domestic production	327 018,75	128 454,55	4 896 284,88	985 431,56	101 779,33	714 045,00	4 748,40	408 739,00	**7 566 501,47**
b. Imports	596 053,54	0,00	13 190,28	44 394,34	0,00	104,40	0,00	0,00	**653 742,56**
c. Total supply (a+b)	**923 072,29**	**128 454,55**	**4 909 475,16**	**1 029 825,90**	**101 779,33**	**714 149,40**	**4 748,40**	**408 739,00**	**8 220 244,03**

Table 8: Energy use table for South Africa, 1996

	Crude oil	Nuclear	Coal	Petroleum products	Gas to users	Electricity	Hydro	Renewables and waste	**Total energy use**
	TJ	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	***TJ***
a. Intermediate consumption by industries	**923 072,29**	**128 454,55**	**3 256 299,61**	**353 226,59**	**101 308,93**	**534 899,42**	**4 748,40**	**8 739,00**	**5 310 748,79**
Agriculture & fishing	0,00	0,00	6 539,70	62 750,15	0,00	18 371,09	0,00	0,00	87 660,94
Mining & Quarrying	0,00	0,00	14 973,61	18 677,43	325,00	125 393,04	0,00	0,00	159 369,08
Manufacturing	923 072,29	0,00	1 212 138,83	73 127,88	100 130,57	304 541,41	0,00	0,00	2 613 010,98
Electricity, gas & steam production	0,00	128 454,55	1 986 852,55	0,00	0,00	0,00	4 748,40	8 739,00	2 128 794,50
Construction	0,00	0,00	0,00	13 595,10	0,00	56,09	0,00	0,00	13 651,19
Transport, storage and communication	0,00	0,00	631,85	184 928,45	13,91	15 367,24	0,00	0,00	200 941,45
Commercial sector	0,00	0,00	35 163,07	147,58	839,45	71 170,55	0,00	0,00	107 320,65
b. Inventory changes	**0,00**	**0,00**	**-76 595,46**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**-76 595,46**
c. Private consumption, total	**0,00**	**0,00**	**59 400,00**	**393 915,58**	**470,41**	**106 405,65**	**0,00**	**400 000,00**	**960 191,64**
Own account transportation by cars	0,00	0,00	0,00	363 233,51	0,00	20,36	0,00	0,00	363 253,87
Heating, use of electricity etc.	0,00	0,00	59 400,00	30 682,07	470,41	106 385,29	0,00	400 000,00	596 937,77
d. Exports	**0,00**	**0,00**	**1 686 283,26**	**282 060,10**	**0,00**	**20 084,40**	**0,00**	**0,00**	**1 988 427,76**
e. Losses in distribution	**0,00**	**0,00**	**-15 912,25**	**623,63**	**-0,01**	**52 759,93**	**0,00**	**0,00**	**37 471,30**
f. Total use (a+b+c+d+e)	**923 072,29**	**128 454,55**	**4 909 475,16**	**1 029 825,90**	**101 779,33**	**714 149,40**	**4 748,40**	**408 739,00**	**8 220 244,03**

Table 9: Energy supply table for South Africa, 1997

	Crude oil	Nuclear	Coal	Petroleum products	Gas to users	Electricity	Hydro	Renewables and waste	**Total energy supply**
	TJ	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	***TJ***
a. Domestic production	327 019,00	137 967,00	5 220 691,00	865 216,00	101 716,00	747 879,00	7 531,00	408 739,00	**7 816 758,00**
b. Imports	538 198,00	0,00	13 190,00	0,00	0,00	18,00	0,00	0,00	**551 406,00**
c. Total supply (a+b)	**865 217,00**	**137 967,00**	**5 233 881,00**	**865 216,00**	**101 716,00**	**747 897,00**	**7 531,00**	**408 739,00**	**8 368 164,00**

Table 10: Energy use table for South Africa, 1997

	Crude oil	Nuclear	Coal	Petroleum products	Gas to users	Electricity	Hydro	Renewables and waste	**Total energy use**
	TJ	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	***TJ***
a. Intermediate consumption by industries	**865 216,00**	**137 967,00**	**3 389 529,00**	**368 906,00**	**101 204,00**	**551 786,00**	**7 531,00**	**8 739,00**	**5 430 878,00**
Agriculture & fishing	0,00	0,00	6 498,00	57 655,00	0,00	20 304,00	0,00	0,00	84 457,00
Mining & Quarrying	0,00	0,00	33 691,00	20 453,00	549,00	109 405,00	0,00	0,00	164 098,00
Manufacturing	865 216,00	0,00	1 219 191,00	67 704,00	99 741,00	325 927,00	0,00	0,00	2 577 779,00
Electricity, gas & steam production	0,00	137 967,00	2 093 489,00	0,00	0,00	0,00	7 531,00	8 739,00	2 247 726,00
Construction	0,00	0,00	0,00	14 266,00	0,00	60,00	0,00	0,00	14 326,00
Transport, storage and communication	0,00	0,00	45,00	207 602,00	12,00	16 404,00	0,00	0,00	224 063,00
Commercial sector	0,00	0,00	36 615,00	1 226,00	902,00	79 686,00	0,00	0,00	118 429,00
b. Inventory changes	**0,00**	**0,00**	**66 027,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**66 027,00**
c. Private consumption, total	**0,00**	**0,00**	**60 750,00**	**391 305,00**	**512,00**	**110 497,00**	**0,00**	**400 000,00**	**963 064,00**
Own account transportation by cars	0,00	0,00	0,00	359 485,00	0,00	21,00	0,00	0,00	359 506,00
Heating, use of electricity etc.	0,00	0,00	60 750,00	31 820,00	512,00	110 476,00	0,00	400 000,00	603 558,00
d. Exports	**0,00**	**0,00**	**1 797 600,00**	**105 006,00**	**0,00**	**23 821,00**	**0,00**	**0,00**	**1 926 427,00**
e. Losses in distribution	**1,00**	**0,00**	**-80 025,00**	**-1,00**	**0,00**	**61 793,00**	**0,00**	**0,00**	**-18 232,00**
f. Total use (a+b+c+d+e)	**865 217,00**	**137 967,00**	**5 233 881,00**	**865 216,00**	**101 716,00**	**747 897,00**	**7 531,00**	**408 739,00**	**8 368 164,00**

Table 11: Energy supply table for South Africa, 1998

	Crude oil	Nuclear	Coal	Petroleum products	Gas to users	Electricity	Hydro	Renewables and waste	**Total energy supply**
	TJ	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*
a. Domestic production	293 876,42	148 374,55	5 278 318,54	998 317,60	85 360,54	730 634,40	5 742,00	237 400,00	**7 778 024,05**
b. Imports	897 696,39	0,00	36 147,18	40 948,17	0,00	8 550,00	0,00	0,00	**983 341,74**
c. Total supply (a+b)	**1 191 572,81**	**148 374,55**	**5 314 465,72**	**1 039 265,77**	**85 360,54**	**739 184,40**	**5 742,00**	**237 400,00**	**8 761 365,79**

Table 12: Energy use table for South Africa, 1998

	Crude oil	Nuclear	Coal	Petroleum products	Gas to users	Electricity	Hydro	Renewables and Waste	**Total energy use**
	TJ	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	***TJ***
a. Intermediate consumption by industries	**1 162 648,05**	**148 374,55**	**3 459 654,42**	**357 613,31**	**85 360,53**	**502 714,23**	**5 742,00**	**47 000,00**	**5 769 107,09**
Agriculture & fishing	0,00	0,00	4 913,51	54 214,74	0,00	20 258,75	0,00	0,00	79 387,00
Mining & Quarrying	0,00	0,00	40 961,05	20 341,89	497,74	105 133,02	0,00	0,00	166 933,70
Manufacturing	1 162 648,05	0,00	1 227 626,90	69 705,28	84 742,83	310 304,71	0,00	0,00	2 855 027,77
Electricity, gas & steam production	0,00	148 374,55	2 160 279,97	0,00	0,00	0,00	5 742,00	47 000,00	2 361 396,52
Construction	0,00	0,00	0,00	12 004,06	0,00	73,72	0,00	0,00	12 077,78
Transport, storage and communication	0,00	0,00	631,45	200 978,63	13,41	16 638,57	0,00	0,00	218 262,06
Commercial sector	0,00	0,00	25 241,54	368,71	106,55	50 305,46	0,00	0,00	76 022,26
b. Inventory changes	**0,00**	**0,00**	**329 874,96**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**329 874,96**
c. Private consumption, total	**0,00**	**0,00**	**50 483,09**	**411 877,56**	**0,00**	**117 225,74**	**0,00**	**190 400,00**	**769 986,39**
Own account transportation by cars	0,00	0,00	0,00	381 440,77	0,00	63,41	0,00	0,00	381 504,18
Heating, use of electricity etc.	0,00	0,00	50 483,09	30 436,79	0,00	117 162,33	0,00	190 400,00	388 482,21
d. Exports	**28 924,77**	**0,00**	**1 716 393,20**	**269 914,01**	**0,00**	**16 315,20**	**0,00**	**0,00**	**2 031 547,18**
e. Losses in distribution	**-0,01**	**0,00**	**-241 939,95**	**-139,11**	**0,01**	**102 929,23**	**0,00**	**0,00**	**-139 149,83**
f. Total use (a+b+c+d+e)	**1 191 572,81**	**148 374,55**	**5 314 465,72**	**1 039 265,77**	**85 360,54**	**739 184,40**	**5 742,00**	**237 400,00**	**8 761 365,79**

Table 13: Energy supply table for South Africa, 1999

	Crude oil	Nuclear	Coal	Petroleum products	Gas to users	Electricity	Hydro	Renewables and waste	**Total energy supply**
	TJ	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*
a. Domestic production	310 492,06	140 040,00	5 286 674,29	1 078 558,97	108 531,80	721 519,20	2 613,60	237 400,00	**7 885 829,92**
b. Imports	824 850,32	0,00	26 648,03	50 420,02	0,00	24 022,80	0,00	0,00	**925 941,17**
c. Total supply (a+b)	**1 135 342,38**	**140 040,00**	**5 313 322,32**	**1 128 978,99**	**108 531,80**	**745 542,00**	**2 613,60**	**237 400,00**	**8 811 771,09**

Table 14: Energy use table for South Africa, 1999

	Crude oil	Nuclear	Coal	Petroleum products	Gas to users	Electricity	Hydro	Renewables and waste	**Total energy use**
	TJ	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	***TJ***
a. Intermediate consumption by industries	**1 072 543,86**	**140 040,00**	**3 302 801,15**	**351 967,67**	**108 481,91**	**508 607,34**	**2 613,00**	**47 000,00**	**5 534 054,93**
Agriculture & fishing	0,00	0,00	2 702,48	51 412,53	0,00	20 716,84	0,00	0,00	74 831,85
Mining & Quarrying	0,00	0,00	20 264,96	20 821,69	340,59	103 958,82	0,00	0,00	145 386,06
Manufacturing	1 072 543,86	0,00	1 201 759,17	62 375,96	107 900,34	304 184,98	0,00	0,00	2 748 764,31
Electricity, gas & steam production	0,00	140 040,00	2 057 108,42	0,00	0,00	0,00	2 613,00	47 000,00	2 246 761,42
Construction	0,00	0,00	0,00	10 676,29	0,00	126,12	0,00	0,00	10 802,41
Transport, storage and communication	0,00	0,00	0,00	206 475,22	24,65	15 868,83	0,00	0,00	222 368,70
Commercial sector	0,00	0,00	20 966,12	205,98	216,33	63 751,75	0,00	0,00	85 140,18
b. Inventory changes	**0,00**	**0,00**	**45 251,70**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**45 251,70**
c. Private consumption, total	**0,00**	**0,00**	**41 932,24**	**418 085,07**	**49,90**	**113 143,03**	**0,00**	**190 400,00**	**763 610,24**
Own account transportation by cars	0,00	0,00	0,00	383 347,79	0,00	73,93	0,00	0,00	383 421,72
Heating, use of electricity etc.	0,00	0,00	41 932,24	34 737,28	49,90	113 069,10	0,00	190 400,00	380 188,52
d. Exports	**62 798,52**	**0,00**	**1 854 571,74**	**358 896,39**	**0,00**	**15 357,60**	**0,00**	**0,00**	**2 291 624,25**
e. Losses in distribution	**0,00**	**0,00**	**68 765,49**	**29,86**	**-0,01**	**108 434,03**	**0,00**	**0,00**	**177 229,37**
f. Total use (a+b+c+d+e)	**1 135 342,38**	**140 040,00**	**5 313 322,32**	**1 128 978,99**	**108 531,80**	**745 542,00**	**2 613,00**	**237 400,00**	**8 811 770,49**

Table 15: Energy supply table for South Africa, 2000

	Crude oil	Nuclear	Coal	Petroleum products	Gas to users	Electricity	Hydro	Renewables and waste	**Total energy supply**
	TJ	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*
a. Domestic production	339 218,94	141 927,27	5 301 907,52	1 084 625,84	104 880,73	749 084,40	4 834,80	237 400,00	**7 963 879,50**
b. Imports	781 529,03	0,00	34 390,22	20 290,99	0,00	16 988,40	0,00	0,00	**853 198,64**
c. Total supply (a+b)	**1 120 747,97**	**141 927,27**	**5 336 297,74**	**1 104 916,83**	**104 880,73**	**766 072,80**	**4 834,80**	**237 400,00**	**8 817 078,14**

Table 16: Energy use table for South Africa, 2000

	Crude oil	Nuclear	Coal	Petroleum products	Gas to users	Electricity	Hydro	Renewables and waste	**Total energy use**
	TJ	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	***TJ***
a. Intermediate consumption by industries	**1 113 149,76**	**141 927,27**	**3 415 217,87**	**323 260,52**	**104 842,38**	**503 928,20**	**4 834,80**	**47 000,00**	**5 654 160,80**
Agriculture & fishing	0,00	0,00	1864,43	48008,95	0,00	14 235,74	0,00	0,00	64 109,12
Mining & Quarrying	0,00	0,00	3 916,11	21 927,06	378,46	104 537,19	0,00	0,00	130 758,82
Manufacturing	1 113 149,76	0,00	1 252 891,49	38 636,62	104 204,38	303 853,87	0,00	0,00	2 812 736,12
Electricity, gas & steam production	0,00	141 927,27	2 135 743,61	0,00	0,00	0,00	4 834,80	47 000,00	2 329 505,68
Construction	0,00	0,00	0,00	10 548,86	0,00	122,44	0,00	0,00	10 671,30
Transport, storage and communication	0,00	0,00	0,00	203 987,74	28,91	19 388,53	0,00	0,00	223 405,18
Commercial sector	0,00	0,00	20 802,23	151,29	230,63	61 790,43	0,00	0,00	82 974,58
b. Inventory changes	**0,00**	**0,00**	**-46 884,15**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**-46 884,15**
c. Private consumption, total	**0,00**	**0,00**	**41 604,46**	**408 180,26**	**38,35**	**122 734,07**	**0,00**	**190 400,00**	**762 957,14**
Own account transportation by cars	0,00	0,00	0,00	380 488,67	0,00	91,10	0,00	0,00	380 579,77
Heating, use of electricity etc.	0,00	0,00	41 604,46	27 691,59	38,35	122 642,97	0,00	190 400,00	382 377,37
d. Exports	**7 598,21**	**0,00**	**1 957 457,01**	**373 476,06**	**0,00**	**14 425,20**	**0,00**	**0,00**	**2 352 956,48**
e. Losses in distribution	**0,00**	**0,00**	**-31 097,45**	**-0,01**	**0,00**	**124 985,33**	**0,00**	**0,00**	**93 887,87**
f. Total use (a+b+c+d+e)	**1 120 747,97**	**141 927,27**	**5 336 297,74**	**1 104 916,83**	**104 880,73**	**766 072,80**	**4 834,80**	**237 400,00**	**8 817 078,14**

Table 17: Energy supply table for South Africa, 2001

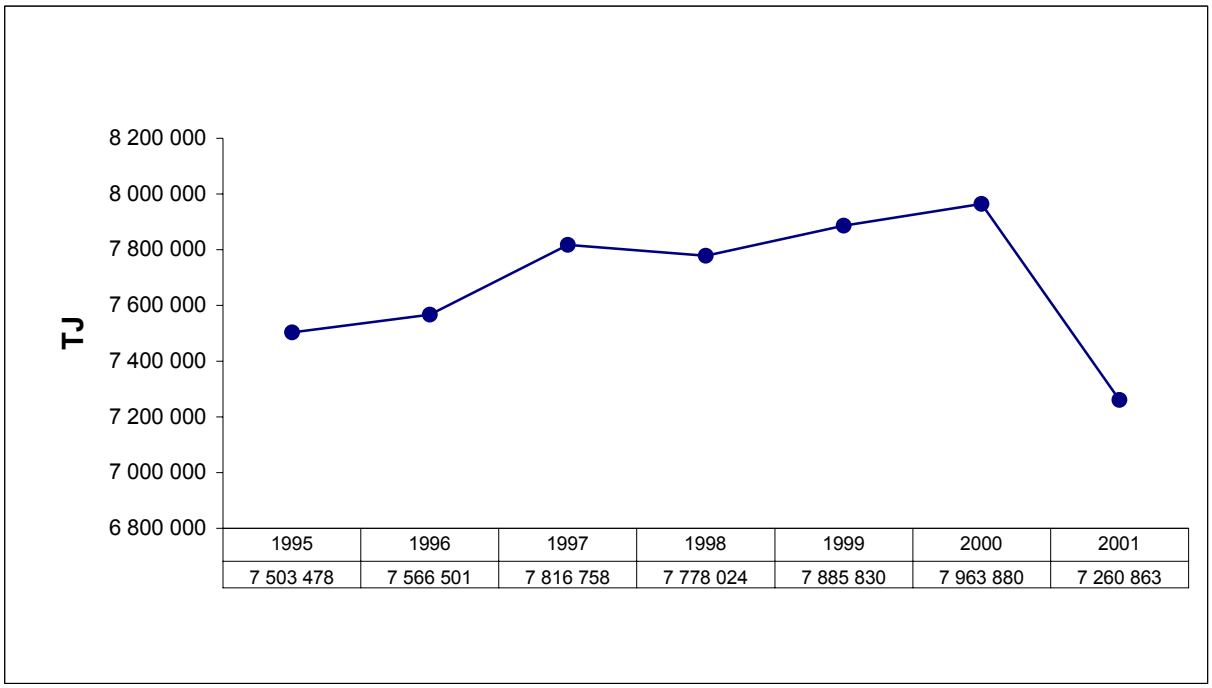
	Crude oil	Nuclear	Coal	Petroleum products	Gas to users	Electricity	Hydro	Renewables and waste	**Total energy supply**
	TJ	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*
a. Domestic production	11 230,88	116 934,55	4 929 201,73	1 125 887,42	126 030,22	706 758,38	7 419,60	237 400,00	**7 260 862,78**
b. Imports	809 762,24	0,00	34 875,62	64 737,09	0,00	33 120,00	0,00	0,00	**942 494,95**
c. Total supply (a+b)	**820 993,12**	**116 934,55**	**4 964 077,35**	**1 190 624,51**	**126 030,22**	**739 878,38**	**7 419,60**	**237 400,00**	**8 203 357,73**

Table 18: Energy use table for South Africa, 2001

	Crude oil	Nuclear	Coal	Petroleum products	Gas to users	Electricity	Hydro	Renewables and waste	**Total energy use**
	TJ	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*	*TJ*
a. Intermediate consumption by industries	**813 132,45**	**116 934,55**	**3 430 397,23**	**363 232,86**	**125 990,22**	**529 741,15**	**7 419,60**	**47 000,00**	**5 433 848,06**
Agriculture & fishing	0,00	0,00	2 742,28	52 229,09	0,00	15 031,29	0,00	0,00	70 002,66
Mining & quarrying	0,00	0,00	42 194,38	27 068,14	394,82	114 086,59	0,00	0,00	183 743,93
Manufacturing	813 132,45	0,00	1 412 726,98	29 721,47	125 324,63	310 774,01	0,00	0,00	2 691 679,54
Electricity, gas & steam production	0,00	116 934,55	1 937 192,66	0,00	0,00	3887,03	7 419,60	47 000,00	2 112 433,84
Construction	0,00	0,00	0,00	14 929,87	0,00	114,48	0,00	0,00	15 044,35
Transport, storage and communication	0,00	0,00	69,60	206 431,66	30,16	19 965,37	0,00	0,00	226 496,79
Commercial sector	0,00	0,00	35 471,33	32 852,63	240,61	65 882,38	0,00	0,00	134 446,95
b. Inventory changes	**0,00**	**0,00**	**-42 356,90**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**-42 356,90**
c. Private consumption, total	**0,00**	**0,00**	**67 083,33**	**432 138,38**	**40,00**	**156 693,85**	**0,00**	**190 400,00**	**846 355,56**
Own account transportation by cars	0,00	0,00	0,00	394 359,70	0,00	59,59	0,00	0,00	394 419,29
Heating, use of electricity etc.	0,00	0,00	67 083,33	37 778,68	40,00	156 634,26	0,00	190 400,00	451 936,27
d. Exports	**7 860,65**	**0,00**	**1 940 815,34**	**424 974,54**	**0,00**	**25 185,60**	**0,00**	**0,00**	**2 398 836,13**
e. Losses in distribution	**0,02**	**0,00**	**431 861,65**	**-29 721,27**	**0,00**	**28 257,78**	**0,00**	**0,00**	**-433 325,12**
f. Total use (a+b+c+d+e)	**820 993,12**	**116 934,55**	**4 964 077,35**	**1 190 624,51**	**126 030,22**	**739 878,38**	**7 419,60**	**237 400,00**	**8 203 357,73**

Figure 12 below depicts the total domestic production of energy from 1995 to 2001.

Figure 12: Total domestic production of energy in South Africa, 1995 – 2001

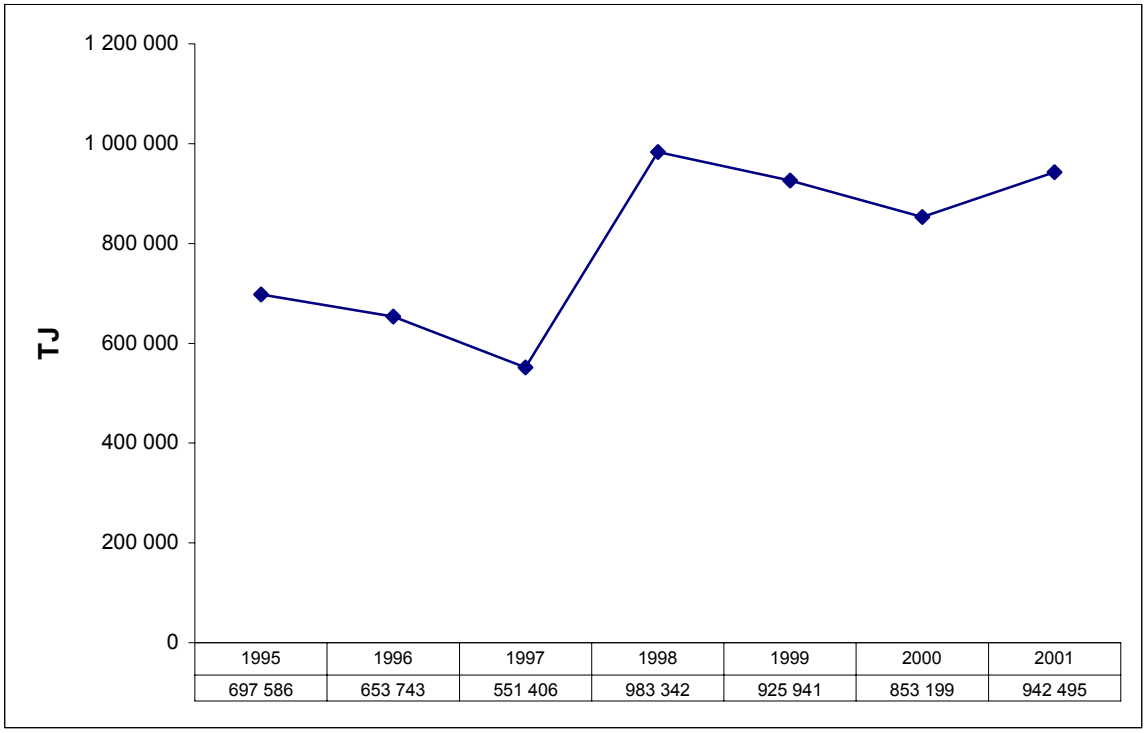


Source: *Energy Balances – RSA, DME*

As can be seen from Figure 12, the total domestic production of energy in South Africa increased between the years 1995 and 2000, except between 1997 and 1998, and 2000 and 2001, when there was a decrease. The decrease from 2000 to 2001 was mainly due to a decrease in the domestic production of coal. The increase between 1996 and 1997 was higher compared to periods between the other years. This was largely attributable to the sharp increases in the domestic production of coal, electricity and hydropower from 1996 to 1997. The decrease in total domestic production from 1997 to 1998 was mainly due to decreasing domestic production in all the energy resources, except for nuclear energy, which had a slight increase.

Figure 13 shows the total energy imports to South Africa between 1995 and 2001.

Figure 13: Total energy imported to South Africa, 1995 – 2001

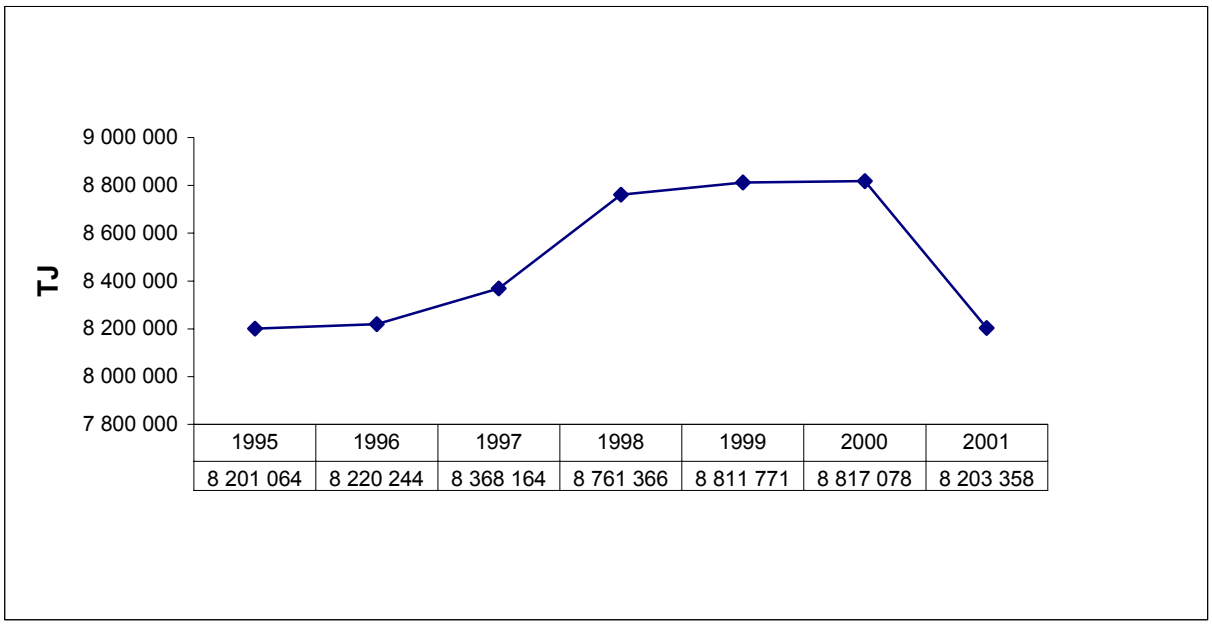


Source*: Energy Balances – RSA, DME*

Figure 13 indicates that there was a sharp increase in energy resources imports from 1997 to 1998. This was mainly attributed to the increases in the imports of crude oil, coal and electricity. Between 1995 and 1997 there was a decline in energy imports because of decreases in crude oil, petroleum products and electricity imports. There was once again a steady decline in imports from 1998 to 2000, this time because of decreases in the imports of crude oil and coal in 1999 and electricity and petroleum products in 2000. In 2001 the import of energy resources started to increase.

Total energy supplied in South Africa between 1995 and 2001 is shown in Figure 14.

Figure 14: Total energy supplied in South Africa, 1995 – 2001



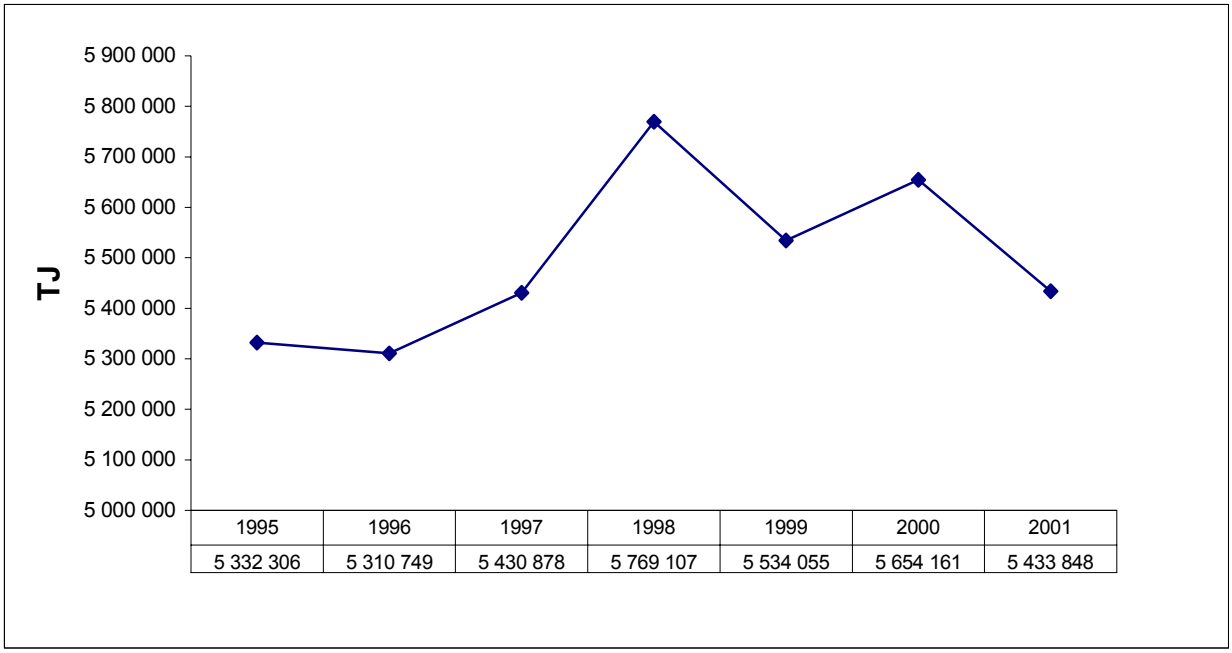
1995	1996	1997	1998	1999	2000	2001
8 201 064	8 220 244	8 368 164	8 761 366	8 811 771	8 817 078	8 203 358

Source: *Energy Balances – RSA, DME*

Figure 14 shows that energy supplied in South Africa between 1995 and 2000 maintained a positive trend. Even though there was a decrease in domestic production of energy from 1997 to 1998, the sharp increases in imports caused an increase in total energy supply up to 2000. From 2000 to 2001 energy supplied in South Africa decreased due to the decrease of the domestic production of coal over this period.

The next figure shows the total energy used in the intermediate consumption by industries from 1995 to 2001.

Figure 15: Total energy used in the intermediate consumption by industries, 1995 – 2001

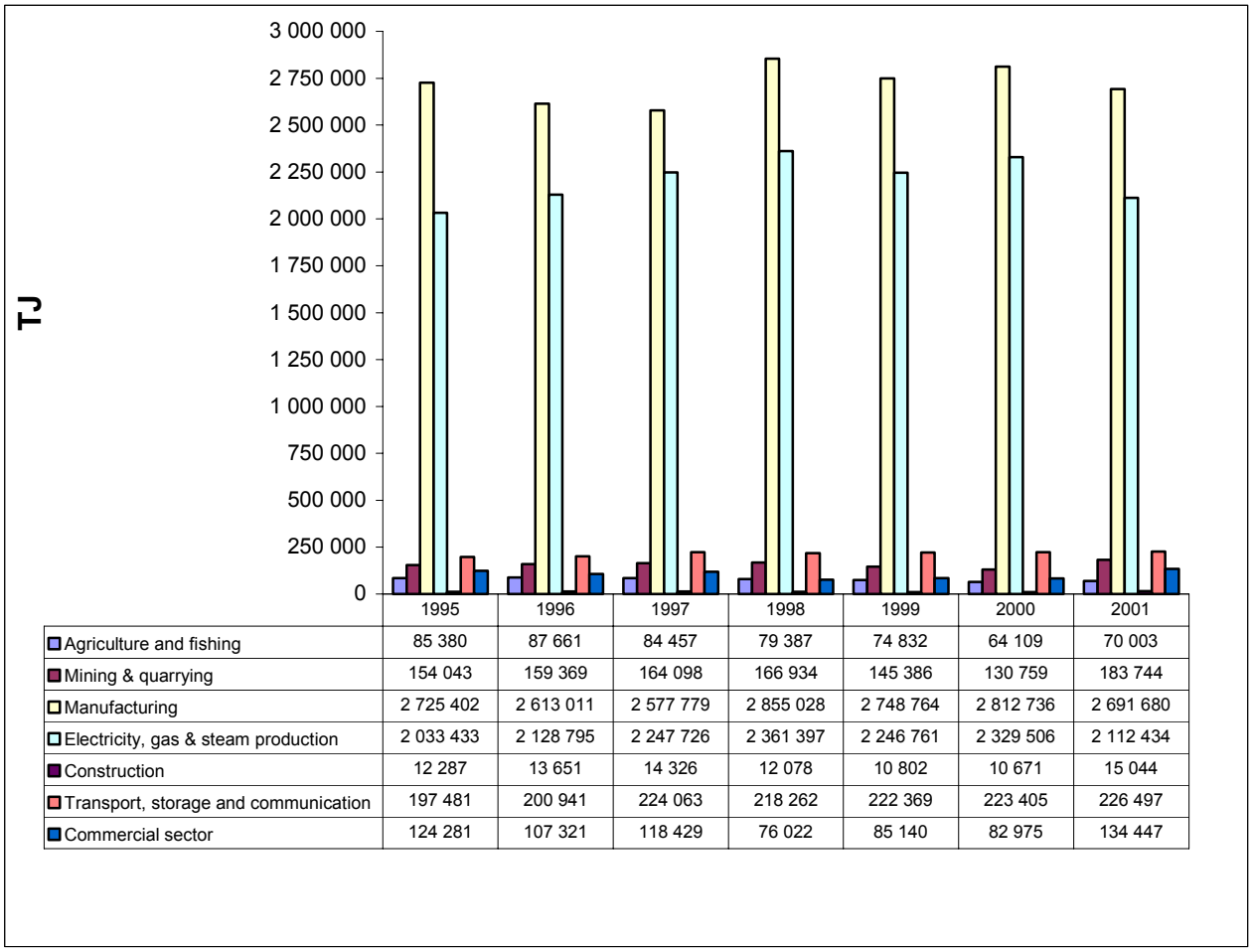


Source*: Energy Balances – RSA, DME*

It can be seen from Figure 15 that there was a sharp increase in the intermediate consumption by industries from 1997 to 1998. This was due to increases in the amount of crude oil, nuclear power, coal and renewables and waste consumed during this period. The decrease from 2000 to 2001 was mainly due to the decrease in the use of crude oil in intermediate consumption by industries.

Figure 16 shows the energy used in the sectors listed under 'intermediate consumption by industries' during 1995 – 2001, for the agricultural and fishing; mining and quarrying; manufacturing; electricity, gas and steam production; construction; transport, storage and communication; and the commercial sectors.

Figure 16: Energy used during intermediate consumption by industries according to sectors, 1995 – 2001



	1995	1996	1997	1998	1999	2000	2001
Agriculture and fishing	85 380	87 661	84 457	79 387	74 832	64 109	70 003
Mining & quarrying	154 043	159 369	164 098	166 934	145 386	130 759	183 744
Manufacturing	2 725 402	2 613 011	2 577 779	2 855 028	2 748 764	2 812 736	2 691 680
Electricity, gas & steam production	2 033 433	2 128 795	2 247 726	2 361 397	2 246 761	2 329 506	2 112 434
Construction	12 287	13 651	14 326	12 078	10 802	10 671	15 044
Transport, storage and communication	197 481	200 941	224 063	218 262	222 369	223 405	226 497
Commercial sector	124 281	107 321	118 429	76 022	85 140	82 975	134 447

Source: *Energy Balances – RSA, DME*

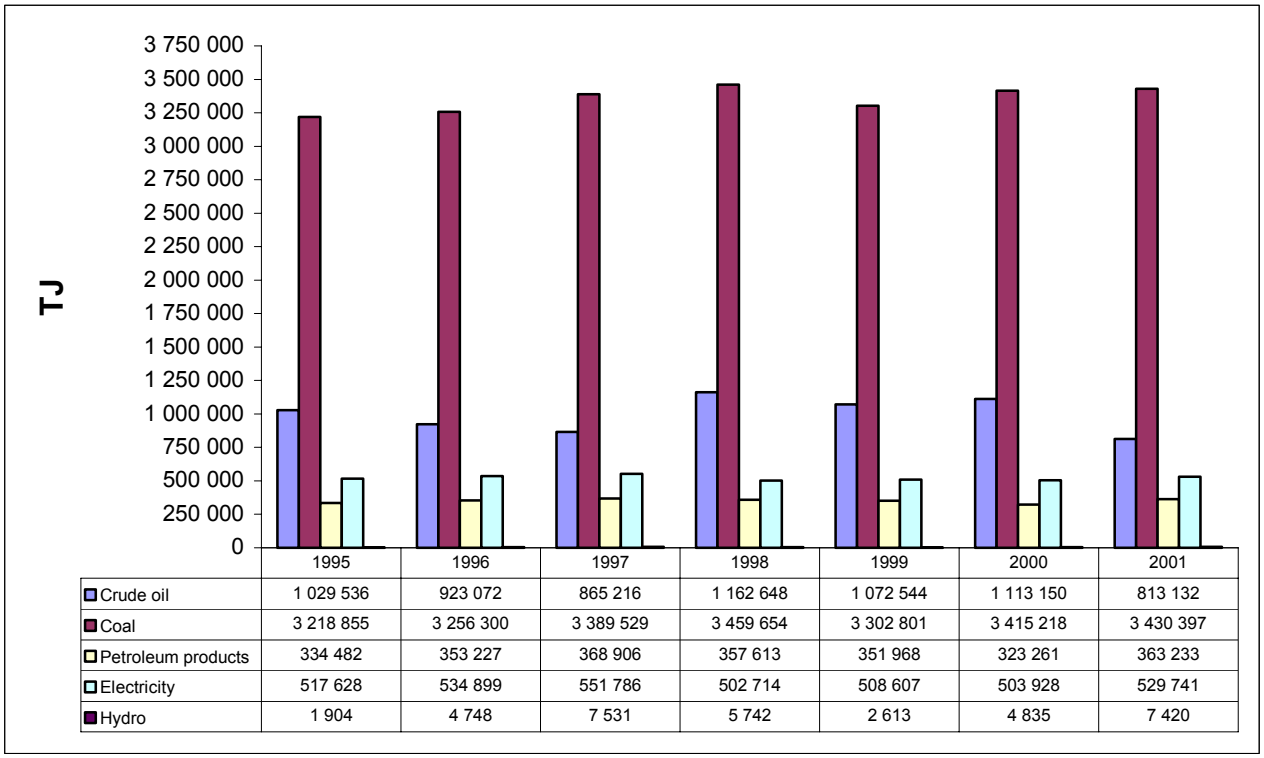
There was a sharp increase in energy used from 1997 to 1998 in the intermediate consumption by industries category, due to increases in energy used in the manufacturing and construction sectors. These were mainly increases in the amount of crude oil and electricity used in the two sectors.

Of the different sectors under this category (intermediate consumption by industries), agriculture and fishing energy consumption had an increase during 2001 (from 64 109 TJ in 2000 to 70 003 TJ in 2001). This was mainly due to an increase in the amount of electricity used, along with increases in the amount of coal and petroleum products used during 2001 in this sector. The mining and quarrying sector's energy consumption decreased during the period 1998 to 2001 due to decreased use of coal and electricity in this sector.

Electricity, gas and steam production reached a high on energy consumption in 1998 for the period 1995 to 2001, at 2 361 397 TJ. But in 2001 it decreased to 2 112 434 TJ. This decrease was due to a large decrease in the use of coal as an energy resource in this sector. The transport sector's energy consumption had a fairly steady growth rate over the relevant period, except for a hike in 1997, mainly because of an increase in the use of petroleum products. The commercial sector was also generally stable except for an increase in energy consumption in 2001, where petroleum products used in this sector had increased dramatically.

Figure 17 shows some of the energy resources used in the intermediate consumption by industries category in South Africa from 1995 to 2001.

Figure 17: Energy resources used in the intermediate consumption by industries in South Africa, 1995 – 2001



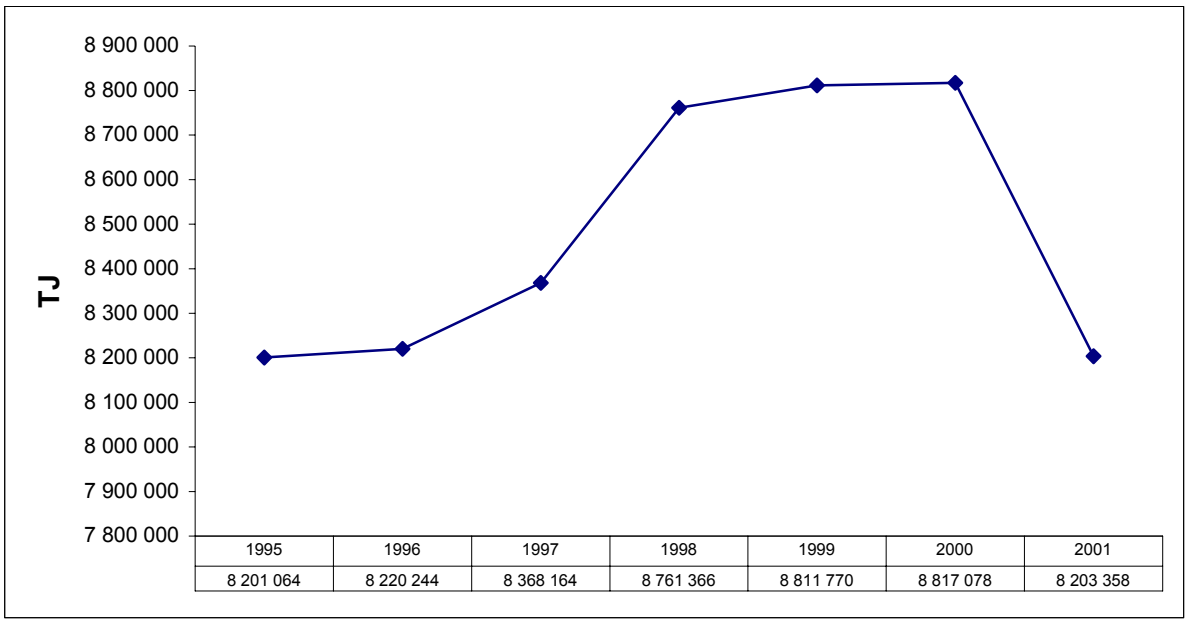
	1995	1996	1997	1998	1999	2000	2001
Crude oil	1 029 536	923 072	865 216	1 162 648	1 072 544	1 113 150	813 132
Coal	3 218 855	3 256 300	3 389 529	3 459 654	3 302 801	3 415 218	3 430 397
Petroleum products	334 482	353 227	368 906	357 613	351 968	323 261	363 233
Electricity	517 628	534 899	551 786	502 714	508 607	503 928	529 741
Hydro	1 904	4 748	7 531	5 742	2 613	4 835	7 420

Source: *Energy Balances – RSA, DME*

Figure 17 shows that coal was by far the greatest energy resource used in the intermediate consumption by industries category in South Africa for the period 1995 to 2001, followed by crude oil, which was used in the manufacturing sector, electricity and petroleum products, which were mainly used in the agricultural, mining, manufacturing and especially the transport sectors.

Figure 18 shows the total amount of energy used from 1995 to 2001 in South Africa.

Figure 18: Total energy used in South Africa, 1995 – 2001



Source: *Energy Balances – RSA, DME*

The sudden increase in the trend from 1997 to 1998 was due to the increase in the use of crude oil, nuclear power, coal and petroleum products. This increase can be broken down as follows:

- An increase in the use of petroleum products in the 'own account transportation by cars' section (from 359 485 TJ in 1997 to 381 441 TJ in 1998).
- An increase in the exportation of crude oil and petroleum products in 1998.
- An increase of electricity, gas and steam production using renewables and waste.
- An increase in the amount of crude oil used in the manufacturing sector (from 865 216 TJ in 1997 to 1 162 648 TJ in 1998).

The sudden decrease of total energy used in South Africa from 2000 to 2001 was mainly due to large decreases in the amount of crude oil and coal used in South Africa, during this period.

5. Conclusion

This initial energy account is a developmental report. Therefore further investigation and research will be beneficial in order to improve the account. Further energy account papers will provide updates on improving data quality and other issues.

The main energy resources in the South African economy are coal, oil, gas, nuclear power, hydropower and renewable sources such as wind, solar, biomass and wave power. The South African economy, for our purpose, is divided into six sub-sectors namely, the residential sector; the commercial sector; the agricultural sector; the transport sector; the industrial sector; and other sectors.

The use and supply of energy is critical to the economy, because almost all economic activities are connected either directly or indirectly to the consumption of energy in some way or another. Energy accounts provide information on the levels of direct energy consumption of industries regarding their production processes and that of private households regarding their consumption.

Manipulation of these energy supply and use tables can provide answers to the following questions:

- What is the level of energy consumption?
- What is the level of energy input (both direct and indirect) into the various categories of final demand (private household consumption, exports, etc.)?
- What is the energy intensity of particular industries taking into account both direct and indirect energy inputs?

These accounts can also provide information on changes in the energy requirements of particular industries in relation to their output. This shows the macro level impacts of new technologies and eco-efficiency measures and behavioural changes. They are also an indispensable prerequisite for reliable estimates of air emissions related to energy consumption. Since we would like to account for air emissions in the near future, this is a very important aspect of the energy use tables.

Once again, it is important to refer to the fact that one should keep in mind that the energy accounts should include both primary and secondary energy sources. There is thus double counting in the sense that both primary energy (e.g. coal) and the converted energy (e.g. electricity produced by coal) are included (See chapter 4).

These accounts will be updated periodically, whenever data is available from our data source, the Department of Minerals and Energy.

This discussion document will be placed on the Stats SA website. We invite all stakeholders to provide us with any comments and suggestions they might have regarding the content of this discussion document. The comments and suggestions will be included into the discussion document before it is published in 2005/2006.

Comments and suggestions can be e-mailed to the following addresses:

- AnnalineH@statssa.gov.za or
- EdithM@statssa.gov.za

6. Glossary

Account	An account is a tool which records, for a given aspect of economic life, (a) the uses and resources or (b) the changes in assets and the changes in liabilities and/or (c) the stock of assets and liabilities existing at a certain time; the transactions accounts include a balancing item which is used to equate the two sides of the accounts (e.g. resources and uses) and which is a meaningful measure of economic performance.
Coal	An accumulation of carbonaceous material derived from vegetation.
Consumption	Consumption is an activity in which institutional units use up goods and services. It can be either intermediate or final.
Crude oil	A mineral oil consisting of a mixture of hydrocarbons of natural origins, yellow to black in colour and of variable viscosity.
Biota	Refers to the flora and fauna of a specific region or country.

Environmental accounting	Under the SEEA framework, environmental accounting refers to the combination of natural resource accounts, which consist of stock and flow accounts in physical terms, and the monetary valuation of these accounts.
Gross domestic product	A measure of the total economic activity occurring within the national boundary of a country.
Intermediate consumption	Intermediate consumption consists of the value of the goods and services consumed as inputs by a process of production, excluding fixed assets whose consumption is recorded as consumption of fixed capital. The goods and services may be either transformed or used up by the production process. Some inputs re-emerge after having been transformed and incorporated into the outputs. Other inputs are completely consumed or used up. Intermediate consumption includes the rentals paid on the use of fixed assets.
Natural gas	Consists mainly of methane occurring naturally in underground deposits. It may be associated or free gas.
Natural resource accounting	An accounting system that deals with stocks and flows of natural assets, comprising biota (produced or wild); subsoil assets (proved reserves); and water and land with their aquatic and terrestrial ecosystems. The term is used frequently in distinguishing physical accounting from monetary (environmental) accounting. However, the terms natural resource

	accounting and environmental accounting are often used interchangeably.
Natural resources	Natural assets (raw materials) occurring in nature that can be used for economic production or consumption.
Non-renewable natural resources	Exhaustible natural resources such as mineral resources (coal or uranium) that cannot be regenerated after exploitation.
Physical accounting	Natural resource and environmental accounting of stocks and changes in stocks in physical (non-monetary) units, for example, weight, area or number. Qualitative measures, expressed in terms of quality classes, types of uses or ecosystem characteristics, may supplement quantitative measures.
System of Environmental and Economic Accounting (SEEA)	The SEEA was developed by the United Nations Statistical Division, as a satellite system to the System of National Accounts (SNA), for the incorporation of environmental concerns (environmental costs, benefits and assets) in the national accounts. The SEEA is intended to be a system with global application and standards, suitable for all countries and all aspects of the environment.
System of National Accounts (SNA)	An international accounting framework consisting of a coherent, consistent and integrated set of macro-economic accounts, balance sheets and tables based on a set of internationally agreed concepts, definitions, classifications and accounting rules. It provides a comprehensive accounting framework within which economic data can be compiled and

presented in a format that is designed for the purposes of economic analysis, and decision and policy making. (UN, 1993, 1.1)

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