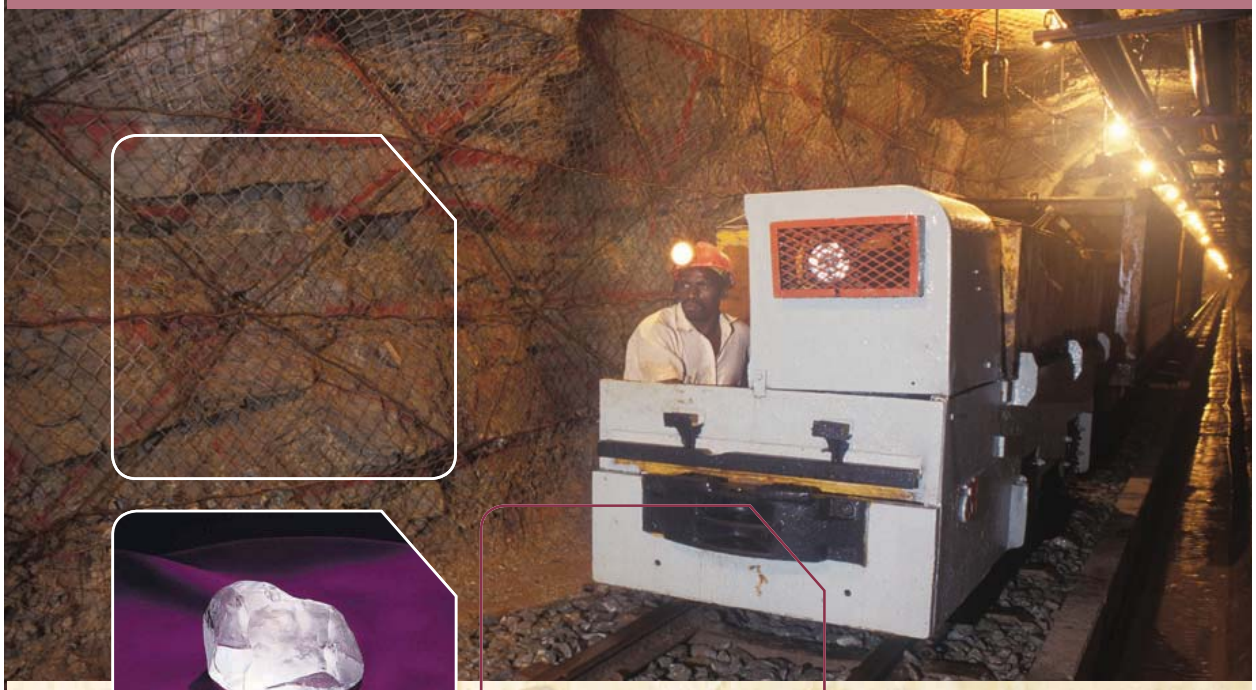
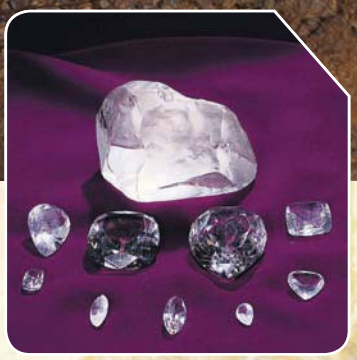
MINERALS, ENERGY AND GEOLOGY





The aim of the Department of Minerals and Energy is to formulate and implement an overall minerals and energy policy to ensure the optimum use of minerals and energy resources.

The Hydrocarbons, Clean Energy and Energy Planning Branch is responsible for coal, gas, liquid fuels and energy efficiency.

The Electricity and Nuclear Branch is responsible for renewable energy, the designated national authority and energy planning. Additional responsibities include data and statistics, the roll-out of integrated energy centres (IECs) and the establishment of a national energy database.

The Mineral Policy and Promotion Branch is responsible for formulating and promoting mineral-related policies that will encourage investment into the mining and minerals industry, making South Africa attractive to investors.

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

The Mineral Regulation Branch regulates the mining and minerals industry to achieve transformation and contribute to sustainable development.

Policy

Mining and minerals policy is based on the principles of the Freedom Charter, according to which the mineral wealth beneath the soil will be transferred to the ownership of the people as a whole.

The Mineral and Petroleum Resources Development Act (MPRDA), 2002 (Act 28 of 2002), has opened doors for the substantial and meaningful participation of black people in the exploration and exploitation of mineral resources. The MPRDA, 2002 enshrines equal access to mineral resources, irrespective of race, gender and creed.

By mid-2008, as a consequence of this Act, employment figures had reached the half-a-million mark for the first time in many years. When the Act was passed, there was only one junior mining company. By mid-2008, there were 21 junior mining companies.

Aided by the Department of Minerals and Energy, skills development is taking place in the jewellery sector to enable people to take leadership roles and the provinces to play supporting roles.

The South African Diamond Board was established in 1987 in terms of the Diamond Act, 1986 (Act 56 of 1986), to regulate control over the possession, purchase, sale, processing and export of diamonds. During 2007, three pieces of legislation, namely the Diamond Amendments Act, 2005 (Act 30 of 2005), the Diamond Second Amendment Act, 2005 (Act 30 of 2005), and the Precious Metals Act, 2005 (Act 37 of 2005), were promulgated, thereby broadening the legal mandate of the board to also regulate precious metals. Subsequently, the South African Diamond Board was de-listed as a Schedule 3A public entity in March 2007 and replaced by the South African Diamond and Precious Metals Regulator (SADPMR), which was established by Section Three of the Diamonds Act, 1986 (as amended in 2005).

The SADPMR and the State Diamond Trader (SDT) were officially launched in February 2008, although they had already begun operating by proclamation in 2007.

Their establishment signalled a number of significant changes in the regulation of diamonds and precious metals and heralded a new era where the SDT began to sell rough diamonds to those South Africans who were previously excluded. The two entities are a product of the Department of Minerals and Energy's commitment towards maximising value addition of South Africa's mineral resources with particular reference to diamonds and precious metals.

The SDT opened in Johannesburg and is expected to move to Kimberley in the Northern Cape at a later stage. The Precious Metals Act, 2005 provides for the acquisition of smelting, refining, using and disposing of precious metals, with the emphasis on adding increased value.

The Mineral and Petroleum Resources Development Amendment Bill was submitted to Parliament in 2007. After thorough consultation, the following were agreed upon to achieve alignment of environmental management requirements in the MPRDA, 2002 and in the National Environmental Management Act (NEMA), 1998 (Act 107 of 1998):

- one environmental management system to be followed in South Africa
- the Minister of Minerals and Energy to be the responsible authority implementing environmental matters in terms of NEMA, 1998, as it relates to prospecting, mining, exploration, production and related activities in a prospecting, mining, exploration and production area

- the Minister of Environmental Affairs and Tourism to be the appeal authority on all environmental authorisations issued in terms of NEMA, 1998
- both NEMA, 1998 and MPRDA, 2002 needed to be amended to give effect to the agreement made by the ministers.

An amendment to geosciences legislation was also to be made to align it with the MPRDA, 2002 but, more importantly, will empower the Council for Geoscience (CGS) to be the custodian of all geological data received during or after prospecting and mining operations, "for investment purposes".

The Bill will go a long way in providing certainty for investors, thus creating more employment. The Geoscience Amendment Bill aims to align the Geoscience Act, 1993 (Act 100 of 1993), with the MPRDA, 2002 and expand the functions of the CGS. The Bill was introduced to Cabinet in January 2008, but was referred back for further consultation with other departments. By mid-2008, the consultation process was in progress.

The Department of Minerals and Energy is reviewing the Mine Health and Safety Act (MHSA), 1996 (Act 29 of 1996), to improve sanctions for non-compliance and extend the application to cover corporate bodies. The new Bill will also establish a mine inspectorate as an entity of government to help the department to deal with acute skills shortages in this area. This review will effectively regulate occupational health and safety at mines.

The Bill empowers the Mine Health and Safety Council to appoint its committees to deal with current and emerging sector challenges. This review will enhance the effectiveness of the council as an advisory body on mine, health and safety. In 2008, the Energy and Security Bill was approved by the National Assembly. This covers sustainable energy development and gives certain powers to the Minister of Minerals and Energy.

It will make interventions possible to ensure energy security and uninterrupted availability of energy supplies, make regulations pertaining to appliances, address environmental requirements on the subject of climate change and water use, enforce mandatory co-operation in the development of sector energy plans and establish the National Energy Efficiency Agency.

The Electricity Distribution Industry (EDI) Restructuring Bill will focus on issues surrounding the establishment of regional electricity distributors (REDs) and the transfer of Eskom's assets and business. The Department of Minerals and Energy has tabled the National Radioactive Waste-Management Agency Bill in Parliament.

The agency will be responsible for, among other things, the production of disposal solutions, the issuing of disposal certificates, managing disposal facilities and designing new facilities when needed. Emphasis will be placed on improving communication to the general public on waste-management issues.

The National Energy Regulator Amendment Bill will provide a legislative mandate for the present body over the whole energy sector.

Implementation of the Mineral and Petroleum Resources Development Act, 2002

The Department of Minerals and Energy's efforts to pursue and consolidate gender empowerment in the mining industry have culminated in the revitalisation of the South African Women in Mining Association (Sawima) and the official launch of their national offices in Johannesburg. Through Sawima, the department will continue to lend assistance to women in mining to ensure that this sector does not continue to be the domain of men only.

The department hosted the Women in Mining Colloquium in November 2007 to deliberate on issues and challenges facing the active participation of women in the mining sector. The colloquium provided the platform for dialogue as well as for the exchange of experiences and information pertinent to women in mining.

From 2006 to March 2008, the department ran a sustainable development project targeting women and the youth and focusing on training and skills development in beneficiation, mining and rehabilitation. The mining communities in Griekwastad, Prieska and Kuruman in the Northern Cape were given training on the dangers of asbestos, rehabilitation of asbestos mines and beneficiation of semi-precious stones.

Training in the Free State and Limpopo focused on crushing waste rocks to produce aggregates for the construction industry. About 173 beneficiaries were trained, 54% of whom were male and 46% female.

The department continued with training interventions in niche areas of beneficiation, particularly stone-setting in jewellery manufacturing to alleviate the shortage of skilled labourers in the jewellery manufacturing industry.

By mid-2008, the third group of trainees in the Jewellery Manufacturing Programme with China had already been placed with jewellery companies in South Africa. This group from the Western Cape received training in China from September 2007 until January 2008. The department, in partnership with the Mining Qualifications Authority (MQA), facilitated training on computer-aided design for 12 students, which was done parallel to the Design Indaba Expo that took place in February 2008.

Youth in Energy and Mining was established in 2006 to facilitate youth programmes and reach out to as many youth in the country as possible.

To further fulfil the objectives of the Joint Initiative on Priority Skills Acquisition (Jipsa), the CGS, the Central Energy Fund (CEF) Group of Companies and the University of Fort Hare are collaborating on a skills-development programme in the fields of geology, chemistry and economics.

Furthermore, the department uses the MPRDA, 2002, through its requirements for a social and labour plan, to intensify the struggle against poverty.

Housing projects, schools and clinics are initiatives undertaken by mining companies in an effort to fulfil the criteria as set out in the Act.

Mine environmental management

Mine environmental management, which forms an integral part of the management of mineral resources, focuses on:

- the approval and monitoring of the implementation of environmental management plans and mine environmental management programmes
- regular inspections to strengthen enforcement to prevent mining legacies
- identifying and managing "hot spots"
- approval of mine-closure applications and the monitoring of implementation of these
- rehabilitating abandoned and ownerless mines.

Considering the extent of environmental damage caused by mining in South Africa, the Department of Minerals and Energy entered into a three-year agreement with the Council for Scientific and Industrial Research (CSIR), the CGS and Mintek to find solutions for long-term rehabilitation and environmental management. The Sustainable Development Through Mining Programme was established and resulted in addressing the following:

- a derelict and ownerless mines database
- a regional mine closure strategy for the Witwatersrand Water Basin
- a sustainable development strategy for minerals and mining
- mine environmental management guidelines for implementation, monitoring and mine closure
- instruments and tools to assist with evaluating, inspections and decision-making.

The department has been assigned the responsibility to reduce government's environmental liabilities as a result of pollution emanating from unrehabilitated, derelict and ownerless mines.

In 2007, about 13 projects were implemented with a budget of R55 million. The focus was on asbestos mines because of the potential health hazards posed by them.

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 mining outcomes, the Department of Minerals and Energy initiated a process in 2005 by developing a strategy to address the WSSD outcomes for minerals and mining.

In 2008, the department was finalising a strategy to achieve the mining priorities of the Johannesburg Plan of Implementation. The key strategic objectives of the strategy are:

- That the South African mining sector reflects the sustainable development values, principles and aspirations of the country. All stakeholders in the sector must share a sustainable development vision based on a culture of mutual respect.
- The vision of sustainable development in the sector must be communicated effectively to all stakeholders.
- To recognise that sustainable development strategy and policy must transcend both the Government of the day and the requirements of the United Nations Conference on Science and Technology for Development and should be valid and appropriate across all time scales. Furthermore, that community empowerment, and environmental and social rights are central and enduring tenets of the sector and that all those operating within the minerals sector earn a social licence to do so.

- That the Sustainable Development Strategy facilitates the transition from finite resource-based industries and economies to sustainable knowledge-based economies and that building and accounting for social and natural capital is implicit.
- That the Sustainable Development Strategy promotes economic diversification in existing and future mining industries and that the minerals sector should take due cognisance of globalisation's influence on sustainable development and the consequences of these (including the implications of trade barriers, global market forces, international agreements, requirements and conventions).
- That the Sustainable Development Strategy acknowledges the potential and realised contribution of the industry for socio-economic empowerment and that policy creates conditions to ensure the continuation of this contribution.
- That value extraction from South Africa's minerals sector benefits vulnerable groups and value addition from South Africa's mineral resources is maximised locally.
- That government is empowered to facilitate sustainable development outcomes and link to national and international sustainable development strategies and initiatives and that all role-players realise the synergies achieved through effective co-operation.
- That the minerals sector moves towards sustainable end states and internalises negative costs and associated consequences and that the cumulative and life-cycle aspects of the sector are fully aligned with sustainable development principles.

African Mining Partnership (AMP)

The AMP had been established to champion, among other things, the mining and mineral-related initiatives of the New Partnership for Africa's Development (Nepad).

The Global Mining Dialogue was also established to promote WSSD mining outcomes in the international arena. During an AMP meeting, held in 2007, it was reported that there was progress on the AMP Sustainable Development Strategy.

The approach is based on the outcomes of the WSSD. Progress was as follows:

- The Draft Charter for Sustainable Development for the Minerals and Mining Sectors in Africa had to be finalised and adopted.
- More women should participate in mining and it has been identified as one of the main constraints for achieving sustainable development.
- A proposal was made that an AMP Women in Mining Desk be established to promote the participation of African women in the mining sector.

Sustainable development on the African continent

The Intergovernmental Memorandum of Understanding (MoU) on the Western Power Corridor Project (Westcor) was signed in October 2004.

This Nepad flagship programme intends to pilot the use of hydroelectric energy of the Inga rapids site in the Democratic Republic of Congo (DRC). It will ensure the security of supply in the Southern African Development Community (SADC). The participating utilities are those of Namibia, South Africa, the DRC, Botswana and Angola. A joint-venture company has been formed to initiate studies determining the viability of the project and to build, own and operate the infrastructure.

Mining industry

With the implementation of the MPRDA, 2002 and the Mining Charter, there has been an increase in the number of women participating in the mining industry. The most significant transactions approved recently saw the creation of black-owned companies.

Anglo Platinum sold a majority stake in the Lebowa Platinum Mines to Anooraq, the third-largest producer of platinum in South Africa. Furthermore, Anglo Platinum sold its 22% shareholding in Northam to Mvelaphanda Resources, making Northam a black-owned and -controlled mine. Anglo Platinum also sold 50% of its stake in the De Brochen Project to Mvelaphanda, making this project 100% black-controlled.

In relation to coal, Anglo Operations through Anglo Coal, facilitated the creation of a new coal company Anglo Inyosi Coal, wherein historically disadvantaged South Africans (HDSAs) own 26% of its equity. Kgalagadi Manganese is 80% owned by an empowerment company.

A number of community projects have been approved, wherein communities are holders of mining rights. Some examples of these are the following: Itereleng Bakgatia Resources, Marual Platinum and Lesizwe Platinum.

South Africa produces 10% of the world's gold, and has 40% of the world's known resources. It is estimated that 36 000 tons (t) of undeveloped resources – about one third of the world's unmined gold – still remains. These ores are increasingly difficult to exploit due to the great depths where they are situated and their fairly low-grade quality.

Following the successful conclusion of the protracted land claim by the Richtersveld community, the state-owned mining firm Alexkor is in a period of transition and has entered into a process of restructuring.

Black Economic Empowerment (BEE)

The Mining Charter, which is founded on an accord reached between government and the private mining sector, promotes BEE. In June 2007, the Department of Minerals and Energy announced that the South African Supplier Development Agency (Sasda) would be incorporated into the CEF Group of Companies as part of broader initiatives to accelerate the empowerment of BEE suppliers in the oil industry. Sasda was established in March 2005 by the department in conjunction with the seven major oil companies which constitute the South African Petroleum Industry Association (Sapia). Sasda's brief is to facilitate increased access by BEE suppliers to procurement opportunities in the petroleum industry, in compliance with the Liquid Fuels Charter of 2000. One of its key focus areas is the development of black suppliers to meet the industry's required standards.

Mineworkers

According to the Chamber of Mines, the South African mining sector in 2007:

- Directly employed 495 474 workers, compared with 458 600 in 2006. It was estimated that another 165 000 workers were employed in associated industries that either supplied products to, or used products from the mining industry (the multiplier linkages of the industry). Around five million people are directly dependent for their daily subsistence on mine employees.
- Accounted for 6% of those employed in the non-agricultural formal sector of the economy and 7,5% of the total private sector of non-agricultural employment.
- Paid R50 billion in wages and benefits to employees, which accounted for about 5,9% of the total compensation paid to all employed people in the country. This contributed substantially to domestic demand in the South African economy.

Mine health and safety

The MHSI, established in terms of the MHSA, 1996, is responsible for protecting the health and safety of mineworkers or people affected by mining activities.

The activities of the MHSI focus on achieving a safer and healthier mining industry for all. The MHSI works closely with industry and worker unions to reduce the incidence of mine accidents, with stakeholders committing themselves to continuously reduce fatalities by at least 20% a year. The inspectorate is also pursuing a strategy to eliminate silicosis and noise-induced hearing loss or occupational deafness by 2013, and to reduce the social costs of diseases and injuries to vulnerable communities in particular.

The Department of Minerals and Energy continues to work with security forces to develop a strategy of combating illegal mining, which is one of the biggest threats to mineworkers' health and safety.

South Africa is committed to combating HIV and AIDS in the mining industry.

Mine Qualifications Authority (MQA)

The MQA was established as a Sector Education and Training Authority under the leadership of the Department of Labour. The MQA aims 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 is responsible for:

- developing and monitoring the implementation of a sector skills plan
- registering skills-development facilitators at workplaces within the sector
- approving work-skills plans and annual training reports of companies in the sector
- developing unit standards and qualifications
- maintaining the quality of standards, qualifications and learning provision in the sector
- establishing, registering, administering and promoting learnerships

- administering existing apprenticeship systems
- administering and disbursing skills-development levies.

The MQA has introduced several initiatives to address skills shortages that specifically aim to support transformation across the mining and minerals sector. Two strategic documents support BEE in the mining industry. Firstly, the service-level agreement signed with the Department of Labour commits to targets set by the National Skills Development Strategy that are underpinned by equity principles aimed at accelerating Broad-Based BEE and employment equity.

Therefore, of all people trained, 85% should be black, 54% women and 4% people with disabilities.

The second strategic document that supports BEE in the mining industry is the MQA Mining Charter Support Strategy. In support of the Mining Charter, the MQA has introduced the Executive Preparation Programme, the Graduate Development Programme, a bursary scheme (including support for undergraduate practical training), the Universities Employment Equity Project, and support for small-scale miners. The MQA also supports SMMEs in the sector through grants for training in small-scale mining, mineral beneficiation, jewellery manufacturing and diamond processing.

The human-resource development guidelines provide for enhanced opportunities to be made available to HDSAs within the mining and minerals sector. The guidelines specify that by 2010, 40% of managers controlling the full spectrum of activities should be from historically disdvanted backgrounds and that women must occupy 10% of all positions.

Consequently, the MQA Executive Preparation Programme was created to aid HDSAs. Its focus is on developing strategic and in-depth understanding of the mining and minerals sector in some 26 learners per six-month term.

The Graduate Development Programme was also introduced for unemployed graduates from universities of technology who had qualifications and skills that were scarce and critical according to the Mineral Sector Skills Plan, but who needed to gain work experience.

Chamber of Mines

The Chamber of Mines was established in 1889, and 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. It covers areas such as industrial relations; education and training; security and healthcare; technical, legal and communication services; and the provision of statistical data.

Subsidiary companies provide training, examination administration, visits to operational gold and diamond mines, the monthly newspaper *Mining News*, mine-rescue, environmental management, and centres for human development to the South African mining industry and, in some instances, also to customers outside the mining industry.

Other areas of industry networking include:

- the Employment Bureau of Africa (Teba)
- Teba-Bank, which provides efficient and cost-effective banking services for mineworkers
- Rand Mutual Assurance, which provides compensation benefits for accidental injury or workers' death while on duty
- Rand Refinery Limited, the world's largest gold refinery

South Africa's mineral reserves, 2007

Commodity	Unit	Reserves	%	World ranking
Alumino-silicates	Kt	51	n/a	n/a
Antimony	t	200	4,7	4
Chrome ore	Mt	5 500	72,4	1
Coal	Mt	27 981	6,1	8
Copper	Kt	13 000	1,4	14
Fluorspar	Mt	80	16,7	2
Gold	t	36 000	40,1	1
Iron ore	Mt	1 500	0,9	9
Lead	Kt	3 000	2,1	6
Manganese ore	Mt	4 000	80	1
Phosphate rock	Mt	2 500	5,0	4
Platinum-group metals	Kg	70 000	87,7	1
Silver	t	n/a	n/a	n/a
Titanium minerals	Mt	244	16,9	2
Uranium	Kt	341	7,2	5
Vanadium	Kt	12 000	32,0	1
Vermiculite	Kt	80 000	40,0	2
Zinc metal	Kt	15 000	3,3	8
Zirconium	Kt	14 000	19,4	2

Mt=megaton, Kt=kiloton, t=ton, n/a=not available, Kg=Kilogram

Source: Department of Minerals and Energy

- the Nuclear Fuels Corporation (Nufcor)
- Colliery Technical Services, which includes the Colliery Training College
- Rescue Drilling Unit
- Collieries Environmental Control Services
- Mintek, which specialises in mineral processing, extractive metallurgy and related areas.

Junior and small-scale mining

The Department of Minerals and Energy is committed to ensuring that the small-scale mining sector becomes sustainable. The Small-Scale Mining Board is responsible for finding and implementing solutions to overcome identified limitations within the small-scale mining sector.

The National Small-Scale Mining Development Framework assists small-scale miners with the challenges they face. The small-scale mining sector contributes significantly to job creation in the mining industry. It is estimated that about 3 000 jobs can be created for every 15 sustainable small-scale mining projects given assistance. There is a need to involve more technical partners and business professionals to mentor each project in operation.

The framework's target market for assistance comprises:

- illegal or unacceptable operations, which are legalised and converted into sustainable operations
- undercapitalised operations, which require expansion or optimisation
- first-time entrepreneurs interested in new projects.

The small-scale mining sector includes:

- artisanal or subsistence mining operations (new entrants)
- suboptimal formal mining operations
- entrepreneurs with start-up capital.

The Directorate: Small-Scale Mining helps aspiring small-scale miners:

- to establish a legal entity
- to identify mineral deposits
- with environmental impact assessments (EIAs) and mineral rights
- with legal and contractual arrangements
- to calculate a reserve estimation of the selected deposits
- to carry out mining-feasibility studies
- to perform market studies
- with mining equipment.

The directorate co-ordinates a substantial amount of expert capacity and experience, and specialises in planning and developing viable mining projects through its pre-feasibility stages.

The South African Small-Scale Mining Chamber, launched in July 2005 in Kimberley, Northern Cape, represents the interests of small-scale miners nationally. Its objectives include positioning small-scale mining member companies to use available mining opportunities in and beyond South Africa's borders.

It also aims to provide a model for small-scale mining that can be used as a basis to link up with the SADC and the AMP.

The department continued supporting the development of small-scale mining and, for the first time, extended this support to jewellery-fabrication projects in 2007 and 2008.

To create more jobs, the Department of Minerals and Energy, through the Directorate: Small-Scale Mining, has supported 18 small-scale mines that are in operation in the country.

Eight small-scale mining operations were expected to be launched in 2008. In 2007/08, the Directorate: Small-Scale Mining received 40 applications for mining permits requesting funds for equipment.

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 widespread Witwatersrand Basin yields some 96% of South Africa's gold output.
- Diamonds (in kimberlites, alluvial and marine deposits) – the country is among the world's top producers.
- Titanium – heavy mineral-sand occurrences containing titanium minerals are found along the coastline.
- Manganese – enormous reserves of manganese are found in the sedimentary rocks of the Transvaal Super Group.
- Platinum-group metals (PGMs), chrome and vanadium – these minerals occur in the Bushveld Complex in Mpumalanga, Limpopo and North West. More than half of the world's chrome and platinum reserves are in this deposit.
- Bituminous coal and anthracite seams occur in the Karoo Basin in Mpumalanga, KwaZulu-

Natal, the Free State, Limpopo and the Eastern Cape.
- Copper, phosphate, titanium, iron, vermiculite and zirconium are found in the Phalaborwa Igneous Complex in Limpopo.

South Africa's reserves of the following commodities are globally the highest, namely:

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

South Africa's mineral industry is export-oriented as a result of the relatively small domestic market, but emphasis is now placed on encouraging local value addition to raw and semi-processed minerals. South Africa is the world's greatest exporter of gold, PGMs, chromite and ferro-chrome, manganese ores and ferro-manganese, vanadium and antimony products, as well as vermiculite and zirconium.

Other important export commodities include coal and titanium slag.

South Africa's mineral production, 2007

Commodity	Unit	Production	%	World ranking
Aluminium	Kt	914	2,4	9
Alumino-silicates	Kt	265	59,0	1
Antimony	t	3 354	2,5	7
Chrome ore	Kt	9 683	n/a	n/a
Coal	Mt	247,8	4,5	5
Copper	Kt	110	0,7	16
Fluorspar	Kt	285	6,0	4
Gold	t	253	10,3	2
Iron ore	Mt	41,3	2,5	7
Lead	Mt	42,0	1,2	11
Manganese ore	Kt	5 589	14,2	2
Nickel	Kt	42,0	3,1	9
Phosphate rock	Kt	2 556	1,7	10
Platinum-group metals	Kg	304 031	56,7	1
Silver	t	70	0,3	21
Titanium minerals	Kt	1 181	19,5	2
Uranium	t	639	1,6	11
Vanadium	Kt	23,5	40	1
Vermiculite	Kt	200	38,5	1
Zinc metal	Kt	31,4	0,3	25
Zirconium minerals	Kt	405	41,6	2

Mt=megaton, Kt=kiloton, t=ton, n/a=not available, Kg=Kilogram

Source: Department of Minerals and Energy

South Africa is largely self-reliant with regard to raw minerals, but coking coal, sulphur, potash and soda ash are among those imported.

South Africa's total sales of primary minerals increased to R223,9 billion in 2007. The value of exports of primary minerals in 2007 increased to R161,8 billion.

The Directorate: Mineral Economics of the Department of Minerals and Energy monitors and analyses the global supply and demand of minerals that affect the South African economy.

Gold

South Africa's gold production decreased by 7,2% from 272,1 t in 2006 to 252,6 t in 2007, largely as a result of the mining of lower-grade ore, made economic by higher rand gold prices, as well as new safety procedures, which involved the temporary closure of a shaft where a fatal incident had occurred to facilitate an audit with a view to improving safety.

Gold's total sales revenue increased by 1,6% to R38 billion, due to a 19,7% rise in the average Rand price for the year, despite lower sales volumes.

Silver

South Africa's silver mine production in 2007, at 69,8 t, was 19,7% lower than the 2006 figure of 86,9 t. Silver was produced as a by-product of the gold, lead-zinc, copper and PGM mines. Local sales value decreased from R11,0 million to R10,9 million due to the higher price, despite lower sales volumes. The export sales value decreased from R239,6 million to R224,1 million.

Coal

In 2007, South African mines produced 247,7 million tons (Mt) of coal. Of this 182,8 Mt were sold locally for R19,7 billion, and 67,7 Mt realised R24,4 billion on export markets. South Africa has estimated recoverable coal resources of 31 billion tons.

Platinum-group metals

South African PGM production dropped by 1,7%, to 304 t in 2007 from 309,3 t in 2006. Production of platinum and palladium decreased by 5,3% to 160,9 t and by 3% to 83,6 t respectively, while the production of rhodium rose by 7,2% to 21,1 t. PGM export sales revenue increased by 23,1% to R66 billion, due to a higher average rand basket price for 2007, despite lower sales volumes.

Non-ferrous minerals

This sector comprises a mixture of metals and metal concentrates. Copper, nickel and cobalt production and sales are, for the most part, reported as metals, whereas titanium (actually ilmenite and rutile concentrates), zirconium, zinc, lead and antimony are reported either as tons of concentrate or tons of metal in concentrate.

Of the latter, very little, if any, titanium or antimony concentrate ever reaches the metallic stage, and in the rest of the world these are regarded as industrial minerals (i.e. non-metallics). In 2007, sales in this sector totalled R19 billion, representing 8,5% of total mineral sales. Local sales made up 40,8% of total non-ferrous mineral sales.

Ferrous minerals

South Africa is an important source of ferrous minerals, being the largest producer of chromium and vanadium ores and a leading supplier of their alloys. It is also a significant producer of iron and manganese ores and a significant supplier of manganese alloys, ferrosilicon and silicon metal.

International crude and stainless steels manufacturing industries, which consume over 90% of ferrous mineral production, drive the demand of these minerals.

The recent tightness in raw material supply/demand has pushed ferrous mineral prices to record levels. As a result, revenues generated from mineral sales increased by 40% to R49,8 billion in 2007, when compared to 2006, despite the 4% weakening of the Rand/Dollar exchange rate.

Around R38 billion of sales revenues were derived from exports, which consist of less than 1% of primary minerals, mainly iron ores. When compared to the past two to three decades, the South African ferrous minerals industry has made good progress in mineral beneficiation and has the potential to improve on further downstream beneficiation as security of supply as well as proximity to supply could become priority in future.

The former Minister of Health, Dr Manto Tshabalala-Msimang, signed a historic agreement with the Chamber of Mines and the National Union of Mineworkers on 29 May 2008, allowing for the improvement of access to healthcare and medical benefits for ex-mineworkers.

The agreement commited the three parties to improving public health facilities that will be largely used by ex-mineworkers in South Africa and neighbouring countries for benefit medical examinations.

Industrial minerals

This sector comprises a wide variety of generally non-metallic minerals, with local sales accounting for some 88% of total revenue from industrial minerals in 2007. Local sales increased by R900 million from R6,9 billion to R7,8 billion in 2007.

The greatest contributor to the local sales value was sand and aggregate (43%), with limestone and lime (21,8%) being the second-biggest contributor. Fluorspar (28,7%), andalusite (26,4%), vermiculite (18,3%) and granite (14,9%) were significant contributors to the value of exports.

Processed minerals

Ferro-alloys and aluminum are the greatest revenue earners in this sector, contributing 78% of the R54,76 billion sales in 2007. In rand terms, processed mineral sales were 21% greater than in 2006. Exports yielded 76% of the total sales of processed minerals.

Other minerals

This sector is dominated by diamonds and includes hydrocarbon fuel and uranium oxide. Revenue from these minerals increased by 0,7% over that of 2006, to R15 billion. New investment by companies such as Uranium One and First Uranium have contributed greatly to the recovery of this sector.

Energy

The Department of Minerals and Energy's Energy Policy is based on the following key objectives:

- attaining universal access to energy by 2012
- providing accessible, affordable and reliable energy, especially to the poor
- diversifying primary energy sources and reducing dependency on coal
- good governance, which must also facilitate and encourage private-sector investments in the energy sector
- environmentally responsible energy provision.

Estimates suggest that R107 billion would be needed between 2005 and 2009 to meet the country's growing energy needs. Some R23 billion is reserved for independent power producer (IPP) entrants. Eskom will invest more than R300 billion in new generation, transmission and distribution capacity up to 2013.

In August 2007, Cabinet approved the Energy Security Strategy, a policy document that will change South Africa's approach to energy security.

The fuel shortages of 2005 and projected challenges coming out of studies conducted since then, as well as the load-shedding incidents that have hit the Electricity Supply Industry (ESI), have created the need for the strategy.

The strategy is presented in phases with phase one focusing on liquid-fuels issues, the energy security framework and the proposed energy planning approach. Phase two will address issues pertaining to electricity.

The strategy seeks to:

- secure adequate supplies of affordable energy for continued economic growth and development in the short term
- enable policy- and decision-makers to make informed decisions on these complex interdependent energy outcomes in the medium term
- ensure that strategic planning and subsequent growth and development are sustainable in the long term.

Key elements of the policy include:

- Implementing the Integrated Energy Modeling and Planning Approach, which is aimed at ensuring co-ordination and enhanced planning integration in dealing with future energy policy in support of achieving energy security.
- Improving Spoornet's operational efficiencies regarding its service to the liquid-fuels sector, by focusing on routes that allow for block trains/loads and the allocation of additional capacity to the Durban-Gauteng Corridor.
- Improving operational efficiencies at ports, especially during periods of increased demand for imported crude oil or refined products in South Africa, which includes ensuring that back-of-port facilities are not used as part of refining operations.
- Promoting local refining as far as possible, with a particular preference for production from local resources, including those from South Africa's neighbouring states.
- Developing Transnet Pipelines' new Multi-Products Pipeline, which is necessary to alleviate the identified capacity constraints in the petroleum supply chain by 2010.
- Promoting energy efficiency and other demand-side initiatives in all energy-demand sectors of the economy. This should be complemented by measures aimed at effectively managing interactions with the natural environment.

In January 2008, following the energy situation in the country, government and Eskom announced the Electricity Emergency Programme which entails:

- the Power Conservation Programme
- proposed power-rationing programme.

Other intervention measures that seek to influence consumer behaviour in the medium to long term are discussed below.

Efficient lighting roll-out programme

It has been established that of the 10 million plus electrified households in South Africa, there is an estimate of eight incandescent lights per household. It is projected that 800 megawatt (MW) could be saved by replacing incandescent lamps with compact fluorescent lights (CFLs).

The final target is to reduce the demand by 750 MW by 2010. The programme also accommodates a free CFL exchange for low-income households until 2015.

To ensure that this roll-out is sustained, the Department of Minerals and Energy intends to issue a restriction on the manufacturing of incandescent light bulbs. There will be certain exclusions granted for lamps for ovens, microwaves and for sensitive buildings and special cases.

Solar water-heating programme

The Department of Minerals and Energy and the CEF have embarked on a solar water-heating project, which promotes the use of solar geysers. This project implemented 500 solar water heaters and has reduced energy consumption in residential sector water heating, which contributes about 40% of household electricity consumption.

There is a subsidy of 20% to 30% depending on the cost of the unit. The potential savings of this programme is 650 MW. The programme targets households, group houses (such as army bases and mine residences) and commercial and industrial applications.

Traffic lights and public lighting

All major traffic intersection lights will be converted to solar power with a battery back-up. Other public lighting will be replaced with energy-efficient lights. This will cost about R400 billion and will also be another opportunity for employment creation and skills development.

Hospitality industry

The Department of Trade and Industry will proclaim that the hospitality industry converts all water heating to solar power. The water-heating method can be in the form of solar pre-heaters, thereby ensuring that electricity is not used whenever

there is enough solar radiation available to heat water.

National building standards

Local government has indicated that the municipal bylaws will entrench energy-efficient behaviour. This can be done by ensuring that the building standards to improve energy efficiency are legislated and implemented.

Smart metering for residential customers (load management)

Although smart metering can be initiated in the short term, the benefits will be reaped in the medium to long term. Smart metering requires the use of wireless technologies, which have to be retrofitted to existing conventional and pre-paid meters. In this manner, the utility (Eskom or the municipality electricity distributor) will be able to remotely manage customer load.

A quick cost-benefit analysis indicates that improved communication between the utility and the customer meter will result in big energy savings during the peak demand periods.

The potential reduction is estimated to be 3 265 MW, made up of:

- geysers: 2 161 MW
- laundry (2% contribution to peak): 246 MW
- pool pumps (1% contribution to peak): 122 MW
- other appliances (6% contribution to peak): 736 MW.

Fuel switching

This refers to a Department of Minerals and Energy-driven Liquified Petroleum Gas (LPG) pilot project roll-out, which aims to:

- convert and connect households to LPG
- promote LPG as an appropriate household energy for thermal purposes with a long-term view of converting consumers to natural gas as and when it becomes available throughout the country
- contribute towards the demand-side management (DSM) interventions of energy, especially with regard to electricity use during peak periods.
- use DSM funds to assist those sectors of communities, especially the low-income households to switch to LPG for cooking and space heating
- inform the department on the important policy issues and insights into the operation of the LPG industry, which will be used to inform policy.

Some challenges have to be overcome in respect of fuel switching to LPGs. Firstly, the affordability of LPG appliances for low-income households proves to be a barrier to the usage of LPG, hence the subsidisation undertaken by the department of such appliances. Secondly, sustainable supply of the product will have to be resolved in the long term. This would require investment in logistical infrastructure and import terminals associated with trading in LPG, as well as increased local production during seasons when large volumes of LPG are consumed.

The exorbitant and unregulated retail price of LPG proves to be a further barrier to the massive uptake and usage of LPG by households. To this effect, through the Department of Minerals and Energy's pilot project lessons, draft LPG price regulations have been formulated and a stakeholder workshop was held. The department expected to have these regulations promulgated and effected by March 2009.

Other medium-term interventions

Medium-term interventions that are likely to influence behaviour in the long term are the following:

- implementing the Electricity Regulation Act, 2006 (Act 4 of 2006), as amended, especially on the issues pertaining to energy efficiency
- adjusting the tariff regime to reflect the actual cost of providing electricity
- regulating the maintenance regime of the electricity infrastructure
- addressing technical and non-technical losses in generation, transmission and distribution of electricity
- the availability of primary energy (especially coal) for power generation.

The Department of Minerals and Energy has embarked on a number of renewable energy projects geared at increasing power generation in the country. Most of these projects have been supported by the department either through policy pronouncements or through financial support.

According to National Treasury, Eskom has 26 power stations in the country with the capacity to generate 37 761 megawatt (MW) of electricity. Due to maintenance and technical problems, only 35 436 MW are normally available, with peak hours taking a dedicated 2 325 MW daily.

The power utility's short-term capacity expansion includes the construction of a further two gas-fired power stations in Mossel Bay and Atlantis in the Western Cape, which will add an additional 1 042 MW to the national grid.

The Renewable Energy Subsidy Office has started disbursing subsidies for renewable energy projects and in 2008, the department provided R4 million for the development of these projects.

The department's projects cover hydropower, biogas to electricity, wind-power (Darling Wind Farm) and a green-power pilot project, which includes biomass electricity co-generation. The capacity of these projects is about 30 MW.

Energy and the economy

Energy comprises about 15% of South Africa's gross domestic product (GDP), and creates jobs for about 250 000 people. Eskom's electricity sales totalled 223 621 gigawatt/hour (GWh) by March 2008. Sales volumes of 2,86% were achieved compared with the target of 2,5%.

The peak demand on the integrated system totalled 36 513 MW in July 2007.

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

Coal, as the major indigenous energy resource, is relied on for the generation of most of the country's electricity and a significant proportion of its liquid fuels. Diversification of the primary energy mix, which comprises about 88% coal, is especially challenging.

South Africa has an abundance of low-cost coal, which means that reliable and inexpensive supplies are at hand.

On the face of it, this facilitates Eskom's mandate of providing South Africa with affordable and reliable electricity.

Yet Eskom also has a duty to manage environmental impacts and has a responsibility to combat climate change.

Energy efficiency

The Energy-Efficiency Strategy, which was approved in March 2005, sets a national target for improving energy efficiency by 12% by 2015.

In June 2007, the Department of Minerals and Energy launched the Intensive Multimedia Energy-Efficiency Campaign in partnership with the Department of Public Enterprises, Eskom and other state organs. The campaign targets ordinary households, commercial and industrial consumers to influence prudent consumer behavioural patterns without negatively affecting the economy.

South African thermal-processing specialist Prestige Thermal is leading the way in the global waste-to-energy conversion industry, having opened the world's largest conversion plant in July 2008.

The company has been at the forefront of conversion-technology research for over six years. Its work has led to the development of specialised autoclaving technology through which waste is reduced to cellulous fibre and pyrolysis, a process whereby solid waste material is converted into clean gas. Employing these new technologies, Prestige Thermal's R28-million plant in Wadeville, Gauteng, has the capacity to produce three megawatt of electrical energy from three tons of municipal solid waste.

This intervention should yield enormous benefits in the form of lower energy demand, energy security being promoted, and a contribution to environmental conservation and savings for individual households.

All state-owned enterprises (SOEs) have been requested to make energy efficiency a part of their shareholders' compacts. In addition, large companies have joined forces with the Department of Minerals and Energy and Eskom, by signing an energy-efficiency accord, thus committing themselves to targets in the department's strategy.

By mid-2008, the Department of Minerals and Energy was making progress in implementing the national Energy-Efficiency Accord. However, the biggest savings are expected to take place in 2009/10.

In December 2008, Deputy President Baleka Mbete launched a summer energy-efficiency campaign. In 2008, government addressed energy-saving measures through a range of initiatives. By retrofitting over 4 000 national government buildings alone, a saving of R56 million in energy costs was achieved.

The CEF is expected to ensure that South Africa's energy is fully developed and used efficiently for the benefit of all South Africans. The CEF established two new energy bodies to deal with the country's energy challenges. These are the National Energy-Efficiency Agency (NEEA) and the South African National Energy Research Institute (Saneri).

The NEEA is a division of the CEF and assists with promotional activities regarding the national energy-efficiency drive.

The NEEA's initial focus is on prioritising and recommending energy efficiency and DSM projects. It develops strategies to address the

growing demand for all kinds of energy in South Africa. It also creates energy-efficiency and DSM awareness campaigns to assist the public when purchasing energy-consuming equipment and appliances. The NEEA oversees the integration and co-ordination of training in existing energy-efficiency projects, and assists with skills transfer, capacity-building and the creation of additional jobs in the field of energy conservation.

In line with the national Energy-Efficiency Strategy, the NEEA is subject to review every three years. Initially, it will operate under the CEF corporate umbrella, but is expected to develop its own unique identity as time progresses.

Saneri, a subsidiary of the CEF, facilitates skills development and undertakes research and technology development that will ensure that South Africa's energy resources are used and optimised.

It is designed to generate new ideas to develop practical guidelines for taking advantage of the natural resources of clean and renewable energy.

Eskom launched a DSM programme, which is intended to reduce demand by about 3 000 MW by 2012 and a further 5 000 MW by 2025. The programme's objective is to alleviate imminent supply constraints and obviate the need for more costly supply options. Eskom will pursue energy-saving measures nationally, following the success of a campaign that saved about 500 MW a day in 2006 in the Western Cape during power shortages in winter.

Designated National Authority (DNA)

The Department of Minerals and Energy established the DNA to review clean development mechanism (CDM) projects. The purpose of this initiative is to ensure that the CDM investment taking place in South Africa is in line with sustainable development objectives addressing economic, environment and social development with the emphasis on investments, job creation, poverty alleviation, technology and skills transfer.

During 2007/08, the department approved 80 CDM projects. These projects have the potential of contributing to government's sustainable-development objectives in the form of poverty alleviation and job creation, access to clean energy by contributing to renewable energy and energy-efficient targets, technology transfer and economic development. These projects will assist South Africa reduce to greenhouse gas (GHG) emmissions such as carbon dioxide, which is emitted largely by the energy sector.

The project types reviewed are in the energy sector, namely fuel switching, cogeneration, renewable energy generation and energy efficiency. Collectively, these projects' lifespan will reduce about 20 Mt of carbon dioxide equivalent per year, bring foreign revenue of about R207 million (at 10 euros per ton) and contribute about 34 318 MW by way of electricity generation and energy savings.

Projects are located in various provinces such as KwaZulu-Natal, Gauteng and Western Cape. The majority of these projects are implemented at local government level, notably within the metropolitan municipalities. The potential revenue that will be generated through the sale of certified emission reductions will bring additional revenue streams to municipalities to improve their service delivery.

A number of big industries such as Sasol, Eskom, Mittal Steel, Mondi, Sappi and South African Breweries have also taken up CDM investments with the aim of contributing to sustainable development objectives and emission reduction.

Energy statistics

Detailed, complete, timely and reliable statistics are essential to monitor the energy situation in South Africa. In addition, energy statistics on supply, trade, stocks, transformation and demand are the basis for any sound policy decisions.

The Department of Minerals and Energy, in collaboration with Statistics South Africa, is responsible for providing energy data and statistics.

It has initiated a programme to strengthen the expertise and experience of the department's staff to be able to collect, verify, analyse and publish energy statistics. In addition, it intends to reduce the backlog in providing energy balances to one year. Energy statistics are available from publications such as the *Energy Digest* and *Energy Price Report*, as well as in electronic format and on the department's website.

The department, through the Energy Bill, intends to make the provision of energy data mandatory.

Integrated energy planning (IEP)

IEP involves estimating how much energy all consumers (such as industry or households) will need in future to deliver certain services, and identifying a mix of appropriate sources and forms of energy to meet these needs in the most efficient and socially beneficial manner.

In terms of the *Energy White Paper* (1988), the department will ensure that service-providers and

energy suppliers adopt an integrated resource-planning approach for large investment decisions, in terms of which comprehensive evaluations of the economic, social and environmental implications of all feasible supply- and demand-side investments will have to be undertaken.

The Department of Minerals and Energy published IEP1 in 2003, and has commissioned the development of the National Integrated Energy Modelling System. The system is expected to be in place in 2009, and will allow for data capturing and the development of a long-term energy plan.

Integrated Energy Centre (IEC) Programme

The department, in partnership with municipalities, oil companies and other stakeholders, is establishing IECs countrywide. The main objective is to bring affordable and sustainable energy services and information closer to poor communities.

Underlying this is a strong social-responsibility drive aimed at poverty alleviation, job creation and capacity-building.

By mid-2008, there were five operational IECs, namely: Kgalagadi IEC in Kuruman, Northern Cape; Caba Mdeni IEC in Matatiele, Eastern Cape; Moshaweng IEC in Laxey, Northern Cape; Eshane IEC in Greytown, KwaZulu-Natal; and Mutale IEC, Limpopo. Other IECs are at various stages of development. The department has approved a sustainability strategy and roll-out plan to establish more IECs until 2015, targeting the nodal areas first, followed by peri-urban and urban areas.

Energy demand by the economic subsector

Households

Energy consumed by households represents some 17% of the country's net use. Most household energy is obtained from fuel wood (50% of net household energy), primarily in rural areas, with the remainder obtained from coal (18%), illuminating paraffin (7%) and a small amount from LPG.

Currently, South Africa produces over 10 000 t of this commodity a year. The total sales of the product generate turnover of close to R2 billion.

LPG consumption has been growing at an average of 4% over the past few years. South African LPG consumers include commercial, industrial and households.

LPG can also be used by low-income households in both rural and urban areas in South Africa.

The estimated number of households with access to electricity increased from 4,4 million in 1994 to 8,8 million in 2007. The rate of new electrical connections is slowing down as it now has to be preceded by the establishment of bulk infrastructure in areas that were not previously served.

Close to half of all customers who receive electricity services from municipalities receive free basic electricity, with a large percentage of users in Gauteng and Free State receiving free basic electricity. Better long-term planning in terms of generation, distribution and maintenance is critical for the achievement of the goal of universal access to electricity by 2014.

Coal

South Africa's indigenous energy resource base is dominated by coal. Internationally, coal is the most widely used primary fuel, accounting for about 36% of the total fuel consumption of the world's electricity production.

Coal meets about 88% of South Africa's primary energy needs. Eskom announced its intention to begin diversifying its primary energy mix (using less coal) five years ago. It is building open-cycle gas turbines at Atlantis and Mossel Bay, of which 1 024 MW was commissioned in 2007 in record time. In addition, Eskom plans to build a 100-MW wind facility in the near future, pending licensing approvals. Feasibility studies continue regarding other renewable-energy and gas-plant initiatives.

Many coal deposits can be exploited at extremely favourable costs and, as a result, a large coal-mining industry has developed.

In addition to the extensive use of coal in the domestic economy, some 28% of South Africa's production is exported internationally, mainly through the Richards Bay Coal Terminal, making South Africa the fourth-largest coal exporter in the world.

South Africa's coal is obtained from collieries ranging from among the largest in the world to small-scale producers. Operating collieries decreased to 60 during 2006. Of these, a relatively small number of large-scale producers supply coal primarily to electricity and synthetic fuel producers. About 46,5% of South African coal mining is done underground and about 53,5% is produced by opencast methods.

The coal-mining industry is highly concentrated, with five companies, namely Anglo Coal, BHP Billiton, Sasol Mining, Exxaro Coal, Kumba

Coal and Xstrata Coal accounting for 90% of the saleable coal production. The eight largest mines account for 61% of the output.

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 65 Mt of coal discards being produced annually. The remainder of South Africa's coal production feeds the various local industries. About 109 Mt is used for electricity generation; 44 Mt for petrochemical industries such as Sasol; 10,4 Mt for general industrial sector use; and 5,7 Mt for the metallurgical industry. Coal merchants buy 8,4 Mt to sell locally or abroad.

The key role played by South Africa's coal reserves in the economy is illustrated by the fact that Eskom ranks first as a steam-coal user and seventh as an electricity generator in the world. Sasol is the largest coal-to-liquids producer.

Total discards on the surface could reach more than two billion ton by 2020, should none of this material be used. As a result, the Department of Minerals and Energy is investigating ways to promote and encourage the economic use of discards.

Environmental concerns pose the main challenge to coal as an energy source. Not only does the burning of coal cause air pollution, but the extraction of coal also affects the environment negatively. The department and the coal-mining industry are fostering the introduction of clean coal technologies in South Africa.

Eskom has successfully commissioned an underground coal-gasification pilot plant next to Majuba Power Station in Mpumalanga. The underground coal-gasification process uses a matrix of wells drilled into the coal bed.

Air is injected and the coal is ignited underground, thus producing a synthetic gas, which is harvested and used as fuel for either boilers or turbines. The technology promises a commercially competitive combustible gas and has synergies with conventional mining, that would enable mines to exploit coal reserves that could not normally be mined. This application is a first for Africa and the frontrunner in terms of Eskom's research into clean coal technologies.

During the first year of operation, it produced more than 13 million cubic metres of gas, or enough to supply the heating and cooking requirements of 330 medium-sized houses. In parallel with the research and development (R&D) phases, a motivation is being compiled for a new 2400-MW commercial power station which will be proposed to Eskom and stakeholders. An EIA has also been commissioned for this concept.

Nuclear

The nuclear sector in South Africa 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 Department of Minerals and Energy administrates these Acts.

The Department of Health administrates the Hazardous Substances Act, 1973 (Act 15 of 1973), related to groups III and IV hazardous substances.

Cabinet approved the Nuclear Energy Policy for South Africa in June 2008. This approval follows the consideration of public comments. The objective of the policy is to increase the role of nuclear energy as part of the process of diversifying South Africa's primary energy sources to ensure energy security. The policy will also ensure the reduction of the over-reliance on coal, which contributes to South Africa being among the highest emitters of GHGs. In 2008, the Department of Minerals and Energy was finalising an implementation plan in consultation with key stakeholders.

Eskom is investigating up to 20 000 MW of new nuclear power capacity by 2025. This would entail recapitalising certain nuclear agencies, financing others and setting up new ones.

The following main organisations are directly involved in the nuclear sector:

- The Department of Minerals and Energy plays a leading governance role regarding nuclear technology, non-proliferation and safety. The Minister of Minerals and Energy is the executive authority responsible for overseeing the South African Nuclear Energy Corporation (Necsa) and the NNR.
- Necsa undertakes and promotes R&D in the fields of nuclear energy, radiation sciences and technology, medical-isotope manufacturing, nuclear liabilities management, waste management and decommissioning. Necsa's reactor-produced radioisotopes are exported to more than 50 countries.
- The NNR oversees safety regulation of nuclear installations and activities involving radioactive material at Necsa's Pelindaba site, Vaalputs Radioactive Waste Disposal Facility, the Koeberg Nuclear Power Station, certain mines and other small users.
- The Department of Health (Directorate: Radiation Control) issues licences for Group III

hazardous substances (electronic-product generating X-rays, other ionising beams, electrons, neutrons or other particle radiation or non-ionising radiation) and Group IV hazardous substances (radioactive material outside a nuclear installation, which does not form part of or is used or intended to be used in the nuclear fuel cycle, and which is used or intended to be used for medical, scientific, agricultural, commercial or industrial purposes).

- The Koeberg Nuclear Power Station is responsible for about 6% of total electricity generation. It is owned by Eskom, which reports to the Minister of Public Enterprises.
- iThemba Laboratories is responsible for medical isotopes and medical applications. This public entity falls under the Department of Science and Technology.
- Nufcor is responsible for uranium-ore refinement and export. It is privately owned by AngloGold.

The department continues to participate in the Women in Nuclear South Africa (Winsa) Programme. Government is expected to accelerate preparatory work to ensure greater reliance on nuclear energy and other renewable energies. The department has introduced initiatives such as the South African Young Nuclear Professionals Society and Winsa to promote the industry among historically disadvantaged people.

Necsa will receive R10 million a year for the next three years to establish the National Nuclear Manufacturing Centre. It will incorporate Necsa's existing facilities at the Pelindaba complex outside Pretoria, including Fabritek (the manufacturing component of the former Atomic Energy Corporation), an existing design centre, and Necsa's current fuel-manufacturing activities at the Safari-1 research reactor.

This centre intends to do its own manufacturing but also assists other South African companies to meet the required standards and be able to manufacture for nuclear.

The NNR has to strengthen its capacity to evaluate different technologies, and the State will also have to improve its system for ensuring compliance with its non-proliferation obligations.

The expanded nuclear programme is expected to result in the development of a nuclear energy industrial complex, which will lead to job creation in the nuclear sector. This envisaged energy complex will centre on uranium beneficiation and power-plant manufacturing infrastructure.

Liquid fuels

The liquid fuels industry was licensed for the first time in 2005. The objectives of the licensing framework as detailed in the Petroleum Products Amendment Act, 2003 (Act 58 of 2003), include:

- promoting an efficient manufacturing, wholesaling and retailing petroleum industry
- facilitating an environment conducive to efficient and commercially justifiable investment
- promoting the advancement of HDSAs
- creating employment opportunities and small businesses in the petroleum sector.

Aggregate sales of major petroleum products showed an increase of 4% in the first quarter of 2008 as compared to the first quarter of 2007. The most significant increases were in diesel, (9,5%) and industrial heating fuels (35,6%). Volume growth of other products were between -3,2% and 7,6% compared to the first quarter of 2007.

Petrol and paraffin sales declined by 0,9% and 3,2%, affected by price increases while jet fuel sales grew by 3,3%. LPG volumes were the same as in 2007 and bitumen volumes increased by 7,6%.

Energy Champions (ECs) were inaugurated in June 2008, to inform, educate and mobilise the entire societal spectrum towards the sustainable use of electricity. Specific short-term targets to be reached by the ECs were identified during a workshop in September 2008:

- energy efficiency in government buildings reported on 38 buildings to be retrofitted over six months and 56 in the 2009/10 financial year
- taking part in media briefings on progress made once a month for a period of a year
- working with government to enforce the campaign against electricity theft
- engaging in immediate high-visibility campaigns, providing energy-saving tips targeting, among other things, households, industries, commercial customers, agriculture and tourism
- accelerating an efficient traffic-signal and street-lighting programme
- working with the departments of education and health and Sports and Recreation South Africa to intensify the campaign
- embarking on a comprehensive programme for skills development
- mobilising children and elders
- enhancing environmental awareness with regard to efficient use of technology before, during and after the 2010 Soccer World Cup.

In the first quarter, the percentage split of petrol sales between unleaded petrol (ULP) and lead-replacement petrol (LRP) was 62,4% for ULP and 37,6% for LRP. This indicates a growing increase in the penetration of ULP.

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

The Petroleum, Gas and Oil Corporation of South Africa (PetroSA) is responsible for exploring and exploiting oil and natural gas, as well as producing and marketing synthetic fuels produced from offshore gas at the world's largest commercial gas-to-liquids plant in Mossel Bay.

The Department of Minerals and Energy, together with the oil industry, established the Fuel Strategic Supply Task Team. It identified current and future supply constraints. Possible strategies and options to deal with these issues include the need for investment by SOEs in pipelines, storage and handling facilities. The findings pointed to inefficiencies emanating from industry practices, especially in port and railway operations. Changes in the industry's operations are expected to result in rail-infrastructure capacity doubling and port capacity increasing.

South Africa's national oil company, PetroSA, is well placed to provide a sustainable solution to the fuel-supply challenges. The Government endorses PetroSA's plan to build a world-class crude refinery at Coega. This refinery will have a capacity of 400 000 barrels per day, producing high-quality gasoline and diesel, which will meet the proposed clean fuels specification legislation.

The deep-water port of Coega is the location for the new refinery to alleviate South Africa's reliance on Durban, which currently handles 75% of the country's crude imports. The refinery project will create 8 000 direct and 39 000 indirect employment opportunities. Once commissioned, it will provide commercial growth to a relatively underdeveloped area.

Work-in-process includes:

- upgrading discharge and storage facilities at Cape Town
- additional storage cover at Mossel Bay
- product-handling terminals at Coega
- a two-phase, R5-billion, eight-well drilling programme has commenced to maintain fuel production beyond 2010.

The Government is confident that these initiatives will attract foreign investment, which will enable South Africa to expand its liquid fuels presence, also in Africa and the world.

In collaboration with the oil industry and Transnet, adequate port, pipeline and rail capacities to guarantee uninterruptable supply of liquid fuels into the country will be ensured.

Sasol

Sasol Limited is an innovative and competitive global energy company.

It is engaged in the commercial production and marketing of chemicals and liquid fuels, with a growing interest in oil and gas exploration.

Sasol was established in 1950 by the South African Government to manufacture fuels and chemicals from indigenous raw material. The company has developed world-leading technology for the commercial production of synthetic fuels and chemicals from low-grade coal, as well as the conversion of natural gas to environment-friendly fuels and chemicals. It is committed to sustainable development and is a signatory to Responsible Care, a worldwide initiative by the chemical industry that strives to improve performance in safety, health and environment.

About 30 000 workers drive the company forward in exploration, mining, science, technology R&D and business development. Sasol is listed on the Johannesburg Securities Exchange and the New York Stock Exchange.

Central Energy Fund

The CEF is involved in the search for appropriate energy solutions to meet the future energy needs of South Africa, the SADC and the sub-Saharan African region. This includes oil, gas, electrical power, solar energy, low-smoke fuels, biomass, wind and renewable energy sources. The CEF also manages the operation and development of the South African Government's oil and gas assets and operations.

The CEF, through its integrated oil-company subsidiary, PetroSA, is involved in exploration for oil and gas onshore and offshore in South Africa and the rest of Africa. It is also involved in producing environmentally friendly petroleum fuels and petrochemical products from gas and condensate at its synfuels refinery outside Mossel Bay, and the management of oil-storage facilities. The Strategic Fuel Fund manages South Africa's strategic crude oil reserves.

The CEF has established the Energy Development Corporation (EDC) to pursue commercially viable investments in renewable energy. The EDC's focus is on niche areas, and commercial and development projects that catalyse the renewable energy sector and social projects that benefit previously disadvantaged communities.

CEF subsidiary Oil Pollution Control SA provides oil-prevention control and clean-up services, mainly in South African ports and coastal areas.

CEF subsidiary Petroleum Agency South Africa (Pasa) manages the promotion and licensing of gas exploration, development and production in South Africa and the coastal areas offshore as part of creating a viable upstream oil industry in South Africa.

CEF subsidiary iGas is the official agent of the South African Government for the development of the hydrocarbon gas industry, comprising liquified natural gas and LPG in South Africa.

Oil and gas

South Africa has very limited oil reserves and about 95% of its crude oil requirements are met by imports from the Middle East and Africa (Saudi Arabia, Iran, Kuwait, the United Arab Emirates, Yemen, Qatar, Iraq, Nigeria, Egypt and Angola).

Refined petroleum products such as petrol, diesel, residual fuel oil, paraffin, jet fuel, aviation gasoline, LPG and refinery gas are produced by the following methods:

- crude oil refining (oil refineries)
- coal to liquid fuels and gas to liquid fuels (Sasol)
- natural gas to liquid fuels (PetroSA).

The wholesale and retail markets for petroleum products in South Africa are subject to a set of government controls. The Government regulates wholesale margins and controls the retail price of petrol. The industry has entered into product-exchange agreements to serve different markets. Together, these controls provide for access to fuel throughout the country and protect consumers, while providing a reasonable return on investment to the oil industry and enhancing opportunities for employment.

The refiners and wholesale marketers move products from the refineries by coastal barge, rail, truck and pipeline to roughly 200 depots. From these, about 4 600 service stations and 100 000 direct consumers (mostly farmers) are served.

Refineries and Sasol produce LPG and illuminating paraffin (kerosene). Most LPG is consumed in the country and the rest is used in refineries as fuel and/or exported regionally.

Limited natural gas reserves exist around the South African coast. PetroSA exploits the reserves off the coast of Mossel Bay, where the Mossgas plant converts the gas into liquid fuels.

Sasol produces gas from coal and is researching prospects to import gas from Namibia. Even though gas consumption has increased in recent years, the importance of gas in the South African energy economy is still low compared with other countries. By August 2008, the Department of Minerals and Energy was increasing the sources of introducing natural gas into the South African economy for thermal applications of energy. The department started with LPG, followed by liquefied natural gas (LNG) and hopefully ending up with natural gas from South Africa's own or neighbouring shores.

High LPG retail prices have prompted the department to investigate an appropriate and cost-effective way to deliver LPG to the people. The department has embarked on pilot programmes in partnership with municipalities.

The department launched two pilot projects in Tshwane and Mpumalanga. By June 2008, more than 18 252 households had been connected through the Atteridgeville project. The Thembisile (Mpumalanga) pilot project had connected over 8 616 households.

This demonstrates that the LPG uptake is on the increase and that households are keen to use it. The department has developed draft regulations in respect of the maximum retail price of LPG supplied to residential customers. The objective of these regulations is to regulate the price of LPG to make it more affordable for households. These were expected to be promulgated during 2008.

The department will also start a new pilot project in Mamelodi, outside Pretoria, which will be based on natural piped gas taken from the Sasol pipeline.

Import and export of fuel products

The importation of refined products is restricted to special cases where local producers cannot meet demand. It is subject to state control to promote local refinery usage. When overproduction occurs, export permits are required and generally granted, provided that the needs of both South Africa and other Southern African Customs Union members 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.

Biofuels

The Biofuel Industrial Strategy for South Africa, approved by Cabinet in December 2007, has a short-term focus (five-year pilot) to achieve a 2% penetration level of biofuels, or 400 million litres a year.

Pasa promotes the exploration for natural oil and gas resources.

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.

Piped-gas regulations were promulgated in 2007. The regulations address, among other things, issues such as distribution criteria, price regulation principles and procedures, a review of licence conditions, third-party access to transmission pipelines, third-party access to storage facilities and the determination of gas specifications.

Cross-border gas trade agreement

To facilitate the movement of gas across international borders, cross-border gas trade agreements have been signed with Mozambique and Namibia.

Since the arrival of natural gas from Mozambique in 2004, the contribution of natural gas to the primary energy supply rose from 1,5% to 3,3% (2005). This figure is expected to rise to 4,3% when the new Mozambique-South Africa gas-transmission pipeline reaches maximum capacity.

The South Africa-Namibia Gas Commission addresses harnessing the natural gas reserves in Kudu Gas Field.

Electricity

Eskom generates about 95% of electricity in South Africa and about 45% in Africa. About 88% of South Africa's electricity is generated in coal-fired power stations. Koeberg, a large nuclear station near Cape Town, provides about 6% of capacity. A further 2,3% is provided by hydroelectric and pumped storage schemes.

In South Africa there are few, if any, new hydro sites that could be developed to deliver significant amounts of power, due to water scarcity. Eskom currently dominates electricity generation. This national SOE also owns and operates the national electricity grid.

In global terms, the utility is among the top 10 in generating capacity, among the top 11 in terms of sales, and has one of the world's biggest dry-cooled power stations, namely Matimba Power Station.

Electricity, as a key strategic economic sector, underpins government's growth and development objectives. The Department of Minerals and Energy has several policies to ensure an adequate supply of electricity-generation capacity and that the distribution infrastructure is maintained.

Ever-increasing demand for electricity in an expanding economy has brought the era of excess capacity to an end. Eskom's net generating reserve margin is about 8% compared to the internationally accepted range of between 15% and 18%. Between October 2007 and February 2008, the country suffered major supply interruptions as load shedding had to be implemented to manage the energy shortage.

Eskom's power stations are ageing. In many cases, refurbishment is necessary to extend their economically useful life. Continued high-load factors at the stations (required to meet demand) put severe stress on all parts of the plant as they are frequently required to operate outside initial design parameters. These loads require a high level of planned maintenance.

Additional power stations and major power lines are being built at a massive scale to meet rising electricity demand in South Africa. The approved capacity expansion budget is R343 billion up to 2013 and is expected to grow to more than a trillion rand by 2026. Ultimately, Eskom will double its capacity to 80 000 MW by 2026.

The budget, approved by the Eskom Board and Government, is designed to meet the challenges of electricity reliability and availability and is aligned

In accordance with the South African Power Project, South Africa plans to double its electricity capacity over the next 20 years, and diversify its primary energy source from fossil fuels, to nuclear and renewable energy sources.

The estimated cost of this over the next two decades is about R1 trillion. This power project provides a comprehensive framework that links new investments in plants, skills, technology transfers, as well as research and development projects.

with government's target of a 6% GDP growth between 2010 and 2014. Eskom will deliver an additional 14 759 MW in generating capacity by 2017.

The Eskom Build Programme is on track to deliver the projects as planned. Since the programme started in 2005, an additional 2 248 MW has been commissioned.

The formal opening of both Ankerlig and Gourikwa power stations took place in October 2007 at Ankerlig. In May 2007, Nersa granted Eskom the licence to build the first new coal-fired power station in more than 20 years – Medupi Power Station in Lephalale, Limpopo. An official sod turning took place on 14 August 2007. In November 2007, Hitachi Power Africa and Alstom S&E were awarded the R20-billion boiler and the R13-billion turbine contracts respectively for the power station. More than 50% of the combined value of the contracts will be procured locally.

On 29 February 2008, Eskom awarded contracts worth about R31,5 billion for its "Bravo Project", a coal-fired power station to be built at Emalahleni in Mpumalanga by 2017. Hitachi Power Africa was awarded the boiler contract worth R18,5 billion and Alstom S&E the turbine contract valued at R13 billion. Site preparation was expected to start in June 2008.

The return to service of the three moth-balled power stations – Camden, Komati and Grootvlei – is progressing well. The original planned target date of end October 2011 for commercial operation of all 23 units (3 677 MW installed capacity) will be achieved.

Work is also progressing well on Ingula, a pumped storage scheme near Ladysmith, KwaZulu-Natal, with a sent-out capacity of 1 332 MW. The station is planned to be fully operational by the middle of 2013.

The Apollo substation refurbishment was completed by June 2008 and increased the availability and maintainability of the Cahora Bassa/Apollo HVDC interconnection.

The transmission power-delivery programme is being severely impacted on by outstanding approvals, such as land, servitudes, environmental authorisations, etc.

A team of more than 2 500 engineering, project management and commercial resources, supplemented by 19 local and foreign engineering and project-management companies that are contracted as partners over the next 10 years, is actively involved in the execution of the Build Programme.

While Eskom does not have exclusive generation rights, it has a practical monopoly on bulk electricity. It also operates the High-Voltage Transmission System and supplies electricity directly to large consumers such as mines, mineral beneficiators 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.

The department is procuring about 1 000 MW of new-generation capacity from the private sector. This is in line with government's objectives to introduce private-sector participation and to promote BEE in the energy sector. This will be achieved through a competitive tender process for IPPs to provide the required capacity by the first quarter of 2009.

One open-cycle gas turbine plant (of approximately 300 MW) is planned for the Eastern Cape and another (of about 750 MW) for KwaZulu-Natal, as part of a R150-billion expansion programme over the next five years. Eskom is playing an active role as the purchaser of this energy and provider of transmission infrastructure. The process of identifying a successful bidder was expected to be finalised in 2008.

In 2007, Nersa released an audit report conducted in 11 electricity-distribution utilities in the country. The report showed that the distribution industry's operations were suboptimal, with an infrastructure maintenance backlog of about R7 billion. This scenario calls for the acceleration of the restructuring of the EDI.

In October 2006, Cabinet decided to restructure the EDI into six wall-to-wall regional electricity distributors (Reds) as public entities managed through the Public Finance Management Act, 1999 (Act 1 of 1999), and regulated by Nersa.

By June 2008, the department was in the process of finalising legislation governing the establishment of Reds.

By June 2008, EDI Holdings and the department had visited all nine provinces and 121 of the 187 municipalities that distribute electricity had signed co-operative agreements with EDI Holdings.

Four metros, Eskom and 13 other municipalities had completed the process of ring-fencing their electricity distribution businesses.

In September 2007, Cabinet resolved that Eskom be designated as the single buyer of power from IPPs in South Africa.

Eskom is offering home owners rebates of 15% to 20% on the cost of installing solar water-heating systems through its Solar Rebate Programme, enabling home owners to save from about R1 860 to R4 900 on the cost of a solar water-heating system.

Typically, installed systems can range between R14 000 and R33 000, depending on the make and size of the geyser, type of roof, as well as overall complexity of installation.

The programme applies only to systems that have been tested by the South African Bureau of Standards.

The requirements for receiving the rebate include that the system incorporates a functioning timer, and is installed by an Eskom-approved service-provider, while a valid claim for the rebate must be submitted, using forms provided by the installer.

Eskom will be responsible for ensuring that adequate generation capacity is made available and that 30% of the new power-generation capacity is derived from IPPs.

This policy will ensure that the responsibility and accountability for the construction of power-generation capacity is coordinated, and will provide more certainty to private providers.

The introduction of the private sector into the power-generation sector will also allow production-cost benchmarking with the State utility, thus ensuring that electricity is produced at the lowest possible cost. Eskom is running the pilot National Cogeneration Programme to source cogeneration capacity from the market. Cogeneration involves the use of unused waste heat, power or resources by private companies to generate electricity.

In October 2007, organisations were invited to submit tenders to take part in cogeneration with Eskom. The potential bidders in the programme were given two opportunities to comment on the power purchase agreement (PPA) that would be offered under this programme. A final PPA was released to bidders on 20 March 2008.

The closing date for bid submissions for the pilot programme was 30 May 2008, and contracts were expected to be awarded before the end of September 2008. Eskom received a good response from interested parties and it is hoped that PPAs for more than 900 MW of capacity can be signed with cogenerators under this programme.

Over the next 20 years, Eskom will build all nuclear power plants in South Africa while the IPPs will build more than 50% of all non-nuclear power plants. The Department of Minerals and Energy will develop the Integrated Resource Plan that will define the magnitude of power-generating capacity needed to meet the country's electricity demands. Nersa will regulate the single-buyer function and specifically approve all commercial agreements between the single buyer and the private producers. Institutional and regulatory mechanisms will be put in place as per the Electricity Regulation Act, 2006 (Act 4 of 2006).

Integrated National Electrification Programme

The INEP remains the flagship of the Department of Minerals and Energy. Eskom is responsible for implementing the programme in its licensed areas of supply on the department's behalf.

In 2008, out of R1,4 billion allocated for household electrification, a further R380 million was set aside for the building of 10 substations with primary emphasis on the provinces with the least development, namely Limpopo, KwaZulu-Natal and the Eastern Cape.

In 2008, the department planned to electrify 150 000 households and 2 500 schools and improved the quality of electricity supply in preparation for 2010 and beyond. The department has eradicated the backlog of electrification of clinics and aims to achieve universal access to schools by the end of the 2009/10 financial year.

Out of 2008's electrification expenditure of R1,4 billion, R894 million was used for empowerment initiatives. Of this amount, 52% was spent on BEE companies. In 2007, a total of 5 594 jobs (479 women, 146 disabled and 3 661 youth) were created through the electrification programme. As far as learnerships are concerned, Eskom exceeded its target and reached 1 599.

Eskom continues to exceed its electrification targets. The target for 2007 was 160 321 connections but the actual number connected was 168 538.

Since the inception of the electrification programme in 1991, 3 638 188 (2007: 3 469 650) homes have been electrified. The Electricity Basic Services Support Tariff Policy aims to bring relief, through government intervention, to low-income households and to ensure optimal socio-economic benefits from the INEP. Qualifying customers are eligible for 50 kilowatt-hours (KWh) of free electricity per month. Eskom and municipalities are the service-providers for free basic electricity in their respective areas of supply.

Between April 2007 and March 2008, access to free basic electricity increased from 60% to 73%.

By providing this basic service, government hopes to offer social relief to those who typically earn less than the national minimum-wage levels.

Although these users have access to a basic quantity of 50 KWh per household per month in terms of the policy, they pay the normal tariff for any consumption exceeding 50 KWh per month.

The programme is funded by the Department of Provincial and Local Government through the equitable share allocation.

Each household connected to the Solar Home System receives up to R48 worth of electricity a month.

Rural solar-energy users are liable for any amount above the monthly subsidy.

To make paraffin more affordable, the Department of Minerals and Energy removed the value-added tax levy on it.

National Energy Regulator of South Africa

Nersa, which was launched in November 2005, is the regulatory authority established in terms of the National Energy Regulator (NER) Act, 2004 (Act 40 of 2004), with the mandate to undertake the functions of the gas regulator as set out in the Gas Act, 2001; the Petroleum Pipelines Regulatory Authority, as set out in the Petroleum Pipelines Act, 2003 (Act 60 of 2003); and the NER as set out in the Electricity Act, 1987 (Act 41 of 1987), as amended.

While Nersa has regulated the electricity industry for the past 10 years, the piped-gas and petroleum-pipeline industries in South Africa are now regulated for the first time. Three industries fund Nersa through levies.

The funds consist of money appropriated by Parliament, levies imposed by, or under, separate legislation, charges for dispute resolution, licence fees, and funds collected under Section 5B of the Electricity Act, 1987.

The Electricity Regulation Amendment Bill will ensure that Nersa plays an unambiguous role in its quest to achieve better regulation outcomes in the entire electricity value chain.

Nuclear Energy Corporation of South African

Necsa was established as a public company in terms of the Nuclear Energy Act, 1999 (Act 46 of 1999), and is wholly owned by the State. The main functions of Necsa are to undertake and promote R&D in the field of nuclear energy and radiation sciences 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, which include the Safari-1 research reactor, Necsa also operates the Vaalputs National Radioactive Waste Disposal Facility, which is licensed to receive low and intermediate radioactive waste. South Africa has technical expertise on nuclear technology at Necsa, including expertise on uranium conversion and enrichment remaining from South Africa's previous nuclear programme.

The Nuclear Energy Policy and Strategy for South Africa states that government, through Eskom, is taking the lead in respect of the extensive Pressurised Water Reactor to substantially diversify the generation base and reduce overall carbon emissions. The policy also highlights that in this extended programme, Necsa will play a vital role as the State's body to serve as the anchor for nuclear energy R&D and innovation in South Africa. To implement a sustainable nuclear programme and obtain all the potential economic benefits, South Africa, through Necsa, will endeavour to implement, or obtain interests in, the complete nuclear fuel cycle, including uranium conversion, enrichment and fuel fabrication. Necsa hosts the Pebble Bed Modular Reactor nuclear fuel development laboratories, helium tests facility and the future Fuel Production Plant.

Necsa, through its fully owned commercial subsidiaries Pelchem (Pty) Limited (Ltd) and NTP Radioisotopes (Pty) Ltd, sells fluorine and fluorine-based products as well as radioisotopes on the international market.

NTP Radioisotopes (Pty) Ltd is among the top three global producers and suppliers of radiation-based products and services that are routinely and reliably provided to customers throughout the world. Its principal product, Fission Mo-99, is used in products that allow for the estimated 30 million nuclear medicine imaging scans performed on patients throughout the world every year. NTP supplies more than 90% of the total South African nuclear medicine demand through its subsidiary companies AEC Amersham (Pty) Ltd and Cyclotope (Pty) Ltd. The latter pioneered the introduction to South Africa of the first commercially available positron emission tomography

tracer. In addition, NTP supplies radioisotopes used for industrial applications to the entire South African market and exports these products to a number of countries through its distributors. NTP Logistics (Pty) Ltd specialises in the international and domestic transport of radioactive and other dangerous goods.

National and regional co-operation

Nersa, represented by its chief executive officer, was elected as chair of the African Forum for Utility Regulators (Afur) from 2006 to 2009.

The Afur focuses on issues related to the regulation of energy, telecommunications, transport, and water and sanitation industries, with particular emphasis on common issues. Afur is regarded as a key building block in the African Union's efforts and its socio-economic programme, the New Partnership for Africa's Development (Nepad), in the integration and rebirth of Africa.

Afur's vision and objectives are derived from Clause 110 of the Nepad Framework Document, which recognises the establishment of the Afur and regional regulatory associations.

Afur operates as a formal association of African regulators, with its own constitution stipulating its objectives, functions and other operational requirements.

Afur's objectives entail supporting the development of effective utility regulation in Africa by facilitating the harmonisation of regulatory policies, exchange of information and lessons of experience among regulators, and capacity-building in support of the socio-economic development of the continent.

Nersa is also a founding member of the Regional Electricity Regulators' Association and the South African Utility Regulators' Association, which were launched in September and October 2002 respectively.

Southern African Power Pool (SAPP)

The SAPP is the first formal power pool in Africa.

The objectives of the SAPP are, among other things, to:

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

Member countries are Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, Swaziland, Tanzania, Zambia, Zimbabwe and the DRC.

The SAPP faces the following challenges:

- lack of maintenance of infrastructure
- lack of funds to finance new investments
- insufficient electricity generation
- high losses.

To lay down the rules governing electricity exchange between utilities, the SAPP Agreement between operating members was drafted.

Biomass

Biomass is estimated to comprise 8% of South Africa's primary energy supply. Renewable energy comprises biomass and natural processes that are replenished and can be used as an energy source. Biomass is used commercially in pulp and paper mills and sugar refineries by burning bulk from logs, black liquor and bagasse to produce process heat. The energy produced is used by those industries to meet their needs.

In future, some of this energy could be sold to the national grid (depending on electricity prices and environmental regulations). However, given the limited potential for agricultural expansion due to a lack of water and arable land, it is unlikely that this could make a major contribution.

In households, biomass is used for cooking and heating.

Renewable energy

Renewable energy sources, other than biomass, have not yet been exploited optimally in South Africa.

The Department of Minerals and Energy strengthened international relationships in this area through the support offered to partnerships established during the World Summit on Sustainable Development (WSSD) in 2002. Such partnerships will overcome market barriers and promote widespread use of sustainable energy solutions. These include the Global Village Energy Partnership and the Renewable Energy and Energy-Efficiency Partnership.

Cabinet approved the *White Paper on Renewable Energy* in November 2003, which stipulates the following target: a 10 000-GWh renewable energy contribution to final energy consumption by 2013,

to be produced mainly from biomass, wind, solar and small-scale hydro. The renewable energy is to be used for power generation and non-electric technologies such as solar water-heating and biofuels.

This is equivalent to replacing two 660-MW units of Eskom's combined coal-fired power stations, or replacing 1 100 ML of diesel (14%) with biodiesel. This is in addition to the estimated existing 8% to 9% renewable energy contribution mainly from fuel wood and waste.

A macroeconomic analysis of the targets in the White Paper concluded that:

- the target is economically viable with government financial support and "green" funding (such as CDM and "green" premium)
- achieving the target could add about 1 667 MW new renewable energy capacity with a net impact on GDP of as high as R1 071 million per year compared with coal-fired power stations, and additional government revenue of R299 million.

Just over 20 000 new jobs would be created and water savings of 16,5 million kilolitres would be achieved, translating into a R26,6-million saving.

The study also highlighted the 10 000-GWh low-cost renewable energy technologies and applications to be implemented first, based on the level of commercialisation of the technology and the natural-resource availability.

These technologies include:

- sugar-cane bagasse for cogeneration (59%)
- landfill gas extraction (6%)
- mini-hydroelectric schemes (10%)
- commercial and domestic solar water-heaters (23%)
- wind energy (1%)
- biomass pulp and paper (1%).

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 that 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.
- Small-scale hydropower.
- Landfill gas exploitation.
- Rural water supply and sanitation.
- Domestic and commercial solar water heating. Solar thermal-power generation is a collaborative programme with Eskom. It also involves the SolarPACES Programme of the International Energy Agency.

The Department of Minerals and Energy's capacity-building programme for renewable energy and energy efficiency, which was funded by the Danish International Development Agency (Danida), yielded significant value in capacity-building in the department, as well as various strategies and studies to support the enabling environment created by government.

The Department of Minerals and Energy and National Treasury approved the Renewable Energy Subsidy Scheme in September 2005. The scheme started off with once-off capital grants that are made available for renewable energy projects.

In October 2005, the Renewable Energy Finance and Subsidy Office's website – *www.dme.gov.za/dme/energy/refso.htm* – was established. It is useful for providing information and application forms to potential applicants.

The department is working with stakeholders such as the National Treasury and Nersa on a long-term sustainable financing mechanism for grid-based renewable energy applications.

Eskom participated in a pilot project of the Department of Minerals and Energy, which investigates green power trading.

Eskom contributed to the development of draft market rules and will act as the independent market operator for the duration of the project.

Eskom's Renewable Energy Strategy states a commitment to increase the share of renewable energy in Eskom's energy mix.

The aim is to include 1 600 MW of renewable energy in the mix by 2025.

Eskom has also partnered with the World Wildlife Fund South Africa to develop a renewable energy research fund for renewable energy projects outside Eskom.

Eskom has committed R3 million to the fund over three years.

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/m^2 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/m^2 for South Africa, compared with about 150 W/m^2 for parts of the USA, and about 100 W/m^2 for Europe.

This makes the local resource one of the highest in the world. The solar resource is 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 (PV) panel-assembly capacity totals 5 MW, and a number of companies in South Africa manufacture solar water heaters.

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 m^2) and swimming pools (327 000 m^2), commerce and industry (45 000 m^2) and agriculture (4 000 m^2).

Pebble Bed Modular Reactor (PBMR) (Pty) Limited was established in 1999 with the intention to develop and market small-scale, high-temperature reactors both locally and internationally. The PBMR project team is based in Centurion near Pretoria.

The PBMR is a high temperature reactor (HTR) with a closed-cycle gas turbine power conversion system. Although it is not the only HTR currently being developed in the world, the South African project is on schedule to be the first commercial scale HTR in the power-generation field.

The PBMR comprises a steel pressure vessel, which holds the enriched uranium dioxide fuel encapsulated in graphite spheres. The system is cooled with helium and heat is converted into electricity through a turbine.

From a small research and development company with about 100 employees at its inception in 1999, the PBMR has grown into one of the largest nuclear reactor design teams in the world. In addition, more than 1 000 people at universities, private companies and research institutes are involved with the project. The PBMR is preparing for a project at Koeberg near Cape Town, where Africa's only nuclear power station is based, and a fuel plant at Pelindaba near Pretoria, where the pebble fuel will be manufactured.

Three co-operatives with over 10 permanent employees each have been started in the Eastern Cape to maintain 8 000 solar home systems installed under the previous electrification programme.

Solar-passive building design

Research has shown that low-cost housing could be made "energy smart" by using elementary "solar-passive building design" practice. This could result in fuel savings of as much as 65%, which could significantly benefit households' energy costs. 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. Government is considering the following building norms and standards: orientation for the purposes of passive solar design, lighting, and installation of solar water heaters, insulation, ventilation, heating and air conditioning.

Solar-thermal power generation

The minimum direct normal radiation (DNR) to justify a combined solar-thermal power plant is 1 800 kWh/m^2 per year. According to the Renewable Energy Resource Database, the area exceeding the minimum required DNR in South Africa covers about 194 000 km^2. A 100-MW solar-thermal plant requires roughly 3 km^2 (1 800 kWh/m^2 per year).

If 1% (1 940 km^2) of the identified area is available for solar-thermal power generation, then South Africa has an installed potential of 64,6 GW, which is about 36 217 GWh/year. Back-up and energy-storage constraints are limiting the wider economical utilisation of solar-electricity generation (solar thermal and PV).

Concentrating Solar Power (CSP) Project

If feasibility studies provide satisfactory results in assessing the new technology, Eskom will establish a 100-MW pilot CSP plant in the Northern Cape. An EIP was completed and positive environmental authorisation obtained from the Department of Environmental Affairs and Tourism in September 2007, while the project feasibility assessment was finalised in November 2007.

A prototype heliostat (large two-axis mirrors), one of the key components, has been installed at Eskom's R&D facility.

The Upington area in the Northern Cape was identified as a feasible location for the CSP plant. Upington further has one of the highest solar

values with a direct normal insulation level of about 2 900 kWh/m^2 per year.

The CSP plant being considered has molten salt-type central-receiver technology, which is based on the concept of thousands of large heliostats tracking the sun and reflecting the beam radiation to a common focal point. This focal point (the receiver) is located well above the heliostat field to prevent interference between the reflected radiation and the other heliostats.

Wind

Eskom's Klipheuwel, just north of Cape Town, is the first large wind-turbine facility in sub-Saharan Africa. The pilot phase of the Klipheuwel research and demonstration project ran from August 2002 to the end of 2005. During that time, the Klipheuwel Pilot Wind Farm generated more than 12 GWh of electricity, thus reducing carbon dioxide emissions by 11 000 t. The three wind turbines operated at an average availability of 90%. The project's research phase has been completed and this wind farm will be operated commercially for its anticipated 20-year lifespan as calculated from 2006.

In 2007, Eskom decided to invest in a 100-MW wind facility in the Western Cape, which will consist of 50 turbines, each rated at 2 MW. Subject to the necessary approvals being obtained, the plant could be in operation by 2010.

The R75-million national demonstration project in Darling in the Western Cape is the first "green-energy" initiative in the country to produce electricity from wind power on a commercial basis.

The Darling Wind Farm has four wind turbines which can supply 5,2 MW. All the electricity produced will be sold to the City of Cape Town as part of a long-term power agreement with the city. The facility consists of four German-designed wind turbines. The structures are 50 m high with the blades spanning 31 m. Each turbine will produce 1,3 MW, bringing the total output of the wind farm to 5,2 MW.

The project is referred to as the National Demonstration Project and will be used as an example for future public-private partnerships in the establishment of alternative electricity generation. The project was developed by the Darling Independent Power Producer, the Development Bank of Southern Africa and the CEF. Danida is also funding part of the project.

Hydro

An assessment conducted by the Department of Minerals and Energy, the *Baseline Study on Hydropower in South Africa*, indicated that specific areas in the country show significant potential for developing all categories of hydropower in the short and medium term.

The Eastern Cape and KwaZulu-Natal are endowed with the best potential for developing small, i.e. less than 10-MW hydropower plants.

The advantages and attractiveness of these plants are that they can either be stand-alone or can exist in a hybrid combination with other renewable energy sources.

Advantage can be derived from the association with other uses of water (such as water supply, irrigation and flood control), which are critical to the future economic and socio-economic development of South Africa.

Eskom has started the construction of the Ingula Pumped Storage Scheme (1 332 MW) near Van Reenen, KwaZulu-Natal. It is expected that the first unit will be operational in 2012. Preliminary work for the design and construction of a second pumped storage scheme in Mpumalanga has commenced.

The SAPP allows for the free trading of electricity between SADC member countries, providing South Africa with access to the vast hydropower potential in the countries to the north, notably the significant potential in the Congo River (Inga Falls).

The main project outside South Africa's borders is Westcor. It entails a five-way intergovernmental MoU signed between the utilities of the DRC, Angola, Namibia, Botswana and South Africa. Westcor will tap into some of the potential in the DRC. The first project is Inga III, a 3 500-MW hydro plant on the Congo River.

At the same time, the countries to the north could benefit through access to the coal-fired power resources in the south. Such an arrangement should stabilise the energy requirements of the region well into this century.

Exploitation of the vast hydropower resources will constitute a significant infusion of renewable energy resources into the energy economy of the region over the medium to long term. The Lesotho Highlands Water Project can contribute some 72 MW of hydroelectric power to the system in the short term. Global pressures regarding the environmental impact and displacement of settlements by huge storage dams are likely to limit the exploitation of hydropower on a large scale.

Irrespective of the size of installation, any hydropower development will require authorisation in terms of the National Water Act, 1998 (Act 36 of 1998).

Ocean energy

Ocean energy could potentially be derived from the various characteristics of the sea. For example, the rise and fall of the waves could be converted into hydraulic pressure by mechanical compression devices.

Such pressure could drive a turbine generator to produce electricity, while the tidal variation, sea current and different thermal layers in the ocean could also be used.

The main reason why this energy resource is not currently being harnessed is that no reliable technology exists that can generate electricity from this resource.

Various companies are testing systems internationally to develop technically viable solutions. Once technical reliability has been proven, cost-effectiveness in relation to other solutions will have to be established.

Eskom has continued with resource surveys of the Agulhas Current on the east coast of South Africa and of wave energy, in partnership with Marine and Coastal Management, of the Department of Environmental Affairs and Tourism, and the Bayworld Centre for Research and Education.

Results have proved the technical feasibility of extracting significant large-scale renewable energy from the current.

Sasol, Eskom, Petrolium Oil and Gas Corporation of South Africa, Anglo American and the South African National Energy Research Institute are sponsoring the development of the South African Carbon-Dioxide (CO^2) Storage Atlas. The total sponsorship amounts to R2 million. The purpose of the atlas is to identify potential sites for geological storage of CO^2 as a measure for lowering greenhouse emissions from industrial sources that mainly use coal. CO^2 will need to be captured from industrial gases and geologically stored by compressing it into liquid form. It is possible to track international developments in capture technology, but storage potential has to be determined locally. The onshore central basin of the Karoo Supergroup may offer storage oppportunities. Offshore sedimentary rocks along the coastline also hold some potential for storage.

The Council for Geoscience and the Petroleum Agency of South Africa will publish the initial assessment of storage potential in a user-friendly atlas by April 2010. This information will provide guidance for further exploration, should carbon capture and storage technologies be pursued in South Africa.

Energy and the environment

Energy and the global environment

South Africa is among the top 20 emitters of GHGs in the world and is the largest emitter in Africa, largely because of the economy's dependence on fossil fuels. The National Climate Change Strategy, developed by the Department of Environmental Affairs and Tourism, requires that government departments collaborate in a co-ordinated manner to ensure that response measures to climate change are properly directed and carried out with a national focus. The Department of Minerals and Energy is expected to respond to and mitigate climate change.

South Africa is a developing country or a non-Annex 1 country. This means that within the international political and negotiation context, South Africa is not required to reduce its GHG emissions. However, the South African economy depends greatly on fossil fuels for energy generation and consumption and therefore is a significant emitter due to relatively high values being derived from emission intensity and emissions per capita. These calculations make South Africa one of the top 15 most energy-intensive economies that contribute significantly to GHG emissions.

Therefore, South Africa must proactively move the economy towards becoming less carbon-intensive, with the Department of Minerals and Energy playing a prominent role. The department has introduced systems to access investment through the CDM of the Kyoto Protocol. It has developed the *White Paper on Renewable Energy and Clean Energy Development*, together with an energy-efficiency programme, to support diversification in pursuit of a less carbon-intensive energy economy.

Sources of greenhouse gas emissions

The energy sector is a major source of GHGs, because of South Africa's heavy reliance on coal for electricity generation, the Sasol oil-from-coal process and a variety of other indigenous energy uses, such as household coal-burning.

The reduction of particulate emissions from Eskom coal-fired power stations has been the most significant environmental challenge the organisation has faced. Particulate reduction began in the 1980s. Initial reductions followed the mothballing and closure of many of the older plants. From the early 1990s, reductions were achieved by installing bag filters and managing electrostatic precipitators better. In the late 1990s, Eskom

Eskom has signed an agreement with French development agency, *Agence Francaise de Dévelopment,* for a €100-million loan over 20 years to help finance a new wind-farm project.

The 100-megawatt wind farm will be built on the West Coast near the town of Koekenaap, east of Vredendal in the Western Cape and will be operational in early 2010.

The two companies concluded the deal in March 2008 during an official visit to South Africa by French President Nicolas Sarkozy.

developed a stringent five-year target to cut particulate emissions from an average of 0,37 kg/MWh to 0,28 kg/MWh. Between 1990 and 2003, total annual particulate emissions were reduced from 271 000 t to 57 000 t, while the energy delivered increased by 64 000 GWh.

Energy and the national environment

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

Eskom has announced a much higher proportion of nuclear energy as part of the future energy mix by 2025. Eskom's proactive climate-change strategy contains a commitment to reduce its GHG emissions. The strategy has been summarised into Eskom's six-point plan on climate change. The elements of this plan are:

- diversifications of the general mix to lower carbon-emitting technologies
- energy-efficiency measures to reduce demand, GHG and other emissions
- adaptation to the negative impacts of climate change
- innovation through research, demonstration and development
- investment through carbon-market mechanisms
- progress through advocacy, partnerships and collaboration.

Energy and the household environment

Coal is used by about 950 000 households countrywide. This causes indoor air-pollution problems, which have a serious health impact.

It has been found that in some cases, especially regarding particulate matter, exposure 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 to introduce low-smoke energy alternatives into the townships.

Fuel wood is used by millions of 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 of Minerals and Energy participates in the 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.

The *White Paper on the Promotion of Renewable Energy and Clean Energy Development* (2002) commits South Africa to producing 5% of the country's energy supply from renewable energy sources by 2013.

One way of doing this and simultaneously dealing with South Africa's electricity infrastructure pressures, is to have more energy-efficient houses that use the sun's free energy.

The Department of Science and Technology, the Overstrand Municipality and the Cape Town Grail Centre Trust are collaborating on a sustainable development project involving the construction of more than 600 low-cost houses that will use building material offering better insulation, and have solar water heaters. Projects of this nature could yield useful lessons and technologies to support the Department of Housing in its shift towards environmentally sustainable housing projects.

In the search for energy solutions, the Department of Science and Technology's work on hydrogen fuel cells continues.

Geology

South Africa has a long and complex geological history dating back more than 3 700 billion years. Significant fragments of this geology have been preserved and along with them, mineral deposits.

The preservation of so much Archaean geology, dating back more than 2 500 million years, has resulted in the Archaean Witwatersrand Basin, as well as several greenstone belts, being preserved. Ten of the more significant geological formations in South Africa are discussed below.

Barberton mountain land

This beautiful and rugged tract of country with some of the oldest rocks on Earth is found south of Nelspruit, Mpumalanga. The renowned Barberton Greenstone Belt, the largest of its kind in South Africa, contains remnants of original crust, dated at around 3,5 billion years old.

The greenstone formations represent the remains of some of the earliest clearly decipherable geological events on the Earth's surface. Silica-rich layers within the greenstone have revealed traces of a very early life form – minute blue-green algae. Granites surround the formations and gneisses that are more than 3 000 million years old. Gold, iron ore, magnesite, talc, barite, chrysotile asbestos and verdite are mined in the area.

Witwatersrand

The geology and gold mines of the "Ridge of White Waters" are world famous. Nearly half of all the gold ever mined has come from the extensive Witwatersrand conglomerate reefs that were discovered in 1886, not far from Johannesburg's city centre. The Witwatersrand is the greatest goldfield known to mankind. More than 50 055 t of gold have been produced from seven major goldfields distributed in a crescent-like shape along the 350-km long basin, from Welkom in the Free State in the south-west, to Evander in the east.

The geology of the region can be seen at many excellent outcrops in the suburbs of Johannesburg. The sequence is divided into a lower shale-rich group and an upper sandstone-rich group. The latter contains the important gold-bearing quartz-pebble conglomerates. These "gold reefs" were formed from gravels transported into the basin and reworked 2,75 billion years ago. The gold and uranium originated from a rich source in the hinterland.

Bushveld Complex and escarpment

The Bushveld Complex extends over an area of 65 000 km^2 and reaches up to 8 km in thickness. It is by far the largest known layered igneous intrusion in the world and contains most of the world's resources of chromium, PGMs and vanadium.

This mega-complex was emplaced in a molten state about 2 060 billion years ago into pre-existing sedimentary rocks, through several deep feeder zones.

The impressive igneous geology of the Bushveld Complex is best viewed in Mpumalanga, in the mountainous terrain around the Steelpoort Valley. The imposing Dwars River chromitite layers, platinum-bearing dunite pipes, the discovery site of the platinum-rich Merensky Reef, and extensive magnetite-ilmenite layers and pipes near Magnet Heights and Kennedy's Vale are in this area.

The Great Escarpment of Mpumalanga is one of South Africa's most scenic landscapes. This area features potholes at Bourke's Luck, the Blyde River Canyon and the dolomite formation in which giant stromatolites bear witness to the 2,5 billion-year-old fossiled remains of vast oxygen-producing algae growth.

Drakensberg Escarpment and Golden Gate Highlands National Park

The main ramparts of the Drakensberg range, reaching heights of more than 3 000 m, lie in KwaZulu-Natal and on the Lesotho border. These precipitous mountains are the highest in southern Africa and provide the most dramatic scenery.

They were formed by the partial erosion of a high plateau of basaltic lava, which is more than 1 500 m thick, and covers the Clarens sandstones. Prior to its erosion, the continental basalt field covered significantly more of the continent.

The northern area of the Drakensberg has been declared a world heritage site. More than 40% of all known San cave paintings in southern Africa are found here.

The scenic Golden Gate Highlands National Park in the Free State features spectacular sandstone bluffs and cliffs. The sandstone reflects a sandy desert environment that existed around 200 million years ago. Dinosaur fossils are still found in the area.

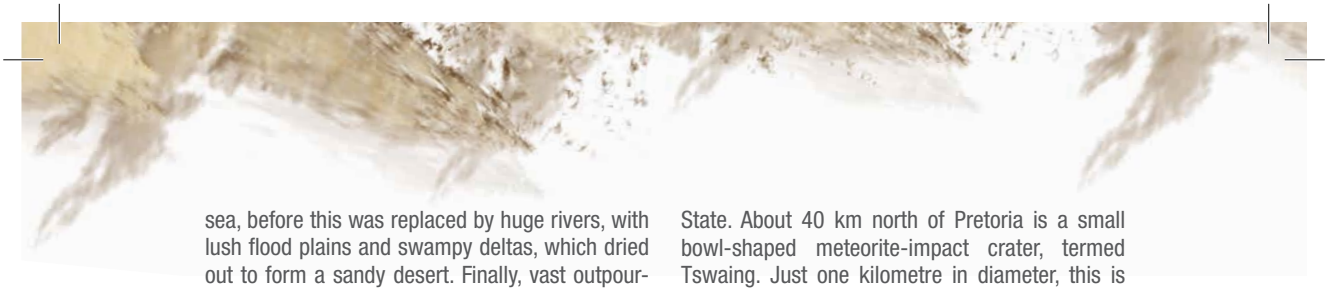
Karoo

Rocks of the Karoo Supergroup cover about two thirds of South Africa and reach a thickness of several thousand metres. The sedimentary portion of this rock sequence reveals an almost continuous record of deposition and life, from the end of the Carboniferous into the mid-Jurassic periods, between 300 million and 180 million years ago.

Karoo rocks are internationally renowned for their wealth of continental fossils, and particularly for the fossils of mammal-like reptiles that show the transition from reptiles to early mammals, and for their early dinosaur evolution.

During this long period of the Earth's history, southern Africa was a lowland area in the centre of the Gondwana supercontinent.

Initially, the prehistoric Karoo was a place of vast glaciation. It then became a shallow inland



sea, before this was replaced by huge rivers, with lush flood plains and swampy deltas, which dried out to form a sandy desert. Finally, vast outpourings of continental basaltic lava accompanied by the break-up of Gondwana occurred.

Diamond fields

Kimberlite is the primary host-rock of diamonds and was first mined as weathered "yellow ground" from the Kimberley mines, starting in 1871 at Colesberg koppie, now the site of the Big Hole of Kimberley. At increasing depths, less-weathered "blue ground" that continued to yield diamonds was encountered.

The discovery of kimberlite-hosted diamonds was a key event in South Africa's economic and social development, and paved the way for the later development of the Witwatersrand goldfields.

Kimberlite originates as magma from very deep below the surface, and typically occurs as small volcanic pipes and craters at the surface. Included within solidified kimberlites are fragments of deep-seated rocks and minerals, including rare diamonds of various sizes.

The Orange and Vaal rivers' alluvial diamond fields and the rich West Coast marine diamond deposits all originated by erosion from primary kimberlite pipes.

Meteorite impact sites

Impacts by large meteoritic projectiles played a major role in shaping the surface of the Earth.

One such site is the Vredefort Dome, the oldest and largest visible impact structure known on Earth.

Declared a world heritage site in 2005, it lies some 110 km south-west of Johannesburg, in the vicinity of Parys and Vredefort in the Free State and North West.

This spectacular and complex geological feature, measuring 70 km across, was caused by the impact of a 10 km-wide asteroid some two billion years ago. Only a partial ring of hills remains of the dome, created by the rebound of rock below the asteroid's impact site. The original crater – now eroded – is estimated to have been between 250 km and 300 km in diameter.

The Vredefort structure comprises a core zone of granitic rocks, surrounded by a ring-like collar zone of younger bedded formations. Only the north-western portion of the structure remains visible. The south-eastern half was flooded by sediments of the Karoo Supergroup, which cover the Free State. About 40 km north of Pretoria is a small bowl-shaped meteorite-impact crater, termed Tswaing. Just one kilometre in diameter, this is one of the best-preserved and accessible impact craters of its kind on Earth. It was created about 220 000 years ago when a meteorite of about 50 m wide slammed into the Earth, and is one of the few impact craters containing a crater lake.

Pilanesberg

The Pilanesberg complex and National Park, located some 120 km north-west of Johannesburg in North West, is a major scientific attraction which includes a number of unique geological sites.

The complex consists of an almost perfectly circular, dissected mountain massif some 25 km in diameter, making it the third-largest alkaline ring complex in the world.

The geology reflects the roots of an ancient volcano that erupted some 1,5 billion years ago. The remains of ancient lava flows and vulcanic breccias can be seen.

The dominant feature of the complex is the concentric cone sheets formed by resurgent magma that intruded ring fractures, created during the collapse of the volcano.

There are old mining sites for fluorite and dimension stone, and a non-diamond-bearing kimberlite pipe in the region.

Pilanesberg is also the site of a magnificent game reserve containing the Big Five and the world-renowned Palace of the Lost City hotel complex and golf course.

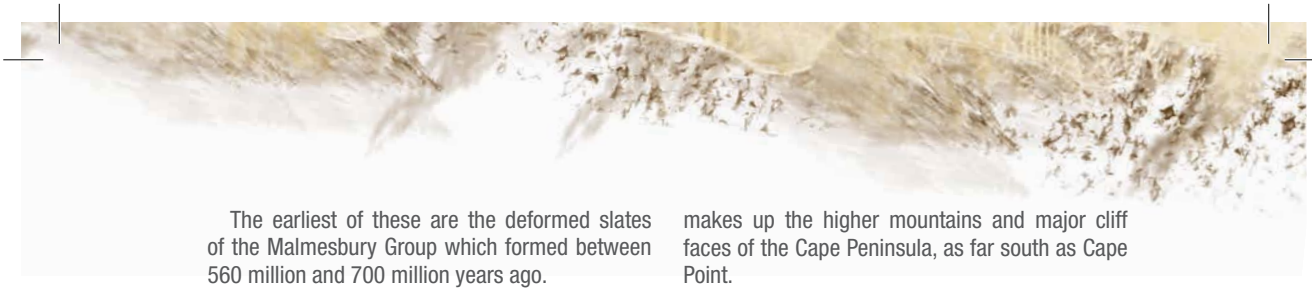
Cradle of Humankind

This world heritage site extends from the Witwatersrand in the south to the Magaliesberg in the north, and is considered to be of universal value because of the outstanding richness of its fossil hominid cave sites.

The Sterkfontein area near Krugersdorp is the most prolific and accessible fossil hominid site on Earth. It comprises several scientifically important cave locations, including Sterkfontein, Swartkrans, Drimolen, Kromdraai, Gladysvale and Plover's Lake, all of which have produced a wealth of material crucial to palaeoanthropological research material.

Table Mountain and the Cape Peninsula

Table Mountain is, arguably, South Africa's best known and most spectacular geological feature, comprising a number of major rock formations.



The earliest of these are the deformed slates of the Malmesbury Group which formed between 560 million and 700 million years ago.

Coarse-grained Cape granite intruded around 540 million years ago. The Table Mountain Group, which started forming about 450 million years ago, consists of basalt, reddish mudstone and sandstone that is well exposed along Chapman's Peak. Overlying this is the light-coloured sandstone that makes up the higher mountains and major cliff faces of the Cape Peninsula, as far south as Cape Point.

Much younger sandy formations make up the Cape Flats and other low-lying areas adjacent to Table Mountain. The Table Mountain Group continues further inland across False Bay in the strongly deformed Cape Fold Belt.

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