



chapter 16

Minerals and energy

Mining continues to play an important role in the national economy. Preliminary 2002 figures indicated that mining contributed R30,6 billion or 8,5% of gross value added, an improvement of R13,86 billion from 2001. The preliminary figures also indicated a 1,5% rise in employment in the mining sector from 407 154 in 2001 to 413 087 in 2002. Sales of primary mineral products accounted for 34,3% of South Africa's total export revenue during 2001.

Earnings from platinum surpassed gold for the first time in 100 years. Total revenue from platinum-group metals (PGMs) in 2001 was \$3,88 billion compared with the gold revenue of \$3,37 billion for 2001.

South Africa continues to export a very high proportion of its raw mineral resources.

There is still a lot of potential for growth in the exploitation of minerals in the country, especially where the country is ranked number one in terms of reserves. For example, in manganese, chrome and the PGMs, South Africa has 80%, 72,4% and 55,7% of world reserves respectively.

The Department of Minerals and Energy is the primary government institution responsible for formulating and implementing policy. It reports to and advises the Minister of Minerals and Energy who, in consultation with the Cabinet, takes final responsibility for policy.

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- ◀ South Africa, which supplies two-thirds of Africa's electricity, is one of the four cheapest electricity producers in the world.

Within the Department, the Electricity and Nuclear Branch is responsible for electricity and nuclear-energy affairs; the Hydro Carbons and Energy Planning Branch is responsible for coal, gas, liquid fuels, energy efficiency, renewable energy and energy planning, including the energy database; while the Mineral Development Branch manages, among others, mineral prospecting and mining rights.

The Mine Health and Safety Inspectorate (MHSI) is responsible for the application of mine health and safety legislation.

Policy

The Minerals and Petroleum Resources Development Act, 2002 (Act 28 of 2002), aims to:

- recognise that mineral resources are the common heritage of all South Africans and collectively belong to all the peoples of South Africa
- promote the beneficiation of minerals
- guarantee security of tenure for existing prospecting and mining operations
- ensure that mining contributes to rural development and supports those communities affected by mining operations
- ensure that historically disadvantaged persons participate more meaningfully in the mining industry
- promote junior and small-scale mining
- uphold good environmental practices and sustainable development

- ensure increased access to geological and mining information.

The following concerns have been addressed:

- the Act ensures that new order rights are registrable, transferable, tradable and bondable
- existing operators are guaranteed security of tenure
- prospecting rights will be valid for a maximum period of five years and renewable for a further maximum period of three years
- mining rights are valid for a maximum period of 30 years and renewable for a further period of 30 years.

The cancellation of new rights will only take place if there is a breach of the terms and conditions of the right of tenure by the holder, and only after the holder had been given enough notice to rectify such a breach.

The Draft Mining Titles Registration Amendment Bill, 2003 has been published for comment.



The Department of Minerals and Energy played a leading role in the establishment of the Kimberley Process, which aims to prevent conflict diamonds from getting into the global diamond-market industry and to protect legitimate trade.

The Kimberley Process was initiated by a Working Group of representatives from 39 African diamond-producing and trading countries in 2000, after non-governmental organisations, supported by some governments, threatened to boycott diamonds from conflict-ridden areas.

The Kimberley Process Certification Scheme (KPCS), which was launched and accepted by 52 governments in Interlaken, Switzerland in November 2002, was officially implemented on 1 January 2003. In essence, these countries have agreed that they will only allow for the import and export of rough diamonds if they come from or are being exported to another Kimberley Process participant.

Participants welcomed the resolutions adopted respectively by the United Nations (UN) Security Council in January, and by the UN General Assembly in April 2003, which expressed strong support for the KPCS. The Working Group on Diamond Experts discussed ways and means of improving the manner in which the national certification schemes of participants interact.

By May 2003, all the world's diamond industries and approximately 70 countries were participating.

The Bill will amend the Mining Titles Registration Act, 1967 (Act 16 of 1967), to regulate the registration of mineral and petroleum titles and other rights, and to effect certain amendments necessary to ensure consistency with the Mineral and Petroleum Resources Development Act, 2002.

The Broad-Based Socio-Economic Empowerment Charter for the South African Mining Industry, which has the support of the mining houses and labour unions concerned, was approved by the Cabinet in October 2002.

Targets of the Charter include 15% ownership of mines by historically disadvantaged South Africans within five years, 40% of historically disadvantaged South Africans in both junior and senior management positions in five years, 26% ownership within 10 years, and 10% participation by women within five years. The objectives of the Charter are to:

- promote equitable access to the nation's mineral resources for all South Africans
- substantially and meaningfully expand opportunities for historically disadvantaged South Africans, including women, to enter the mining and minerals industry and to benefit from the exploitation of the nation's mineral resources
- utilise the existing skills base for the empowerment of historically disadvantaged South Africans
- expand the skills base of historically disadvantaged South Africans to serve the community
- promote employment and advance the social and economic welfare of mining communities and the major labour-sending areas
- promote beneficiation of South Africa's mineral commodities.

The proposed Scorecard for the Charter has been introduced, giving effect to the provisions contained in the Charter.

The Scorecard is designed to facilitate the application of the Charter in terms of the requirements of the Mineral and Petroleum



Resources Development Act, 2002 for the conversion of all the 'old order rights' into new rights within a five-year conversion window period, while recognising the full 10-year period.

Mine environmental management

Mine environmental management forms an integral part of mineral-resource management. The following national priorities have been identified:

- The strengthening of enforcement to prevent mining legacies from happening. This relates to the implementation of the Mineral and Petroleum Resources Development Act, 2002 and other short and long-term strategies to strengthen environmental enforcement.
- Identifying mine-pollution 'hot spots' and implementing additional measures, norms and standards to address and manage the pollution problems within these areas.
- Rehabilitating the mine legacies of the past.

In order to facilitate the implementation of these priorities, the *Phephatso* Strategy (meaning 'clean-up' in Tswana) is being finalised. The Strategy is not only an initiative of the Department of Minerals and Energy, but a co-operative government initiative supported by the mining industry, various parastatals and other role-players.

In order to address mine-water pollution problems within the Witwatersrand gold-mining 'hot spots', the Department, in conjunction with the Council for Geoscience and other government departments, is developing a comprehensive strategy to address the polluted underground water that has been a hindrance for many years. In line with the 'polluter pays' principle, the dedicated involvement of the gold-mining industry, local authorities and other role-players must be obtained.

This strategy currently includes measures to prevent water ingress into mines.

Such preventative measures will reduce the impact on the environment and substantially

decrease mining costs within the Witwatersrand gold-mining area. For the prevention of water ingress, a work programme aimed at engineering interventions in the central and East Rand mining basins was expected to be implemented in 2003/04.

Mining outcomes of the World Summit on Sustainable Development (WSSD)

Representatives from nearly 200 countries assembled at the WSSD in Johannesburg in September 2002 to reaffirm their commitment to sustainable development.

As a follow-up to the WSSD outcomes for mining, the Department of Minerals and Energy finalised a strategy with specific programmes, plans and time frames to achieve the objectives and priorities with regard to the implementation of the Johannesburg Plan for Implementation.

The WSSD outcomes for mining include:

- poverty eradication
- changing the unsustainable patterns for consumption and production
- protecting and managing the natural resource base for economic and social development
- globalisation
- initiatives for sustainable development in Africa.

Apart from the national processes being established to take the WSSD outcomes forward, international processes and structures such as the African Mining Partnership will be established to champion, among others, the New Partnership for Africa's Development's (NEPAD) mining and mineral-related initiatives. The Global Mining Dialogue is also being established to promote the WSSD mining outcomes in the international arena.

Rehabilitation of mines

Government follows an integrated and co-operative approach with regard to the rehabilitation of the asbestos legacies of the past. Specific responsibilities regarding the management of asbestos pollution have been assigned

to specific government departments, namely the Departments of Environmental Affairs and Tourism, Minerals and Energy, Water Affairs and Forestry, Trade and Industry, Health, and Labour.

Addressing asbestos legacies has always been a priority for the Department. In accordance with the Asbestos Rehabilitation Priority Index database, 145 derelict and ownerless asbestos dump complexes have been identified for rehabilitation.

In recent years, the Department has implemented a dedicated programme for the rehabilitation of derelict and ownerless asbestos mines/dumps.

Only 84 derelict and/or ownerless asbestos dump complexes in South Africa still need to be rehabilitated. It is also envisaged that the rehabilitation will be finalised within the next 10 years at a cost of R100 million. The Department spent R17 million during 2002/03 at the old Voorspoed Asbestos Mine, Koegas, Neweng and the Whitebank Complex in the Northern Cape.

With regard to the rehabilitation of abandoned and ownerless gold, coal and other mines in South Africa, the Department is in the process of identifying and developing a database. The Department of Minerals and Energy, in co-operation with the Department of Water Affairs and Forestry and other role-players, implemented urgent short-term rehabilitation measures at the burning Transvaal and Delagoa Bay Colliery near Witbank in 2002/03, which included the construction of:

- safety pathways over the site, and access control
- a storm-water diversion system to prevent storm water flowing through the site and becoming acidic.

Investigations regarding the methods of rehabilitating the Transvaal and Delagoa Bay Colliery have been finalised.

These methods include re-mining, blasting and collapsing, flooding and ashing. A combination of the above methods was agreed on as the preferred rehabilitation

option. The rehabilitation of the Colliery will serve as a trial case for the successful rehabilitation of the other abandoned and ownerless coal mines in South Africa.

Excellence in Mining Environmental Management (EMEM) Award System

The EMEM Award System was implemented in March 2000 to motivate the mining industry to excel in environmental management and to recognise those mining companies which have excelled in their field. The EMEM Awards are awarded to regional and national companies. The winners of the 2002 National EMEM Awards were Richards Bay Minerals and Serina Koalın (Pty) Ltd.

Mining industry

During 2001, the mining industry directly contributed 7,5% to gross value added, and an estimated 10,3% through associated multiplier effects. The declining trend in mining's contribution to gross value added in recent years has been reversed since 2001, with the highest levels recorded since 1996, mainly as a consequence of the strong performance in the PGM sector.

Mining contributed 10,1% to South Africa's gross fixed capital formation during 2001, while sales of primary mineral products accounted for 34,3% of total exports. The inclusion of various processed mineral products such as ferro-alloys and aluminium increased this contribution to more than 40% in 2001.

Employers and trade unions in the mining industry have agreed to establish various measures that will help create jobs and alleviate poverty. The parties committed themselves to co-operate, to ensure that skills development becomes a priority in the industry.

Over the last few years, South African mining houses have transformed into large focused mining companies that include Anglo Platinum, AngloGold, De Beers, Implats and Iscor.



The Government is the only shareholder of Alexkor, a diamond mine situated on the west coast in Namaqualand. The Alexkor Limited Amendment Act, 2001 (Act 29 of 2001), was promulgated in November 2001. The Act provides for the sale or disposal of shares held by the State.

In June 2003, government announced that it had resolved to defer the finalisation of the bidding process for the disposal of a 51% interest in Alexkor, pending the outcome of a land claim by the Richtersveld community.

In October 2003, the Constitutional Court returned the land and mineral rights owned by Alexkor to the Richtersveld community who were forcibly removed from the land in the 1920s.

Mineworkers

Gold mining, with 47,4% of the mining industry's labour force, was the largest employer in 2002, followed by PGM mining with 27%. The coal industry employed 12%.

Taking into account the multiplier effect of the supply and consumer industries, including dependants, many millions rely on the mining industry for their livelihood.

Over the past five years, South Africa's gold mines have been plagued by diminishing economic reserves and consequent cost controls. Since 1990, more than 200 000 workers in the gold-mining industry alone have lost their jobs through retrenchments.

This trend was reversed in 2002, with a 1,5% increase in employment in the mining sector.

Mine health and safety

The Mine Health and Safety Inspectorate (MHSI), as an integral part of the Department of Minerals and Energy, was established to protect the health and safety of employees and other persons at mines.

Proposed key measures for the prevention of machinery-related accidents were identified by the Minister of Minerals and Energy, Ms Phumzile Mlambo-Ngcuka, during the

National Union of Mineworkers (NUM) Policy Conference in February 2003.

These include:

- the maintenance of track work to prevent derailment
- the development of a traffic-control system to prevent the collision of vehicles
- a clearance of at least 500 mm between rolling stock and any object to allow sufficient space for pedestrians.

In the next three years, the MHSI will focus on addressing hazards relating to mine falls, machinery and occupational health. Work will also continue on supporting human resource development in the industry, inquiries into recent major accidents, developing and improving occupational health and safety databases, and supporting work to bring about the integration of occupational health and inspectorates at national level.

Key events planned include, among others, convening the Mine Health and Safety Summit, which will involve government, employers and labour discussing concerns, trends and policy; hosting a conference of mine health and safety research organisations; and a series of workshops on implementing new legislation, particularly legislation relating to occupational health.

The 30th International Conference of Safety in Mines Research Institutes was held in Johannesburg from 6 to 8 October 2003. The Conference was presented by the South African Institute of Mining and Metallurgy and the MHSI.

An independent review of the MHSI was commissioned to assess the performance of the industry since the Leon Commission of Inquiry in 1994 and the promulgation of the Mine Health and Safety Act, 1996 (Act 29 of 1996).

The review recommended that the MHSI:

- consider a number of changes in structure and approach, such as establishing a policy unit
- increase the number of inspectors in the field

- develop a more effective recruitment and staffing strategy
- develop the outlook and expertise of inspectors
- develop a more effective and standardised approach to enforcement.

The fatality rate for 2002 was 0,74 per 1 000 people at work, corresponding to 288 deaths during the year. This is a small improvement on 2001's rate of 0,75 (also 288 deaths).

The number of people employed in the mining industry rose in 2002. The reportable injury rate for 2002 was 11,5, corresponding to 4 453 injuries. The corresponding figures for 2001 were 12,34 and 4 728. Against a backdrop of expansion in the gold, platinum and small-mining areas, and particularly serious capacity problems in the platinum and small-mining sector, these results reflect a considerable effort on the part of the MHSI and industry stakeholders to halt deterioration in safety performance.

By March 2003, the MHSI had conducted 3 200 accident investigations and 14 500 inspections and audits.

Audits and inspections are apportioned to various mines according to their risk profile. In 2002/03 the Inspectorate issued 3 464

instructions in terms of Sections 54 and 55 of the Mine Health and Safety Act, 1996 to rectify, stop work and rectify, or review control/management systems.

Extra funding will be allocated to the promotion of mine health and safety over the next three years to provide for:

- the Tripartite Mining Industry HIV and AIDS Committee and programmes in the mining industry
- the receipt and storage of medical records when mines close
- exit medical examinations for employees of liquidated mines.

Human resource development

The overall aim of the Mining Qualifications Authority (MQA) is to facilitate the development of appropriate knowledge and skills in the mining, minerals and jewellery sectors, to:

- enable the development and transformation of the sector
- contribute to the health, safety and competitiveness of the sector
- improve access to quality education and training for all
- redress past inequalities in education and training.

The MQA has been established as a Sector Education and Training Authority (SETA) under the aegis of the Department of Labour. The responsibilities of the MQA are to:

- develop and monitor the implementation of a sector skills plan
- register skills-development facilitators at workplaces within the sector
- approve work skills plans and annual training reports of companies in the sector
- develop unit standards and qualifications
- maintain the quality of standards, qualifications and learning provision in the sector
- establish, register, administer and promote learnerships
- administer existing apprenticeship systems
- administer and disburse skills-development levies.



The African Mining Partnership (AMP) was formed at the African Mining Ministers' Forum in Cape Town during February 2003.

The AMP's main mandate is to support the New Partnership for Africa's Development, as well as mining and mineral-related initiatives.

Other priority issues include finding methods to ensure that Africa's mineral wealth stays on the continent, as well as ways to stop non-Africans from exploiting natural resources.

It was decided to identify four projects in which Africa has fairly large dispersed resources.

Also tabled at the Forum was the exploration of various ways of utilising small-scale mining as a vehicle for the alleviation of poverty, economic empowerment of women in the mineral sector, and, in particular, regional economic growth.

It was agreed that each member country should develop legal and financial strategies to enable this sector, including industrial minerals, to gain access to finance and international markets.



By December 2002, the Minerals and Energy Education and Training Institute had trained 240 students, 78 of whom were women.

Chamber of Mines

Established in 1889, the Chamber of Mines consists of independent mining finance corporations, individual mines and mining companies. The members account for more than 85% of South Africa's mineral output.

The Chamber of Mines provides an advisory and service function to its members and to the industry on a co-operative basis, in areas such as industrial relations; education and training; security and healthcare; technical, legal and communication services; and the provision of statistical data.

South Africa's mineral reserves, 2002

Commodity	Unit	Reserves	%	World ranking
Alumino-silicates	Mt	51	37,4	1
Antimony	kt	250	6,4	4
Asbestos	Mt	Moderate		
Chrome ore	Mt	5 500	77,5	1
Coal	Mt	55 333	10,7	5
Copper	Mt	13	2	13
Diamonds*	kcar			
Fluorspar	Mt	80	18,2	3
Gold	t	36 000	40,4	1
Iron ore	Mt	2 300	3,4	10
Lead	Mt	3,0	2,1	7
Manganese ore	Mt	4 000	80	1
Phosphate rock	Mt	2 500	5,3	4
Platinum-group metals	t	70 000	70,0	1
Silver	kt	10	*	
Titanium minerals	Mt	220	30	2
Uranium	kt	284	9,1	4
Vanadium	kt	12 000	31,6	2
Vermiculite	Mt	80	40	2
Zinc	Mt	15	3,5	5
Zirconium minerals	Mt	14	19,4	2

Mt = megaton, kt = kiloton, t = ton, car = carats

* Confidential information, kcar = kilocarats

Source: Minerals Bureau

The following services to the South African mining industry and, in some instances, also to customers outside the mining industry, are provided by subsidiary companies: training; examination administration; visits to operational gold mines; the monthly newspaper *Mining News*; mine-rescue services; environmental management services; and centres for human development.

Other areas of industry networking include:

- the Employment Bureau of Africa (TEBA)
- TEBA-Bank, providing efficient and cost-effective banking services for mineworkers
- Rand Mutual Assurance, providing workers' compensation benefits for accidental injury or death arising out of and in the course of employment
- Rand Refinery Ltd, the world's largest gold refinery
- the Nuclear Fuels Corporation (NUFCOR), one of the world's largest continuous producers of uranium oxide
- Colliery Technical Services, which includes the Colliery Training College
- Rescue Drilling Unit
- Collieries Environmental Control Services
- the Council for Scientific and Industrial Research' (CSIR) Mining Technology Division (Miningtek).

Junior and small-scale mining

The economic impact of small-scale mining is difficult to measure, as most of this mining is illegal and criteria to monitor these operations have not yet been developed. One of the most crucial tasks facing government is to legalise small-scale mining by assisting in upgrading these operations into economically viable business units. This task is ongoing and for the period April 2001 to March 2002, the National Steering Committee of Service-Providers to the Small-Scale Mining Sector (NSC) received over 200 applications of which 16 projects were approved.

The NSC is focusing on identifying small-scale mining operations in recognised poverty nodes to enhance economic development in these mainly rural areas. A number of areas have been singled out for attention.

The NSC has also played a pivotal role in the regeneration of economic activity in former mining and labour-sending areas currently in a state of economic decline, e.g. in Namaqualand in the Northern Cape, Ndedwe in KwaZulu-Natal, Indwe and Port St Johns in Alfred Nzo, and O.R. Tambo municipalities

in the Eastern Cape, State projects in Sekhukhune in Limpopo, and Zeerust in North West.

The Minister of Minerals and Energy announced in her 2003/04 budget speech the establishment of the Small-Scale Mining Committee (SSMC). The SSMC will be responsible for setting up a diamond-processing plant in the Northern Cape, a phosphate mine in the Western Cape, and implementing coal and brick-making projects in the Eastern Cape.

The projects are expected to create some 1 500 direct jobs.

South Africa's mineral production, 2002*

Commodity	Unit	Production	%	World rank
Aluminium	kt	707		7
Alumino-silicates	kt	161,8	36,9	1
Antimony	t	5746	4,1	3
Asbestos	kt	*	*	*
Chrome ore	kt	6 436	49,5	1
Coal	Mt	221,5	5,8	6
Copper	kt	130		
Diamonds	kcar	-	-	-
Ferrochromium	kt	2 351		
Ferromanganese	kt	934		
Ferrosilicon	kt	184		
Fluorspar	kt	232	5	3
Gold	t	399	15,7	1
Iron ore	Mt	36	3,3	8
Lead	kt	49	1,7	8
Manganese ore	kt	33 22	17,1	2
Nickel	kt	38,5	2,9	9
Phosphate rock	kt	-	-	-
Platinum-group metals	kg	239 761	65,9	1
Silicon metal	kt	42	1,0	7
Silver	t	113	0,6	
Titanium minerals	kt	2 643	53,9	2
Uranium	t	998		
Vanadium	kt	25	37,6	2
Vermiculite	kt	210	58	1
Zinc in minerals	kt	64	0,7	
Zirconium minerals	kt	425	46,7	1

Mt = megaton, kt = kiloton, t = ton, car = carats
kcar = kilocarats

*Preliminary data •Production ceased - Confidential information

Source: Minerals Bureau

Mineral wealth

South Africa's mineral wealth is found in diverse geological formations, some of which are unique and extensive by world standards. Some of the country's minerals include:

- Gold – the unique and wide-spread Witwatersrand Basin yields some 98% of South Africa's gold output.
- Diamonds (in kimberlites, alluvial and marine) – the country is among the world's top producers.
- Titanium – heavy mineral-sand occurrences containing titanium minerals are found along the coasts.
- Manganese – enormous reserves of manganese are found in the sedimentary rocks of the Transvaal Supergroup.
- PGMs and chrome – these minerals occur in the Bushveld Complex in Mpumalanga, Limpopo and North West. More than half of the global reserves of chrome and platinum are found in this deposit.
- Coal and anthracite beds occur in the Karoo Basin in Mpumalanga, KwaZulu-Natal and Limpopo.
- Copper phosphate, titanium, iron, vermiculite and zirconium are found in the Phalaborwa Igneous Complex in Limpopo.

South Africa's reserves of seven commodities rank highest in the world. These are:



South Africa's primary and processed mineral sales, 2002*

Commodity or sector	Unit	Local sales (FOR)**		Export sales (FOB) ***		Total sales	
		Mass	Value (R' million)	Mass	Value (R' million)	Mass	Value (R' million)
Gold	t	4,5	453,4	393,1	40 935	397,5	41 388
Coal	Mt	156,5	1 169,5	69,2	164,0	225,7	30 611,0
Platinum Group Metals	t	-	4 369	208	30 459	~	34 828
Base minerals	Mt	1,9	3 871	0,9	4 920	2,8	8 791
Ferrous minerals	Mt	16,4	2 174,8	26,5	5 661,9	42,9	7 836,7
Industrial minerals	~	60,2	3 957,9	1,5	1 537,9	61,7	5 495,8
Other minerals	~	-	323,7	-	7 039	~	10 443
Processed minerals	Mt	-	5 293	-	18 269	-	23 563

*Preliminary

~ Various mass and volume units (e.g. carats, barrels and tons)

** FOR – Free on rail values

*** FOB – Free on board values

Source: Minerals Bureau

- manganese
- chromium
- PGMs
- gold
- vanadium
- alumino-silicates
- vermiculite.

The small domestic market for most commodities means that South Africa's mineral industry is export-orientated: for vermiculite it contributes 95% of world exports, vanadium 76%, alumino-silicates 51%, ferrochromium 57%, PGMs 51%, chrome ore 24%, and manganese ore and ferromanganese 23% and 25% respectively.

South Africa is the world's largest exporter of these commodities, as well as of gold, zirconium and antimony. Other important export commodities include coal and titanium minerals.

Because of this vast mineral resource base, South Africa is, to a large degree, self-sufficient with respect to the supply of minerals.

However, some minerals and mineral products need to be imported due to an insufficiency of local resources or the fact that their deposits in South Africa cannot be economically exploited.

Another factor is that certain specialised grades and products are not produced in South Africa.

The more notable imports into South Africa in 2002 were diamonds, alumina and other non-ferrous minerals, certain ferro-alloys and coking coal.

South Africa's total primary minerals increased by 17,1% to R115,2 billion in 2002. Total processed mineral sales increased by 8,4% in 2002 to some R24,5 billion.

The combined total for primary and processed mineral sales is estimated to have increased by 15,5% in 2002 to R139,7 billion.

Domestic primary mineral sales revenue increased in 2002 by 18% to R29,8 billion.

The value of exports of primary minerals in 2002 increased by 19,8% to R107,8 billion.

The Directorate: Mineral Economics (Minerals Bureau) of the Department of Minerals and Energy monitors and analyses all mineral commodities with regard to South African and world supply and demand, marketing and market trends.

Full details of South Africa's mineral industry (including the individual commodities) and its recent performance are provided in the Directorate's annual review.

South Africa's 'heavyweight' mineral exports, 2002*

Commodity	Export mass in kt
Aluminium	522
Alumino-silicates	90
Chrome ore	651
Chrome alloys	2 189
Coal	69 200
Dimension stone	677
Fluorspar	197
Iron ore	24 304
Manganese ore	1 539
Manganese products	690
Phosphate rock	197
Silicon products	103
Titanium products	270
Vermiculite	170
Zirconium products	486

*Preliminary data

Source: Minerals Bureau

The recent performance of the more important individual commodities and of the different mineral sectors is summarised as follows.



The Department of Minerals and Energy has increased the funding allocated annually to assist with the development of the small-scale mining sector from R5,1 million in 2002/03 to R15 million for the 2003/04 financial year.

During 2002/03, there were 13 projects in different stages of development. The projects employed 740 people, with the bulk of them, 593, being women. A total of R6,8 million was spent in developing these projects. Strides were made at the brick-making project in KwaZulu-Natal.

The Mining Qualifications Authority enabled young people to study for tertiary qualifications in mining through a total of 135 scholarships mainly to previously disadvantaged South Africans. This is done to ensure that the mining industry has the required number of skills, and that people from previously disadvantaged backgrounds are prepared to seize opportunities made available by the Mining Charter, which states that in five years, 40% of junior and senior managers in the mining industry should be historically disadvantaged South Africans.

Gold

World supply and demand for gold decreased by 1,5% to 3 978 tons (t) in 2002.

The average gold price traded at a five-year high of \$310/oz.

World mine supply decreased by 36 t to 2 587 t, but South African gold production increased for the first time since 1993. According to provisional 2002 data, gold output in 2002 rose by 0,7% to 397 t and gold revenue increased by 22,4% to £3,94 billion.

The country's first new underground gold mine in 20 years, Avgold's Target Mine, was officially opened in March 2002.

ARMgold, the country's largest black-controlled gold producer, listed on the JSE Securities Exchange in May 2002. During 2002, the company was South Africa's largest, and the world's 11th-largest producer of gold.

Coal

Revenue from coal increased by \$163 million, or 5,7%, in 2001 to regain the \$3-billion level that was last exceeded in the 1995 to 1998 period. World coal prices strengthened considerably towards mid-year, but sales volumes were relatively unchanged. Just over 30% of the sales volume was exported, accounting for 63% of the sales revenue.

Investments in new coal-mining and transport infrastructural developments are still awaiting prospects of sustained strong activity and firm prices.

Platinum-group metals

South African PGM production increased by 4,7% to 240 t in 2002, but PGM revenue decreased by 14,6% to \$3,31 billion. The average platinum price for 2002 was 2,0% higher at \$540/oz, while the average palladium price was 44,1% lower at \$337/oz.

A noteworthy feature has been the dramatic increase in domestic sales revenue over five years, from almost zero to \$415 million in 2002, largely to supply a developing manufac-



turing business providing automotive exhaust catalysis systems for world markets.

PGM-mining investments in progress, committed and proposed, involving new mines, extensions, mineral processing plants and smelters will be substantial over the next five years. New entrants, often representing previously disadvantaged community interests, are mostly participating through joint ventures with established major operators.

Base minerals

Refined copper, nickel, cobalt, titanium and zirconium concentrates dominate this sector, with support from zinc, lead and arsenic concentrates. The sector contributes some 12% and 4% respectively to total primary local sales and total primary export sales. About 44% of total revenue is local sales for further added-value operations.

World prices for base minerals stabilised in 2002, and most base metal annual average prices were somewhat below their 2001 levels. Demand was also weak. It was anticipated that the recovery of base metal demand and prices would start towards the end of 2003.

Provisional statistics, however, indicate that South Africa's base mineral sales excluding titanium and zirconium minerals increased slightly by \$12 million or 2,4% to \$503 million. This increase is largely attributed to increased sales by volume.

Ferrous minerals

This sector consists of the ores of iron, manganese and chrome, dominated by iron ore. It has been a leading performer in the primary minerals industry in recent years, with revenue in Dollar terms growing at almost 3% annually. Demand depends on the fortunes of the world's steel and stainless steel industries.

Recessionary economic conditions in the developed world during 2001 impacted negatively on ferrous minerals demand and prices. Improved iron ore sales were insufficient to

offset this trend. Overall, ferrous mineral sales fell by \$28 million, or 3,5%, below the 2000 revenue.

Industrial minerals

This sector comprises a wide variety of mineral products, from which 70% of revenue is local sales. In Dollar terms, domestic activity appears to be decreasing alarmingly, with total sales decreasing by 9,1% in 2001 to \$523 million. In Rand terms, local sales increased by 14,1% to the value of R4,0 billion, and export sales increased by 4,3% to R1,5 billion.

During 2002, 80% of local sales comprised limestone and lime (26%), phosphate rock concentrate (data withheld), aggregate and sand (25%) and sulphur (5%).

Exports were dominated by dimension stone (46%), vermiculite and fluorspar (15% each), andalusite (9%) and phosphate rock concentrate (data withheld).

South African industrial mineral statistics do not include beach sands (ilmenite, rutile and zircon), chromite and manganese ore used in non-metallic applications (e.g. pigments, chemicals and batteries) and antimony trioxide (used in flame retardants), all of which are included in this sector in other parts of the world.

Processed minerals

Ferro-alloys and aluminium dominate this sector, with solid support from titanium slag, phosphoric acid, vanadium, zinc metal and low-manganese pig-iron. Through investment in beneficiation, it has been the outstanding performer in the mineral industry over the last 16 years, with revenue in Dollar terms growing at 5,5% annually.

Weaker international prices during 2002 were responsible for processed mineral sales falling some 5,5% compared with 2001.

Other minerals

This sector is dominated by diamonds, with support from hydrocarbon fuel, uranium oxide

and silver. Sales revenue was boosted enormously in 2000 by diamond sales that were held back from 1999, and by a strategy to amortise commercial diamond inventories.

In 2002, the sector sales amounted to just under \$1 billion, down from 2001 as a result of the stronger Rand against the Dollar. Almost two-thirds of sales were exports, and a strong share of the local sales arose from products of the domestic hydrocarbon wells, which are not directly exported.

New investment potential remains strong in this sector, which has recovered enormously by new investments in operations since 1994, compensating for the rapid demise in the demand for uranium oxide in nuclear applications since the late 1980s.

Energy

Energy in the economy

Energy comprises approximately 15% of Gross Domestic Product (GDP), creating employment for about 250 000 people. The total electricity sales by Eskom in 2002 grew by 1,5% to 187 957 gigawatt-hour (GWh). Total liquid-fuels sales in 2001 grew by 0,3% to 20 934 million litres (ML). These figures demonstrate the growth of the South African economy and the importance of energy as a key driver of the country's economy.

Its energy intensity is above average, with only 10 other countries having higher commercial primary energy intensities. This high-energy intensity is largely a result of the economy's structure, with large-scale, energy-intensive primary mineral beneficiation industries and mining industries dominating.

In addition, there is a heavy reliance on coal for the generation of most of the electricity and a significant proportion of the liquid fuels consumed in the country. Furthermore, South Africa's industry has not generally used the latest in energy-efficient technologies, mainly as a result of relatively low energy costs.

Government has been persistently engaging members of the Organisation of Petroleum Exporting Countries through diplomatic channels to increase production.

Energy efficiency

Significant potential exists for energy efficiency improvements in South Africa in all economic sectors, the largest potential being in industry, which uses 68% of all electricity.

The savings potential of the industrial sector could be as high as 50% for a number of reasons: the low cost of electricity is only a temporary phenomenon, energy-efficient technologies are more easily available than in the past and the payback periods are short. However, maximum benefits for the national economy will only realise if energy efficiency is practised across all sectors, including mining, households, commercial buildings and transport.

The energy-efficiency strategy to be pursued by government envisages achieving a target of 5% improvement over the next 10 years through enabling instruments and interventions. These include economic and legislative means, norms and standards and appliance labelling, energy audits and management, promotion of energy-efficient technologies, as well as the promotion of public awareness and information about the benefits of energy-efficiency measures.

Interventions will be grouped into three phases according to the payback period aimed at implementing 'easy gain' measures in the first phase and 'long-term gains' in the third phase.

The barriers to implementing energy efficiency in the past have been the low cost of electricity and the lack of knowledge among the public about the benefits of energy-efficient technologies, but the situation is set to change. The commitment to sustainable development and cleaner energy utilisation, the low cost of energy-efficient technologies and, above all, the cost-effectiveness of energy



efficiency (including demand-side management on behalf of the electricity utilities) compared with the great expenditure involved in building new power-generation capacity, are driving government policy in a new direction.

Energy demand by the economic subsector

Households

Energy consumed by households represents some 22% of the country's net use. Most household energy is obtained from fuel wood (65% of net energy), primarily in rural areas, with the remainder coming from coal (9%), illuminating paraffin (8%), and a small amount from liquid petroleum gas.

Rural households comprise the majority of poor homes and are characterised by severe poverty. In terms of basic energy services, their energy 'poverty' is exacerbated by the increasingly widespread scarcity of fuel-wood resources. Wood and paraffin are their main energy sources, with few having access to electricity.

Productive sectors

Industry and mining are the most important subsectors in terms of energy consumption. These sectors mainly use electricity and coal as energy sources.

The balance comes largely from coke and blast-furnace gases and small amounts of heating oils.

The mining industry depends heavily on electricity. Mineral and metal processing uses large amounts of electricity and coal, mostly in large-scale mineral beneficiation processes. Base metals, the largest single industrial energy-consuming subsector, is also by far the most energy-intensive one.

The food sector shows 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 mineral and metal industries. The chemical and paper

and pulp industries also consume large amounts of energy at high intensities.

Transport

Liquid fuels such as petrol and diesel account for 92% of energy used for transport. Rail transport accounts for less than 5% of the total national electricity consumption. Petrol sales account for more than half of the total sales of local petroleum products.

The total volume of liquid fuels sold during 2002 in South Africa was 21 267 ML, in comparison with 20 934 ML sold in 2001.

The demand for petrol and diesel has remained relatively static over the last five years. The demand for jet fuel has, however, grown steadily since 1994 as a result of increased business and tourism activities.

Government has accepted a process of managed liberalisation for the liquid fuel industry.

The Petroleum Products Act, 1977 (Act 120 of 1977), will be amended to institute a licensing dispensation for participants in the liquid fuel industry.

A regulatory regime for the petroleum pipeline industry will be established.

Coal

South Africa's indigenous energy resource base is dominated by coal. Many of the deposits can be exploited at extremely favourable costs and, as a result, a large coal-mining industry has developed.

The country ranks as the world's sixth-largest coal producer. In addition to the extensive use of coal in the domestic economy, large amounts are exported mainly through the Richards Bay Coal Terminal. South Africa is ranked the fourth-largest exporter of steam coal.

South Africa's coal comes from collieries ranging from among the largest in the world to small-scale producers with output in the range of between 5 000 and one million t per month. As a result of mergers and purchases, operating collieries were reduced to 55 in 2001. Of

these, a relatively small number of large-scale producers supply coal primarily to the electricity and synthetic fuel producers.

About 54% of South African coal-mining is done underground and about 46% is produced by open-cast methods.

The coal-mining industry is highly concentrated, with three companies, Ingwe (Billiton), Anglo Coal and Sasol, accounting for 82% of saleable coal production. Production is concentrated in large mines, with 13 mines accounting for 74% of production.

South African coal for local electricity production is among the cheapest in the world. The beneficiation of coal, particularly for export, results in more than 60 megaton (Mt) of coal discards being produced annually.

Thirty per cent of raw coal mined for the export market, and between 15% and 25% of the raw coal mined for local demand (excluding power-station coal), is not marketable and therefore discarded.

Total discards on the surface could reach 2 300 Mt by the year 2020, should none of this material be utilised. As a result, the Department of Minerals and Energy is investigating ways to promote and encourage the economic use of the discards.

Nuclear power

Nuclear science employs approximately 3 000 skilled people in diverse areas such as electricity generation, isotope production and non-destructive material studies for industry.

It positions South Africa at the forefront of medical applications of radioisotopes such as cancer diagnostics and therapy, and enables it to absorb and apply new nuclear technologies developed elsewhere in the world. It also gives South Africa the competitive advantage to play a leading role in Africa in the application of nuclear techniques in health, food, agriculture and environmental management.

South Africa has 34 nuclear medicine-imaging centres, of which 75% are privately owned. These centres together perform between

25 000 and 30 000 diagnostic procedures per annum. In addition, 30 oncology clinics and hospitals are equipped with teletherapy and accelerator equipment used in nuclear therapy to treat life-threatening diseases.

The South African nuclear industry is mainly governed by the Nuclear Energy Act, 1999 (Act 46 of 1999), and the National Nuclear Regulator (NNR) Act, 1999 (Act 47 of 1999). The legislation has established the South African Nuclear Energy Corporation Ltd (NECSA), previously called the Atomic Energy Corporation, responsible for nuclear technology, and the NNR, previously called the Council for Nuclear Safety.

Other relevant legislation that also play a regulatory role in the nuclear industry are the Hazardous Substances Act, 1993 (Act 131 of 1993), the Mine Health and Safety Act, 1996, the Minerals Act, 1989 (Act 30 of 1989), the National Environmental Management Act, 1998 (Act 107 of 1998), the Water Act, 1998 (Act 36 of 1998), and the Dumping at Sea Act, 1980 (Act 73 of 1980).

The Minister of Minerals and Energy is responsible for the governance of the nuclear industry and related matters. NECSA and the NNR report to the Minister. Apart from the Minister's authority over radioactive waste and irradiated nuclear fuel, the Minister also regulates matters pertaining to nuclear non-proliferation.

Nuclear energy policy was formulated as part of the *White Paper on Energy Policy*, 1998. In terms of this policy, government will investigate what long-term contribution nuclear power can make to the country's energy economy and, secondly, how the existing nuclear industrial infrastructure can be optimised.

In September 2003, the Deputy Minister of Minerals and Energy, Ms Susan Shabangu, released the Draft Radioactive Waste-Management Policy and Strategy for public comment. The purpose of the Draft Policy is to establish a comprehensive radioactive waste-governance framework, by formulating



a policy and implementation strategy in consultation with all stakeholders.

The Radioactive Waste Management Policy and Strategy outlines government's thinking on radioactive waste management and reflects the following:

- international and national principles for the safe management of radioactive waste
- responsibilities of government, radioactive waste generators and regulators
- basic principles and evaluation/authorisation processes for radioactive waste-management plans
- management structures to service the radioactive waste-management obligations of the Minister of Minerals and Energy
- a national radioactive waste-classification scheme
- a long-term radioactive waste-management fund
- undertakings to investigate the best long-term option for spent-fuel management.

Nuclear Energy Corporation

The NECSA was established as a public company in terms of the Nuclear Energy Act, 1999 and is wholly owned by the State. Apart from several ancillary functions, the main functions of NECSA are to undertake and promote research and development (R&D) in the fields of nuclear energy and radiation science and technology; to process source material, special nuclear material and restricted material; and to co-operate with persons in matters falling within these functions. Apart from its main operations at Pelindaba, west of Pretoria, NECSA also operates the Vaalputs radioactive waste-disposal facility in the Northern Cape.

NECSA is divided into six divisions, two of which are corporatised in structure and commercial in nature, two focusing on R&D and other non-commercial tasks, and two providing support services to the other four and to any other companies which now, or in the future, will operate from NECSA's Pelindaba complex.

The new structure contains two corporatised divisions to allow one to concentrate on nuclear business and the other on the group's high-tech non-nuclear business.

The former is called Nuclear Technology Products (NTP) and is responsible for the production and sale of radioisotopes and for radiation services. Radioisotopes, which are exported worldwide by NECSA, are essential for nuclear medicine and many industrial applications.

In September 2003, the Minister of Minerals and Energy announced that NTP had exported 86% of its sales of R131 million to 40 countries on five continents during 2002/03.

A chemical plant for the production of an advanced fluorine-based gas for use in the global semi-conductor industry has been established and commissioned on the Pelindaba site. The plant will generate in excess of R60 million per annum in foreign exchange over the next 10 years.

During 2003, NTP signed seven agreements involving product and business initiatives with the large Canadian multinational, MDS Nordion Inc.

NTP was the winner of the prestigious Technology Top 100 award in its category for 2002 and also received a special award from MTN for its role in successfully commercialising key domestic nuclear technology.

The non-nuclear commercial division will be corporatised as HTP Marketing and Manufacturing (Pty) Ltd. It focuses on commercial activities involving chemicals and gases – including fluorine beneficiation products and services.

The third of NECSA's divisions is called Nuclear Technology and houses the strategic core business functions of the group. It is here that R&D, training, skills transfer, as well as work that has relevance to the Pebble-Bed Modular Reactor (PBMR) project at Koeberg in the Western Cape, take place.

The fourth of the group's divisions is Nuclear Services. This is a non-commercial division

that is geared to perform State obligatory tasks, including the management of nuclear licences, management of decontamination, decommissioning functions, the ownership of the Safari-1 Research Reactor, as well as all safeguard functions and work with related international agencies, such as the International Atomic Energy Agency (IAEA).

The last two divisions of NECSA are Corporate Services, which supports the management of the other divisions, and Facilities Management, which is the landlord of the Pelindaba complex.

NECSA employs some 1 400 people in such diverse areas as physics engineering, chemistry and electronics.

Safari-1 is the most commercialised such reactor in the world with ISO 9001 accreditation, and is earning South Africa millions of Rands' worth of foreign revenue.

NECSA develops and utilises nuclear technology as part of the National System of Innovation. The Corporation also serves the State's nuclear institutional obligations. Its growth strategy, Vision 2010, is aimed at contributing to national and regional socio-economic development, in line with NEPAD.

In addition, NECSA is actively involved in training the healthcare sector in the safe and optimal use of nuclear material and technology. It also provides a 24-hour emergency service for nuclear-related accidents throughout Africa.

It (among other things) produces radioisotopes that are used to fight diseases and to accurately measure critical process parameters such as levels, mass, density and quality, and thus help keep the wheels of industry turning.

NECSA houses and operates the first gamma-irradiation facility in Africa. The facility, which was commissioned in 1971, is used to sterilise a range of products such as peat moss used as a growth medium in the seed industry.

NECSA is accredited by the IAEA as a regional designated centre, servicing the rest of

Africa in radioactive waste management. The Corporation has been given the responsibility of developing a low-cost radioactive waste-disposal facility – known as the Borehole Nuclear Waste Disposal System – to be used for the disposal of radioactive waste from hospitals on the continent.

Annually, NECSA dispatches top nuclear scientists to help condition and store spent radium sources in countries such as Zimbabwe, Madagascar, Tunisia, Sudan and Mauritius. Other projects include dam-leakage detection and the auditing of radiotherapy and nuclear medicine facilities in countries that include Libya, Nigeria and Ethiopia.

Radiation techniques are benefiting farmers across the continent – its use in agriculture increases crop quality and improves cattle production, thus raising income potential.

Other projects undertaken by NECSA include helping authorities curb the growing illegal trade in elephant and rhino horns, by using radiation techniques to identify the origins of the ivory. The dating of archaeological artifacts is yet another example of the useful and peaceful application of nuclear technology.

Eskom Koeberg Nuclear Power Station

Koeberg's two reactors have operated safely since their commissioning in 1984 and 1985 respectively. Koeberg supplies 1 800 megawatt to the national grid when both reactors are operating at full power, contributing approximately 6% of South Africa's electricity. Koeberg meets the full electricity demand of the Western Cape and was built mainly for economic reasons. It would be approximately 6% more costly to supply electricity to the Western Cape from the power-stations in the northern part of the country owing to losses during transmission.

With most of South Africa's electricity-generating stations situated on the Highveld coalfields, Koeberg provides a necessary 'anchor' for the supply network.



Uranium mining

The Nuclear Fuels Corporation is the uranium sales organisation in South Africa. In 1986, South Africa produced approximately 1 436 t of uranium at four production centres.

Nuclear-safety regulation

The NNR is the prime safety regulator and is responsible for the protection of persons, property and the environment against nuclear damage through the establishment of safety standards and regulatory practices. It exercises regulatory control related to safety over the siting, design, construction and operation of nuclear installations and other actions.

The Department of Environmental Affairs and Tourism announced in June 2003 that the environmental impact of the proposed PBMR at Koeberg, and the manufacturing and transportation of nuclear fuel to and from Pelindaba, was acceptable from an environmental impact point of view, subject to certain conditions.

One of these conditions was adherence by the Department of Minerals and Energy to finalise the Radioactive Waste-Management Policy and Strategy. This was achieved in September 2003.

Possible expansion

Nuclear power has not been excluded as a possible energy-supply option for the future. However, energy policy requires that decisions to construct future nuclear power-stations will be taken within the context of an integrated energy-planning process, and will be subject to consultation with all stakeholders. This integrated energy-planning process has been initiated by the Department of Minerals and Energy.

Eskom has completed a feasibility study of the PBMR with the objective of establishing whether such technology could form part of Eskom's expansion planning, and what advantages/disadvantages it would have compared with other options.

Liquid fuels

South Africa consumed 21 267 ML of liquid-fuel products in 2002. Thirty-six per cent of the demand is met by synthetic fuels (synfuels) produced locally, largely from coal and a small amount from natural gas. The rest is met by products refined locally from imported crude oil.

The petrol price in South Africa is linked to the price of petrol in United States (US) Dollars in certain international markets for petrol. This means that the domestic price is influenced by supply and demand for petroleum products in the international markets, combined with the Rand/Dollar exchange rate.

During 2002/03, there were various petrol-price increases as a result of increased prices for petroleum products in relevant international markets and the deterioration in the Rand/Dollar exchange rate. However, 2003 also saw some price cuts.

The National Petroleum, Gas and Oil Corporation of South Africa (PetroSA) was officially launched in Cape Town in October 2002.

The formation of the Corporation was the result of a merger between Mossgas, Soekor and other assets managed by the Strategic Fuel Fund.

The work on the merger began in 1998 with the adoption of the *White Paper on Energy Policy*.

As the national petroleum company in South Africa, PetroSA is responsible for the exploration and exploitation of oil and natural gas, as well as the production and marketing of synthetic fuels produced from offshore gas at the world's largest commercial gas-to-liquids plant in Mossel Bay.

PetroSA's commitment to the safety and health of its workers led to the company winning the National Association of Clean Air Award for clean air and environmental care at its Mossel Bay refinery operation.

During the State of the Nation Address in February 2003, President Thabo Mbeki announced that with effect from April 2003,

the Basic Fuel Price Formula would be phased in to replace the In Bond Landed Cost Pricing Mechanism.

It is expected that the new pricing mechanism will save fuel users more than R1 billion annually.

The Petroleum Products Amendment Bill was introduced in Parliament on 13 May 2003, and the Petroleum Pipeline Bill on 17 April 2003.

The Department of Minerals and Energy established a monitoring team in 2002 to evaluate the sustainability of Black Economic Empowerment (BEE) deals in liquid fuels and the validity of BEE groups.

Sasol

The Sasol group of companies comprises diversified fuel, chemical and related manufacturing and marketing operations, complemented by interests in technology development, oil and gas exploration, and production.

Its principal feedstocks are obtained from coal, which the company converts into value-added hydrocarbons through Fischer-Tropsch process technologies.

The company supplies 41% of South Africa's liquid fuel needs. It also provides 200 000 direct and indirect jobs, contributes R34 billion annually to South Africa's GDP, and produces 23% of the country's required coal.

Through Sasol Petroleum International and Sasol Synfuels International, the group also has interests in Mozambique, Congo, Equatorial Guinea, Gabon, Nigeria and Qatar.

Among its recent international developments is an agreement signed with the Mozambican Government for the development of natural gas fields in that country, and the construction of a pipeline to South Africa.

The project, a joint venture between Sasol and the Governments of South Africa and Mozambique, involves the construction of a pipeline running for 865 km from the natural gas fields of Pande and Temane in Mozambique to Secunda in South Africa.

The initial capacity of the pipeline is 120 million giga-joules per year, equivalent to 4 000 MW.

The first gas was expected to be delivered to Secunda by February 2004.

Sasol listed its American Depository Receipts on the New York Stock Exchange on 9 April 2003.

Sasol now operates in 23 countries on all continents, producing hundreds of fuel and chemical products for customers in more than 100 countries.

Indigenous oil and gas resources and production

The Petroleum Agency of South Africa (PASA), the Department of Minerals and Energy's Agency responsible for the promotion of oil and gas exploration, has been successful in further encouraging international exploration companies to evaluate the country's oil and gas opportunities.

As a result of increased exploration activities, a better understanding of the potential for commercial oil and gas is being developed. PASA is following this up with a detailed possible resource study.

The EM gas-field complex off Mossel Bay started production in the third quarter of 2000, and will ensure sufficient feedstock to PetroSA to maintain current liquid-fuel production levels at 36 000 barrels (bbls) of petroleum products a day until 2009.

Parallel exploration is being carried out in various other sections of the Bredasdorp Basin off the coast of Mossel Bay in the Western Cape to find reserves for PetroSA beyond 2009.

PetroSA's gas-to-liquid plant supplies about 7% of South Africa's liquid-fuel needs. The



Sasol was named Global Coal Company of the Year for 2002 by the Platts-Business Week Global Energy Awards.



products are supplied to oil companies that market them under their own brand names.

PetroSA also produces anhydrous alcohols and speciality fuels that are exported and earn the company more than R500 million per year.

PetroSA's new oilfield, Sable, situated about 150 km south off the coast of Mossel Bay, is expected to produce 17% of South Africa's oil needs.

The field, which came into operation in August 2003, was initially projected to produce 30 000 to 40 000 bbls of crude oil a day and 20 million to 25 million bbls in the next three years.

The net savings in foreign exchange to the country would be equivalent to PetroSA's bottom-line profit of between \$10 million and \$15 million a year.

PetroSA holds 60% working interest in Sable, while Dallas-based partner company Pioneer Natural Resources holds the remaining 40%.

PetroSA has offered 9% of its Sable interest for sale to a BEE group.

Import and export of fuel products

The import of refined products is restricted to special cases where local producers cannot meet demand. It is subject to State control with a view to promoting local refinery utilisation.

When overproduction occurs, export permits are required and generally granted, provided that both South Africa's and other

Southern African Customs Union members' requirements are met.

More diesel than petrol is exported, owing to the balance of supply and demand of petrol and diesel relative to refinery configurations. Although petrol and diesel make up 55% of total liquid-fuel exports, South Africa is also the main supplier of all other liquid fuels to Botswana, Namibia, Lesotho and Swaziland.

Gas

In addition to coal gas and liquid petroleum gas, South Africa produced some 15 234 t of natural gas and 271 billion t of associated condensate in 2002.

The entire gas and condensate output is dedicated to PetroSA's liquid-fuel synthesis plant, and accounts for about 1,5% of total primary energy supply. Gas manufactured from coal accounts for 1,2% of net energy consumption, while liquid petroleum gas accounts for about 0,5%.

Natural 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 lead to natural gas becoming a more important fuel in South Africa.

Infrastructure

South Africa's gas infrastructure stretches from Sasolburg in the northern Free State, through the industrial areas of Vereeniging, Johannesburg and the East Rand, and from Secunda to Witbank and Middelburg, to Newcastle, Richards Bay and Durban.

Through the Sasol Gas Division, Sasol Oil markets industrial pipeline gas produced by Sasol Synthetic Fuels and Sasol Chemical Industries to about 700 industrial customers. These customers are mostly in the greater Johannesburg-Pretoria region and the industrial areas of Witbank-Middelburg and Durban.



South Africa will host the 18th World Petroleum Congress in 2005.

The Congress, considered the world's biggest and most prestigious meeting in the oil industry, is expected to attract more than 20 Energy Ministers and 5 000 representatives from the oil, gas and related industries, governments, and academics from across the globe.

The South African International Oil and Gas Exhibition will run parallel with the 2005 Congress.

It promises to be the largest exhibition of its kind on the African continent, with some 4 000 exhibitors and 25 000 visitors expected.

Its pipeline network consists of about 1 500 km of underground pipelines.

Most of the remaining 10% of gas sales in South Africa is on-selling of Sasol gas by Metro Gas in Johannesburg, which owns 1 300 km of distribution pipe, and supplies 12 000 domestic and 3 000 industrial customers.

The privatisation of Metro Gas was completed in 2000. It is now owned by Egoli Gas (Pty) Ltd, a joint venture company owned by Cinergy Global Power Inc. Egoli Gas intends to invest R276 million in Metro Gas.

Petronet owns and operates a gas pipeline, known as the Lily Line, which is approximately 600 km long and transports methane-rich gas from Sasol's Secunda plant as far as the Durban area. Easigas (Shell) has a small liquid petroleum gas/air pipe network in Port Elizabeth. A privately owned company in Port Elizabeth distributes a small amount of liquid petroleum gas/air blend by pipe.

Industrial customers use 87% of the gas, and domestic consumers the rest. The supply of cost-competitive pipeline gas is complemented by the fuel oils range of low-sulphur residual and distillate fuel oils derived from coal and other synthesised forms, as well as crude oil.

PASA markets offshore gas exploration and exploitation.



Sasol announced in February 2003 that it would invest R15 million as part of a project to help government set up 10 Integrated Energy Centres over the next three years, in an effort to make energy more accessible and affordable to the country's rural poor.

The project stems from the Integrated Sustainable Rural Development Strategy (ISRDS).

Energy products will be delivered directly to the Integrated Energy Centres that will become sole wholesalers and distributors.

Embalenhle in Mpumalanga, and QwaQwa in the Free State, have been identified as the first two sites. The other eight sites will be determined in line with the nodes identified in the ISRDS and will be set up in KwaZulu-Natal, the Eastern Cape, Free State, Northern Cape, Limpopo and Mpumalanga.

The Gas Act, 2001 (Act 48 of 2001), aims to:

- promote the orderly development of the piped-gas industry
- establish a national regulatory framework
- establish the National Gas Regulator as the custodian and enforcer of the national regulatory framework.

To facilitate the movement of gas across international borders, a cross-border gas trade agreement with Mozambique has been signed.

In 2000, the Cabinet approved the establishment of a national gas-development company, iGas, within the Central Energy Fund (CEF) Group. The task of this company is to enter into joint ventures for gas-transmission pipeline projects.

During 2002/03:

- the Gas Regulator Levies Act, 2002 (Act 75 of 2002), was assented to by President Mbeki. The Act provides for the establishment of a gas regulator
- the Cabinet approved the rationalisation of the regulators of the gas, electricity and petroleum pipelines sectors into a single National Energy Regulator.

Other initiatives included:

- the development of the Draft Gas Infrastructure Plan, which outlines how gas resources will be developed to produce energy for South Africa
- the South Africa/Mozambique Cross-Border Gas Commission, which has commenced its sittings
- the text of the South Africa/Namibia Cross-Border Agreement, which was agreed upon
- the production of the first Integrated Energy Plan, which also makes provision for gas.

In August 2003, the Minister of Minerals and Energy launched the Ibhubesi Gas Field at Redisson, Seapoint, Cape Town.

The introduction of natural gas is in compliance with the *White Paper on Energy Policy* by diversifying primary energy supply. Natural gas has the least negative environmental impact of the fossil fuels.



Ibhubezi Gas Field is presently the only field discovered off the west coast of South Africa containing potentially commercial volumes of gas. This gas would be supplied to a gas-to-electricity project in the Western Cape and to the PetroSA's manufacturing plant in Mossel Bay. The volume of gas already discovered in the Ibhubezi Gas Field is too small to guarantee a production life of 20 years needed to match market demand.

Electricity

South Africa, which supplies two-thirds of Africa's electricity, is one of the four cheapest electricity producers in the world. Ninety-two per cent of South African electricity is produced from coal. Generation is currently dominated by Eskom, the national wholly State-owned utility, which also owns and operates the national electricity grid. Eskom currently supplies more than 95% of South Africa's electricity.

In global terms, the utility is among the top seven in generating capacity, among the top nine in terms of sales, and has the world's biggest dry-cooling power-station.

Eskom was incorporated as a public company on 1 July 2002, as it is financed by net financial market liabilities and assets as well as reserves.

While Eskom does not currently have exclusive generation rights, it has a practical mono-poly on bulk electricity. It also operates the integrated national high-voltage transmission system and supplies electricity directly to large consumers such as mines, mineral beneficiaries and other large industries. In addition, it supplies directly to commercial farmers and, through the Integrated National Electrification Programme (INEP), to a large number of residential consumers. It sells in bulk to municipalities, which distribute to consumers within their boundaries.

During 2002, Eskom electrified 211 628 homes against government's target of 205 371

homes, thereby exceeding the target by 6 257 homes.

Restructuring of the electricity supply industry (ESI)

The recommendations approved by the Cabinet and which represent government's position on the ESI, are the following:

- To meet government's developmental and social objectives, Eskom retains no less than 70% of the existing electricity-generating market sector.
- That the introduction of private-sector participation in the generation sector be increased to 30% of the existing electricity-generating market sector.
- That the involvement of BEE within the generation sector be about 10% of the existing generation capacity by no later than 2003.
- To ensure a meaningful participation of the private sector in electricity in the medium term, Eskom should not be allowed to invest in new generation capacity in the domestic market, other than in existing capacity.
- To ensure non-discriminatory and open access to the transmission lines, and taking into consideration the financial stability of Eskom, government, in the medium term, establishes a separate State-owned transmission company that will be independent of generation and retail businesses, with a ring-fenced transmission-system and market-operation functions. Initially, this transmission company will be a subsidiary of Eskom Holdings and will be established as a separate State-owned company before any investments are made in current or new-generation capacity.
- Over time, a multimarket model electricity-market framework will ensure that transactions between electricity generators, traders and power purchasers take place on a variety of platforms, including bilateral deals, and future and day-ahead markets.
- A regulatory framework is in place that will ensure the participation of independent

power producers, and that diversified primary energy sources be developed within the electricity sector without hindrance.

- The planning and development of transmission systems will be undertaken by the transmission company, subject to government policy guidelines.
- Over time, and taking cognisance of the strategic objectives of the region, the Southern African Power Pool (SAPP) must develop into an independent system operator for the southern African regional grid system, so that public and private generating companies can participate in the Pool.
- Adapting the role of the regulatory system, which will include the reform of the legal framework defining the role of the National Electricity Regulator (NER), the development of a new framework for licensing, the adaptation of price-setting, and the creation of the capacity to monitor the effectiveness of the reformed ESI and ensure security of supply.

Restructuring of the electricity distribution industry (EDI)

The EDI restructuring process differs from most of the other State restructuring activities, as it addresses a number of diverse stakeholders, of which the most important are:

- Eskom
- electricity departments of municipalities
- provinces (related to their governance of municipalities)
- consumers, ranging from very large and electricity-intensive to small
- labour
- a number of government departments.

The normal State restructuring process needs to be modified at the entry level for EDI restructuring in such a manner that the ESI and the EDI restructuring process are interlinked.

The EDI Holdings Company will be responsible for the next phase, which is to move from the current fragmented EDI structure to the implementation of regional electricity distributors (REDS).

The recommendations approved by the Cabinet and which represent government's position on the EDI are the following:

- Endorsing the thrust of the revised EDI Restructuring Blueprint Report.
- The number of six REDs as both the Government's policy direction and the end-state model for the restructured EDI.
- The EDI restructuring implementation plan, especially the time frames, the establishment of the EDI Holdings Company and the transition, will ensure that Eskom and stronger municipalities support the weaker municipal distributors, and that RED 3 and RED 6 receive transitional financial support from the EDI Holdings Company. During 2003/04, the Company was expected to start transforming the EDI. Significant progress in the transformation of the supply industry was also expected to begin in 2003/04.
- Ongoing consultations with stakeholders such as new municipalities, the NER, Eskom, organised labour, customers, and provincial and local governments.
- The Minister of Provincial and Local Government will convene a meeting of relevant Ministers to deal with the issue of debt owed by local authorities to Eskom.

By May 2003, the industry was worth R30 billion and employed more than 30 000 personnel. The work on demarcating the six new REDS has been completed. The REDS will own the distribution business of Eskom and municipalities.

National Electricity Regulator

Established in 1995, the NER is a statutory body funded from a small levy imposed on electricity generators.

Legislation requires anybody wishing to generate, transmit or supply electricity to apply to the NER for a licence. This is issued on the basis of criteria which aim to promote and maintain a viable ESI. During 2002, the NER approved a general price increase of 8,439%.

In 2002/03, the NER:



- Continued to play a key role as a member of government's Electricity Distribution Industry Restructuring Committee (EDIRC). It also provided advice to government on the 'managed liberalisation' of the generation and transmission sectors, as part of the lead-up to a competitive market structure.
- Participated in and provided specific input to the following working groups:
 - ESI working groups (led by the Department of Public Enterprises)
 - EDI working groups (led by the Department of Minerals and Energy).
- Facilitated a process to ensure that the National Integrated Resource Plan (IRP) is published annually. The first National IRP for 2001/02 was published in December 2002.
- Regulated price increases applied for by licencees (including Eskom), resulting in customers enjoying considerable savings as a result of lower-than-applied-for electricity price increases.
- Managed the process to ensure that the Wholesale Electricity Pricing System (WEPS) is ready for implementation. In addition, the WEPS tariffs modelling and simulation were tested and confirmed. WEPS is intended to regulate the wholesale price of electricity in South Africa when REDs are introduced.
- Broadened the Independent Power Producer (IPP) policy and licensing framework to include renewable IPPs and demonstration plants.
- Implemented the NER Power Quality Directive, resolved disputes between suppliers and customers, and dealt with customer complaints so that customers could have recourse at no or little cost.
- Developed the Draft Energy Efficiency Policy.
- Developed the Transmission Grid Code in consultation with industry stakeholders. These stakeholders represent entities that are foreseen to become Grid Code participants. The Grid Code Advisory Committee was established to advise the NER Board on matters relating to the drafting and amendment of the Grid Code.

- approved the first non-grid licences for concessionaires to implement non-grid electrification projects.

Furthermore, the NER was elected deputy chairperson of the South African Regulator's Forum, which was launched in March 2002.

National and regional co-operation

The NER was also elected the first chairperson of the formalised African Forum for Utility Regulators (AFUR). The NER was also the founding member of the Regional Electricity Regulators' Association (RERA) and the South African Utility Regulators' Association (SAURA), which were launched in September and October 2002 respectively. The NER is the chairperson of SAURA and a chairperson of one of RERA's portfolio committees.

The main purpose of RERA is to provide a platform for co-operation between independent electricity regulators within the Southern African Development Community (SADC) region.

In deciding to set up RERA, members recognised:

- the need to co-operate in and promote the development of regulatory capacity-building in the region
- the increasing interconnections of the electricity systems between SADC countries, and the continuous increase in regional electricity trade, driven by the benefits of economies of scale and shared resources
- that the successful integration of electricity systems requires clear frameworks to facilitate the development of harmonised market structures, system operations and institutional arrangements
- the need to harmonise regional policies and strategies to promote infrastructure investment in the ESI across the region.

Integrated National Electrification Programme

The INEP remains the flagship of the Department of Minerals and Energy.

The EDI initiated and initially funded the Programme in the early 1990s. Between 1994 and 2003, a total of 3,8 million households were connected to the extended national electricity grid. According to Census 2001, the percentage of households using electricity has increased from 57,6% to 69,7%.

The Department of Minerals and Energy has taken over direct control of the INEP, with electrification funds flowing through the Department since 2001/02 instead of being funded by the ESI (mainly Eskom).

During 2002/03, a further 24 776 households, 974 schools and nine clinics were grid-electrified at a cost of R950 million. With more emphasis placed on integration with other infrastructures and service-providers, this pace will continue until universal access is reached, which is targeted for 2012.

To reach the more remote and sparsely populated rural areas where grid extension becomes expensive, a non-grid electrification programme using photovoltaic-based solar home systems was launched, involving private-sector service-providers. During 2002/03, a basic electricity service was provided to 6 300 rural households.

President Mbeki announced in the State of the Nation Address in 2003, that poor households, in areas connected to the grid, would receive up to 50 kilowatt (kW) of free basic electricity. In non-grid areas, such households are provided with a subsidy of up to 80% of the market cost to provide them with access to electricity.

As part of government's commitment to delivering basic services, the Department is helping to put in place mechanisms to ensure the supply of free electricity to poor households. The funds for this will flow through the equitable share of local government from 2003/04. Total extra funding for free basic electricity in the next Medium Term Expenditure Framework period is R1,4 billion. This should ensure the delivery of about 50 kW hours free each month to poor households.

Government aimed to establish 275 000 grids and 13 900 non-grid household connections, and provide 1 349 schools and clinics with electricity by March 2004.

Mini-grid hybrid systems

In recent years, much attention has focused on developing a project-implementation plan of a mini-grid for the Hluleka Nature Reserve in the Eastern Cape. The main role-players are the NER, CSIR, Shell, the Department of Minerals and Energy, and the Eastern Cape Provincial Government. An integrated approach resulted in a design consisting of an energy system, a water-purification system and a telecommunications system. The energy system will make use of renewable energy, solar water-heaters and liquid petroleum gas.

Additionally, two villages adjacent to Hluleka Nature Reserve have been identified as sites for pilot mini-grid hybrid systems. Emphasis has been placed on the linking of these mini-grids to new economic activities in collaboration with the Agricultural Research Council. High-value crops have been planted in a number of demonstration plants in co-operation with entrepreneurial farmers. The plan is to evaluate the mini-grid systems with a view to exporting the value-added crops out of the region, thus generating income.

After starting with the identified sites next to Hluleka Nature Reserve, additional sites for mini-grid hybrid systems will be attended to in the Eastern Cape, KwaZulu-Natal and Limpopo.

An integrated framework for a national strategy to roll out hybrid mini-grids will be developed as part of the analysis of the pilot study.

Southern African Power Pool

The Minister of Minerals and Energy participated in the opening of the SAPP in Zimbabwe in November 2002. It is the first formal international power pool in Africa.

The objectives of the SAPP are, among others, to:



- co-ordinate and co-operate in the planning and operation of electricity power systems to minimise costs, while maintaining reliability, autonomy and self-sufficiency
- increase interconnectivity between SADC countries to increase the reliability of power supplies
- facilitate cross-border electricity trading
- fully recover costs of operations, and equitably share benefits, including reductions in generating capacity and fuel costs, and improved use of hydro-electric energy.

Member countries include Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, Swaziland, Tanzania, Zambia, Zimbabwe and the Democratic Republic of the Congo.

Biomass

Fuel wood, which comes mainly from natural woodlands, is the primary source of energy used by households in most rural areas for the purposes of cooking and heating. In some areas, this is already almost completely depleted and in others it is under heavy pressure.

The total annual sustainable supply of wood from natural woodlands in communal rural areas is estimated at about 12 Mt. However, probably no more than half of it is usable as fuel wood. In addition to these sources, residues from commercial forestry total about 4,2 Mt per year. Much of this, as well as wood from bush clearing on commercial farmland, is increasingly being used as fuel.

To be effective, planning for a sustainable fuel-wood supply requires decentralisation, understanding of local conditions and flexibility.

Supply-side interventions focus on satisfying a range of local needs and the realisation that community forestry does not involve only the planting of trees, but community participation, which is central to all activities.

Planning must ensure their integration into broader rural development, land use, natural resource management, and agricultural and energy planning. Interventions should build on

the best indigenous practices identified. (See Chapter 23: *Water affairs and forestry*.)

Renewables

Renewable energy sources, other than biomass, have not yet been exploited to the full in South Africa. There are a number of initiatives to expand their use.

The *Draft White Paper on the Promotion of Renewable Energy and Clean Energy Development* was released in August 2002. The White Paper addresses four key strategic areas, namely:

- financial instruments to promote the implementation of sustainable renewable energy through the establishment of appropriate financial instruments
- legal instruments to develop, implement, maintain and continuously improve an effective legislative system to promote the implementation of renewable energy
- technology development to promote, enhance and develop technologies for the implementation of sustainable renewable energy
- building capacity and education to develop mechanisms to raise awareness of the benefits and opportunities renewable energy offers.

Technological feasibility studies will be conducted for possible implementation in the medium to longer term. These include:

- grid-connected wind farms
- wind farm/pumped storage as a means of addressing peak loads on the national electricity grid
- the local production and commercial dissemination of solar cookers which is a collaborative project between the German development agency GTZ and the Department of Minerals and Energy
- solar thermal power generation – which is a collaborative programme with Eskom, also involving the SolarPACES programme of the International Energy Agency

- small-scale hydropower – a scoping study aimed at developing an implementation strategy
- landfill gas exploitation
- rural water supply and sanitation.

The Minister of Minerals and Energy announced in September 2003 that the Department's Renewable Energy Strategy and Implementation Plan would be approved and implemented within a year with assistance from the World Bank and the Prototype Carbon Fund.

The aim is to consume an additional 10 000 GWh of renewable energy by 2013, which will be achieved through renewable energy power-generation and other sources such as biodiesel, solar-water heating, etc. The Energy SETA is expected to develop renewable energy technology (including biodiesel) and education and training unit standards with the help of the Department of Minerals and Energy.

The CEF is expected to install some 250 domestic solar water-heaters as part of the CEF/GEF (Global Environment Facility) Solar Water-Heating Programme, aimed at the commercialisation of domestic solar water-heating.

Solar

Most areas in South Africa average more than 2 500 hours of sunshine per year, and average daily solar-radiation levels range between 4,5 and 6,5 kWh/m² in one day.

The southern African region, and in fact the whole of Africa, is well endowed with sunshine all year round. The annual 24-hour global solar radiation average is about 220 W/m² for South Africa, compared to about 150 W/m² for parts of the USA, and about 100 W/m² for Europe and the United Kingdom, making the local resource one of the highest in the world. The solar resource is by far the most readily accessible in South Africa. It lends itself to a number of potential uses.

The country's solar-equipment industry is developing. Annual photovoltaic panel-assem-

bly capacity totals 5 MW, and a number of companies in South Africa manufacture solar water-heaters.

The *White Paper on Energy Policy* identifies universal access to electricity as one of the primary goals of South Africa's energy policy.

To achieve this goal, it was decided to integrate non-grid technologies into the INEP as complementary supply-technologies to grid extension.

A pilot programme has been launched to establish a limited number of public-private sector institutions in conjunction with the relevant municipalities to provide electricity services on an integrated basis. The service-provider will own and maintain the systems, allowing longer-term financing to ameliorate monthly payments. It will provide the service against a fee, payable as a monthly tariff.

Once the underlying managerial and funding issues have been resolved, the process will be expanded to cover all the rural areas.

Solar power is increasingly being used for water-pumping through the rural water provision and sanitation programme of the Department of Water Affairs and Forestry.

Solar water-heating is used to a certain extent. Current capacity installed includes domestic 330 000 m² and swimming pools 327 000 m² (middle to high income), commerce and industry 45 000 m² and agriculture 4 000 m².

In 2002/03, some 5 300 solar home systems were installed by the Department of Minerals and Energy, representing a 3% increase from 2001/02.

Solar-passive building design

Houses and buildings in South Africa are seldom designed from an energy consumption or energy-efficiency perspective. The energy characteristics of low-cost housing are particularly bad, resulting in high levels of energy consumption for space heating in winter. The



net result is dangerously high levels of indoor and outdoor air pollution in the townships, due mainly to coal burning.

Research has shown that low-cost housing could be rendered 'energy smart' through the utilisation of elementary 'solar passive building design' practice. This can result in fuel savings of as much as 65%. Such savings on energy expenditure will have a major beneficial impact on the household cash-flow situation. Energy-efficient homes may be constructed at the same direct cost (and lower life-cycle cost) as energy-wasteful houses. The challenge is to develop awareness and to ensure implementation of basic energy-efficiency principles.

National solar water-heating programme

Water-heating accounts for a third to half of the energy consumption in the average household. In South Africa, this derives mainly from electricity, it being the most common energy-carrier employed. Avoidance of this expenditure on household budgets could lead to significant improvements in the disposable incomes of the lower-income sector.

Furthermore, the equivalent of a large coal-fired power-station (2 000 MW+) is employed to provide hot water on tap to the domestic sector alone. Since the inception of the accelerated domestic electrification programme through grid extension, a major distortion of the national load curve has emerged, with the early evening load peak growing significantly.

Modelling indicates that the introduction of solar water-heating can ameliorate the situation substantially.

Switching from electrical to solar water-heating can, therefore, have significant economic and environmental benefits.

There are economic benefits for homeowners in reducing their energy bills. Expensive generation capacity to address load peaks will be obviated, and the introduction of new base-load capacity will be postponed. Benefits for the country include

reducing greenhouse gas (GHG) emissions, and the release of scarce capital for other pressing needs.

Wind

Wind as an energy source is only practical in strong and steady wind areas. South Africa has fair wind potential, especially along the coastal areas. At present, however, wind is not used to generate electricity in this country. For the future it presents itself as a competitive energy source.

Wind power is primarily used for water-pumping, with about 300 000 windmills being used for watering livestock and supplying communities with water.

The first wind-energy farm in Africa was opened at Klipheuwel in the Western Cape on 21 February 2003.

The experimental wind farm, property of Eskom, will explore the use of wind energy for bulk electricity-generation.

Wind energy is environmentally friendly and helps reduce global warming and GHGs.

A further useful aspect of the experimental farm is the ability to update the wind atlas of South Africa that will be used for, among others, identifying other suitable areas for wind-power facilities.

The first turbine was commissioned in August 2002, the second in December 2002, and the third was commissioned at the launch in February 2003.

Hydro

South Africa has limited potential for large-scale hydroelectric power owing to its limited water resources. Although the country's total hydro potential is estimated at 3 500 MW, the economically feasible potential is much lower.

The current total installed large-scale hydropower generation-capacity (larger than 10 MW), is 2 061 MW. The installed capacity of plants smaller than 10 MW totals some 65 MW.

River flows in South Africa are not constant, varying between floods and very low flows. For

this reason, the running of river schemes is generally not a feasible option. Relatively large and expensive storage dams are normally required, even for small hydro-stations.

South Africa has two conventional hydro-electric power-stations and two pumped storage schemes. Pumped storage-generation involves the construction of two adjacent reservoirs, or dams, one at a significantly higher elevation than the other. During periods of low demand on the Eskom grid, normally at night and over weekends, excess energy is used to pump water from the lower reservoir to the higher reservoir via underground tunnels. During peak demand periods, such as early mornings and evenings, the process is reversed. The stored water is allowed to flow back via the tunnels to the lower reservoir through hydraulic turbines, driving generators. Apart from a small quantity of water lost to evaporation, pumped storage schemes, like conventional hydro-stations, do not consume water. Once one of the reservoirs is filled, the same active volume is used over and over again.

Energy and the environment

Energy and the global environment

On a global scale, South Africa's contribution to GHG emissions is small. On a per-capita basis, however, it is well above global averages and that of other middle-income developing countries.

Furthermore, the economy is carbon-intensive, producing only US\$259 per ton of carbon dioxide emitted, as compared with US\$1 131 for South Korea, US\$484 for Mexico and US\$418 for Brazil.

Sources of greenhouse gas emissions

The energy sector is a major source of GHG because of the heavy reliance on coal for electricity generation, the Sasol oil-from-coal process, and a dearth of other indigenous energy resources, such as hydro and wind

energy. In addition, 57% of the coal-mining methane emissions can be attributed to these two uses of coal.

Energy and the national environment

There is some contention regarding the polluting effects of the energy sector, particularly in the Mpumalanga Highveld – the location of most of Eskom's coal-powered stations and the largest Sasol plants.

As is the case internationally, there is ongoing debate about the desirability of nuclear energy.

Energy and the household environment

Coal is used by about 950 000 households countrywide. This brings with it indoor air-pollution problems, which have a serious health impact. It has been found that some people's exposure, especially to particulate matter, can exceed World Health Organisation (WHO) standards (180 mg.m⁻³) by factors of six to seven during winter, and two to three in summer. A national programme has been established, with the objective of introducing low-smoke alternatives into the townships.

Fuel wood is used by three million rural households as their primary energy source. Studies have shown that fuel-wood users are exposed to even higher levels of particulate emissions than coal users. In one study, exposure levels were found to exceed the WHO lowest-observed-effect level by 26 times. The Department participates in a National Housing Interdepartmental Task Team and has contributed towards the development of norms and standards for solar-passive and thermally-efficient housing design.

The Department is investigating the introduction of improved woodstoves and other alternatives, such as solar cookers and biogas, in an attempt to address these pollution problems.

More widespread is the use of paraffin by low-income households, rural as well as urban. Paraffin has, however, associated



health and safety problems. The distribution of child-proof caps and the dissemination of information on the safe storage and use of paraffin are some of the measures being taken by the Department and other role-players to address the problem.

Institutions involved

Apart from the Department of Minerals and Energy, the Departments of Health, Environmental Affairs and Tourism, and Water Affairs and Forestry, are involved to greater or lesser degrees in the monitoring of and legislation on pollution.

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Central Energy Fund
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 Eskom
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