



ENERGY

SOUTH AFRICA  
YEARBOOK

2010/11

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Energy use in South Africa is characterised by a high dependence on cheap and abundantly available coal. South Africa imports a large amount of crude oil. A limited quantity of natural gas is also available.

The country also mines uranium, which is exported, and imports enriched uranium for its nuclear power plant, Koeberg. South Africa uses renewable energy in the form of electricity generated by hydropower, most of which is imported.

Electricity is also generated from other renewable energy sources, mainly biomass and to a lesser extent solar and energy.

The Government intends to diversify energy supply and is promoting the use of renewable energy technology as well as other new energy technologies. In addition, it aims to improve energy efficiency throughout the economy.

The energy sector is critical to South Africa's economy, contributing about 15% to the country's gross domestic product (GDP).

The Department of Energy is responsible for ensuring exploration, development, processing, utilisation and management of South Africa's energy resources. As the country's economy continues to grow, energy is increasingly becoming a key focus.

The Electricity and Nuclear Branch is responsible for electricity and nuclear-energy affairs, while the Hydrocarbons and Energy Planning Branch is responsible for coal, gas, liquid fuels, energy efficiency, renewable energy and energy planning, including the energy database.

The Department of Energy was appropriated:

- R5,535 billion for 2010/11
- R5,739 billion for 2011/12
- R5,538 billion for 2012/2013.

Ninety-seven percent of the budget, about R5,3 billion, will be transferred to the Integrated National Electrification Programme (INEP), the Nuclear Energy Corporation of South Africa (Necsa), the National Efficiency and Demand-Side Management (DSM) Programme and Transnet, leaving the department with R202 million, which translates to 3% of the total budget allocation.

A key activity is to develop an electricity system operator independent of Eskom Holdings and target 10% of electricity supply from independent power procedures.

## Policy and legislation

The Department of Energy's Strategic Plan for 2010/11 to 2012/13 seeks to deliver results along eight strategic objectives:

- ensure energy security: create and maintain a balance between energy supply and energy demand, develop strategic partnerships, improve coordination in the sector and ensure reliable delivery and logistics
- achieve universal access and transform the energy sector: diversify the energy mix, improve access and connectivity, provide quality and affordable energy, promote the safe use of energy and transform the energy sector
- regulate the energy sector: develop effective legislation, policies and guidelines; encourage investment in the energy sector; and ensure compliance with legislation
- provide effective and efficient service delivery: understand stakeholder needs and improve turnaround times
- utilise optimal energy resources: develop enabling policies and encourage energy-efficient technologies
- ensure sustainable development: promote clean-energy alternatives, encourage economic development and promote job creation
- enhance the department's culture systems and people: attract, develop and retain appropriate skills and promote good organisational culture
- promote corporate governance: optimal use of resources, manage budget effectively, implement fraud and risk management and ensure compliance with relevant prescripts.

In 2010, the Department of Energy was mandated to draft and publish the Integrated Energy Planning Strategy to outline the requisite processes, systems and structures that would lead to the development of the comprehensive Integrated Energy Plan (IEP), as envisaged in the National Energy Act, 2008 (Act 34 of 2008).

The Energy Act, 2008 was signed into law by President Jacob Zuma on 17 November 2009. This legislation focuses, among other things, on ensuring that diverse energy resources are available, in sustainable quantities and at affordable prices in support of economic growth and poverty alleviation. It further provides for energy planning,

increased generation and consumption of renewable energies and contingency energy supply.

The department also reviewed the Petroleum Products Act, 1977 (Act 120 of 1977), with a view towards strengthening its legislative framework to address the needs of a developmental state, including the transformation of the liquid-fuels industry.

The Department of Energy developed the Strategic Stocks Policy for petroleum products to ensure that the economy does not suffer from shortages during severe liquid-fuel supply disruptions.

### Integrated Resource Plan (IRP)

To ensure reliable power supply, government established the Inter-Ministerial Committee on Energy to develop a 20-year integrated resource plan.

The department promulgated the IRP1 in December 2009. This indicated the intention to achieve the following targets:

- 10 000 Gigawatt hour (Gwh) (about 4% of the energy mix) of renewable-energy usage (as indicated in the *2003 Renewable Energy White Paper*)
- the implementation of energy efficiency and DSM through a financial incentives scheme
- the installation of one million solar water-heaters.

In October 2010, the Inter-Ministerial Committee on Energy approved the draft IRP, a 20-year blueprint that indicates that the country is planning to commit to 14% nuclear power as part of its future energy mix.

According to the draft plan, South Africa's electrical energy will, by 2030, comprise 48% baseload coal, 14% baseload nuclear, 16% renewable energy, 9% peaking open cycle gas turbine, 6% peaking pump storage, 5% mid-merit gas and 2% baseload import hydro.

The IRP is a long-term electricity capacity plan, which defines the need for new generation and transmission capacity for the country.

The IRP is intended to:

- improve the long-term reliability of electricity supply through meeting adequacy criteria over and above keeping pace with economic growth and development
- ascertain South Africa's capacity investment needs for the medium-term business planning environment
- consider environmental and other externality impacts and the effect of renewable-energy technologies

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

### Energy and the economy

The energy sector creates jobs for about 250 000 people. It generates around 95% of the electricity used in South Africa and exports to countries in Africa.

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.

### National Energy Regulator of South Africa (Nersa)

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, (Act 48 of 2001); the Petroleum Pipelines Regulatory Authority, as set out in the Petroleum Pipelines Act, 2003 (Act 60 of 2003); the NER as set out in the Electricity Act, 1987 (Act 41 of 1987), as amended; and the Electricity Regulation Act, 2006 (Act 8 of 2006), as amended.

### Central Energy Fund (CEF)

The CEF is involved in the search for appropriate energy solutions to meet the future energy needs of South Africa, the Southern African Development Community (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



The Government supported clean-energy research at a number of universities and universities of technology in 2010.

In March 2010, the Department of Energy invested in an electric car and the prototype of a hybrid e-bike.

The hydrogen-fuelled bike called "A hi Fambeni" (Tsonga for "let's go") was designed by a leading South African-born motorbike designer, Pierre Terblanche, and was being developed at the Tshwane University of Technology.



in the 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 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 liquified petroleum gas (LPG) in South Africa.

## Energy efficiency

Government set a target of 15% energy efficiency for the industry and 12% nationally to be achieved by 2015.

The energy industry leads by example by committing to energy efficiency.

While the focus had been on energy-intensive industries, room has been created for other industries and the commercial sector to join the Energy-Efficiency Campaign, through the introduction of, among other things:

- efficient lighting and heating, ventilation and air conditioning and employee-education
- efficient production processes and cogeneration in the industrial sector.

Government remains committed to the efficient use of available resources. It is also committed to broadening the energy mix, thereby moving away from being fossil-dominated to a more balanced combination, which places a high premium on the use of more efficient technologies and renewable-energy resources.

Government had put together a number of initiatives to promote energy efficiency.

One such initiative is a proposal, through the National Treasury, that tax incentives be applied to companies that demonstrate energy-efficient practices.

A financial incentive scheme is expected to be introduced in terms of which project developers will be able to claim a rebate in respect of the amount of energy they have saved from the electricity system.

The Department of Energy's energy-efficiency and DSM policies guide the implementation of DSM, with energy and demand savings being verified by independent university measurement and verification professionals.

Initially, Eskom's DSM focused on realising energy and average demand savings during evening weekday peak periods (18:00 to 20:00) via energy-service company projects in the industrial and commercial sectors and hot-water load management within municipal environments.

With the need to reduce demand, the focus expanded to include mass energy-efficient programme roll-outs that could be rapidly implemented.

These included energy-efficient lighting utilising compact fluorescent lamps (CFLs), solar water-heaters and improving the efficiency of electric motors and pumps.

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 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 assists with promotional activities regarding the national energy-efficiency drive.

Its initial focus is on prioritising and recommending energy efficiency and DSM projects.

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In April 2010, President Jacob Zuma launched the national Solar Water-Heating Programme at Winterveldt, outside Pretoria.

The launch was in line with government's target of installing at least one million solar water-heaters by 2014 to reduce the water-heating load on the national grid.

Some of the objectives of the programme are to offset rising electricity costs for residential households through savings on water heating and to contribute to the reduction of South Africa's carbon footprint.

The agency 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 coordination 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.

Saneri 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.

## Carbon capture and storage roadmap

Although South Africa has a programme to increase the use of renewable energy and energy-efficiency, coal is likely to provide most of the country's primary energy for the next few decades.

The displacement of fossil fuels by renewable and nuclear energy is seen as a gradual task. Carbon capture and storage is a transition measure from fossil fuel to nuclear and renewable energy. To this end, the South African Centre for Carbon Capture and Storage was established in March 2009.

The five phases of the roadmap and their status are:

- A preliminary investigation was undertaken by the Council for Science and Industrial Research for the then Department of Minerals and Energy to ascertain whether South Africa had potential capturable carbon-dioxide sources and storage sites. The results of that investigation, released in 2004, showed that South Africa had capturable emissions and potential storage sites. Based on this premise, further investigations were initiated. The preliminary investigation also identified that the synfuel industry in South Africa produced 30 million tons (Mt) per year of 95% concentration carbon dioxide.
- The Carbon Dioxide Geological Storage Atlas (launched in August 2010) will locate

and characterise potential storage sites at a theoretical level and on a geological basin extent. The atlas will then be taken into the South African Centre for Carbon Capture and Storage's programme of work and be developed to locate a storage site suitable for a test injection. Pre-atlas knowledge had identified four possible carbon-dioxide geological storage basins:

- Orange Basin (off-shore of the west coast)
- Outeniqua Basin (off-shore of the southern coastline and site of the only producing gas/petroleum wells in South Africa)
- Durban/Zululand Basin (east coast)
- Karoo On-Shore Basin (near the main coal fields and the majority of the coal-based electricity generation and synfuel production).

The first three are conventional types of storage – that is depleted oil/gas wells and deep saline formations. The fourth, the Karoo Basin, has sandstone formations that are subject to low permeability and also to dolerite intrusions. Consequently, further investigation is required as to how carbon dioxide could be stored in these less favourable formations. The Karoo Basin is the closest to the current major sources of carbon dioxide emissions.

- The CO<sup>2</sup> Test Injection Experiment of safely injecting carbon dioxide into South African reservoirs is essential to the understanding of the suitability of the local geology as a storage medium. It is also necessary to ascertain the dispersion and transformation reactions of carbon dioxide in the storage medium and its

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In 2010, the Swiss Agency for Development and Cooperation funded a climate-change mitigation programme in South Africa worth R120 million. In July, the Department of Energy announced that R13,95 million from the agency would be used for an energy-efficiency project.

The bilateral agreement states that the funds will be used to monitor the energy-efficiency targets in the public buildings of five municipalities (Sol Plaatje, Polokwane, King Sabata Dalindyebo, Rustenburg and Mbombela).

The aim of the project is to contribute to a significant reduction in energy consumption in the building sector through enhanced energy efficiency in the full life cycle of buildings.

The project runs from 2010 to 2013 and will include focusing on building local ownership, facilitating South-South expertise and technology transfer and regional outreach.

effects on the surroundings of the storage medium. This experiment will be informed by similar injection activities underway internationally.

- A demonstration plant will test an integrated operating system under local conditions, and forms an essential link between feasibility trials and a full-scale commercial plant. This phase will demonstrate the safe injection of carbon dioxide into South African geological formations. The magnitude of the demonstration plant is in the order of hundreds of thousands of tons of carbon dioxide per year.
- If positive outcomes of the demonstration plant ensue, a full-scale commercial plant is envisaged. This phase will be dependent on the outputs of the previous phases.

### Integrated energy planning

Energy efficiency is an important facet of the IEP process carried out by the Department of Energy.

By virtue of its size and economic importance, the energy sector periodically requires considerable investments in new supply capacity, which impacts on the economy. Integrated resource-planning decisions around the world consider not only maintaining security of supply, but give consideration to the economic, environmental and social impacts of all alternatives, such as DSM and energy-efficiency programmes.

### Working for Energy Programme

In 2010, the Department of Energy launched the Working for Energy Programme, with the primary objective of using the feedstock created from clearing alien biomass vegetation to produce power.

The programme has two distinct focuses, one being the provision of energy through renewable-energy technologies and the second being the facilitation of energy management. They both use labour-intensive methodologies to stimulate sustainable job creation, local economic development, technology skills transfer and capacity development within a South African context.

### National building standards

In June 2010, members of the public and interested parties were invited to submit comments and input on the energy-efficiency regulations for new buildings, which were published in the *Government Gazette* in June 2010.

The regulations form part of the deliverables of the National Energy Strategy that

was identified in the Industrial Policy Action Plan (IPAP) to strengthen South African standards and regulations for energy efficiency, and were expected to be finalised by the end of 2010.

The energy-efficient regulations for residential and commercial buildings, places of learning and worship, certain medical clinics and other categories of buildings make it compulsory for all new buildings to be designed and constructed to a standard that makes it possible for the user to minimise the energy required to meet the functional requirements. Significant energy savings can be affected by users, which will relieve pressure on the electricity supply grid.

The different elements of the building envelope, that is, roofs, ceilings, walls and windows, will have to meet minimum requirements for preventing heat loss (in winter) or heat gain (in summer) to meet the energy-efficiency targets.

All buildings will also have to be fitted with renewable-energy water-heating systems such as solar water-heating systems. Solar water-heating systems also have to comply with the South African National Standards (SANS).

The regulations require that buildings, heaters, air-conditioners and mechanical ventilation systems have to be energy efficient.

The Department of Trade and Industry, in partnership with the South African Bureau of Standards as well as the National Regulator for Compulsory Specifications, was instrumental in the development of regulations and supporting the SANS.

### Designated National Authority (DNA)

As a signatory to the Kyoto Protocol, government has established the DNA to facilitate the development of 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, environmental and social development with the emphasis on investments, job creation, poverty alleviation, technology and skills transfer.

The projects submitted to the DNA for initial review and approval included biofuels, energy efficiency, waste management, cogeneration, fuel switching and hydro-power, and sectors such as manufacturing, mining, agriculture, energy, waste management, housing, transport and residential.

These projects will assist South Africa to reduce greenhouse-gas (GHG) emissions

such as carbon dioxide, which is emitted mainly by the energy sector.

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.

South Africa is assisting other countries in Africa to establish DNAs.

### 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 decision.

The Department of 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 National Energy Act, 2008, intends to make the provision of energy data mandatory.

### 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-2010, there were six established IECs across the country, 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; Mutale IEC, Limpopo; and Ratlou IEC in Makgobistad, North West. 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.

Discussions are underway to align the IEC Programme with the Comprehensive Rural Development Programme. The programme, which was approved by Cabinet in 2009, is one of the key priorities of government, aimed at creating sustainable rural communities throughout the country.

### 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 has traditionally dominated the energy-supply sector in South Africa, from as early as 1880 when coal from the Ver-eeniging area was supplied to the Kimberley diamond fields.

About 77% of the country's primary energy needs are provided by coal.

South Africa produces an average of 224 Mt of marketable coal annually, making it the fifth-largest coal-producing country in the world.

About 25% of the production is exported internationally, making South Africa the third-largest coal-exporting country. The remainder of South Africa's coal production feeds the various local industries, with 53% used for electricity generation. The key role played by coal reserves in the economy is illustrated by the fact that Eskom is the seventh-largest electricity generator in the world, and Sasol the largest coal-to-chemicals producer.

### 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 Energy administers these Acts.

The Department of Health administers 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.

The long-term vision of the policy is for South Africa to become globally competitive in the use of innovative technology for the design, manufacture and deployment of state-of-the-art nuclear energy systems and power reactors as part of the energy mix, as well as the deployment of nuclear fuel cycle systems to ensure security of supply. These nuclear power reactors will play a role in



mitigating climate change by reducing GHG emissions.

Skills-development strategies and acquisition and retention of the relevant skills to support the nuclear programme have to be formulated. The following categories will be addressed:

- construction skills
- plant-operation skills
- skills for the relevant government departments
- regulatory skills
- supporting industry skills
- decommissioning and rehabilitation skills
- radioactive waste management.

The Nuclear Fuel Cycle Strategy for the beneficiation of uranium resources is a key factor with special focus on:

- securing South African uranium mineral resources
- developing a uranium conversion plant
- developing a uranium enrichment plant
- developing a fuel fabrication plant.

Eskom is investigating the possibility of generating up to 20 000 MW of new nuclear power capacity by 2025. This will 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 Energy plays a leading governance role regarding nuclear technology, non-proliferation and safety.

The Minister of Energy is the executive authority responsible for overseeing the South African Nuclear Energy Corporation (Necsa) and the NNR.

- Necsa undertakes and promotes research and development (R&D) in the fields of nuclear energy, radiation science and technology (S&T), 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, the only nuclear power station on the African

#### South African proposals and measures to reduce greenhouse gas (GHG) emissions

- 2003 White Paper on the Production of Energy by Renewables. Targets established for 2013.
- 2006 Treasury draft policy paper: *A Framework for Considering Market-Based Instruments to Support Environmental Fiscal Reform in South Africa*.
- Introduction of electricity levy, 2008.
- Eskom Demand-Side Management Programme to reduce electricity demand (from 2008).
- Measures in 2010/11 Budget: Supplementary depreciation allowance for investments by companies in energy-efficient equipment; increased levy on plastic shopping bags (to 4 cents, increased from 3 cents in 2009); proposed increase in the international air passenger departure tax (which was last raised in 2005/06).
- Preferential tariffs for electricity produced with wind, solar, landfill gas, biomass, or hydro energy, beginning in March 2010.
- Planned second nuclear power station to come on line by 2020.
- Building regulations revised to require the installation of energy-efficiency equipment such as solar water-heaters and efficiency lighting in new buildings.
- An energy-efficiency measurement standard is being developed to support the tax rebate for energy-efficiency incorporated into the Income Tax Act, 1962 (Act 58 of 1962).
- New standard prescribing maximum energy consumption standards.
- Commitment by national government to support municipalities' efforts to upgrade the housing and building stock so as to prevent future negative impacts on climate change.
- Planned Department of Energy (with donor support) Industrial Energy-Efficiency Programme, focusing on system optimisation.
- Copenhagen commitment to reduce 2020 GHG emissions by 34% relative to a no-policy change scenario.
- Installation of one million solar water-heaters (target), beginning in March 2010.
- New tax on vehicles varying by CO<sub>2</sub> emissions.

Source: Organisation for Economic Cooperation and Development (OECD) *Economic Surveys: South Africa*



continent, is responsible for about 6% of total electricity generation. It is owned by Eskom, which reports to the Minister of Public Enterprises.

- The iThemba Laboratory for Accelerator-Based Sciences brings together scientists working in the physical, medical and biological sciences. The facilities provide opportunities for modern research, advanced education, the treatment of cancers and the production of unique radioisotopes.
- Nufcor is responsible for uranium-ore refinement and export.

The National Radioactive Waste Disposal Institute will be responsible for the management of all radioactive waste.

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.

## Nuclear Energy Corporation of South Africa

Necsa was established as a public company in terms of the Nuclear Energy Act, 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 S&T; to process source material, special nuclear material and restricted material; and to cooperate 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.

Necsa successfully converted the Safari-1 Reactor from a high-enriched uranium to a low-enriched uranium-based facility. South Africa will be the first radioisotope-producing country to have completed this conversion process, which is a requirement for supplying radioisotopes to certain key markets.

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

The 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.

One of the principal products, 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.

The 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.

The NTP Logistics (Pty) Ltd specialises in the international and domestic transport of radioactive and other dangerous goods.

## Liquid fuels

The South African liquid-fuels sector presents several opportunities for investors throughout the petroleum value chain.

In 2010, PetroSA concluded its feasibility study on a 400 000-barrels-a-day refinery at the Coega Industrial Development Zone (IDZ) in the Eastern Cape.

The proposed Mthombo oil refinery will save South Africa some R12,6 billion a year in energy costs once it is running and exporting oil across Africa.

The refinery will also result in employment for 27 500 people.

Construction of the refinery, which will be the biggest in Africa, was expected to start in 2012, with completion by 2015.

A key feature of the South African liquid-fuels sector is the fact that most of the transport fuel is produced in the coastal areas but about 68% thereof is consumed in the

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South Africa's radioisotope market is the world-leader in the supply of Molybdenum-99 – a clear indication that it is among the world's best in the nuclear industry.

As a result of a worldwide shortage of medical isotopes, NTP Radioisotopes, a subsidiary of the Nuclear Energy Corporation of South Africa, has managed to increase group sales by more than 80% year-on-year, and unaudited finances show net sales of more than R700 million for the 2009/10 financial year.

inland region of Gauteng. This requires investments in the storage and distribution facilities for the supply of petroleum products at the point of need.

A new R15-billion pipeline to transport petroleum from Durban to Johannesburg is under construction for completion in the 2011/12 financial year.

Through the new multiproduct pipeline, Transnet Pipelines will increase fuel-carrying capacity by 8,7 billion litres per year in 2011; by 12,2 billion litres per year in the second phase of the project; and by 26,2 billion litres in the ultimate fifth phase of the project. This investment is in direct aid of South Africa's security of supply of energy going into the future.

These mega infrastructural projects and the related support infrastructure require a close and ongoing partnership between state-owned entities and private companies.

The Department of Energy, having undertaken pilot projects on LPG, has embarked on a drive to promote the use of LPG by households for space heating and cooking. As a first step in efforts to promote LPG, the department promulgated regulations for the retail price of LPG supplied to residential customers in 2010.

Since the use of fossil fuels like coal is expected to persist into the foreseeable future, clean coal technologies and carbon capture and storage programmes are essential. While pursuing the energy mix strategy, the pool of viable substitute energy carriers should be expanded.

In November 2010, the Minister of Energy, Ms Dipuo Peters, launched the review of the industry's compliance with the Liquid-Fuels Charter. The first-ever industry transformation charter came into effect in 2000.

## 20-Year Liquid-Fuels Infrastructure Plan

The Department of Energy was expected to develop a comprehensive 20-year Liquid-Fuels Infrastructure Plan in 2010/11.

This plan will cover port, pipeline, storage as well as distribution infrastructure. It will also include future refining capacity-development requirements.

## Sasol

Sasol is an integrated energy and chemical company. It beneficiates coal, oil and gas into liquid fuels, fuel components and chemicals with the help of its proprietary Fischer-Tropsch processes.

Sasol mines coal in South Africa and produces gas in Mozambique and oil in Gabon. Its chemical manufacturing and marketing operations span the globe. In South Africa, Sasol refines imported crude oil and retail liquid fuels through its network of retail convenience centres. Sasol also supplies fuels to other distributors in the region and gas to industrial customers in South Africa.

Through Sasol Synfuels International, Sasol is pursuing international opportunities to commercialise its gas-to-liquids (GTL) and coal-to-liquids (CTL) technology. In partnership with Qatar Petroleum, Sasol started its first international GTL venture, Oryx GTL, in Qatar in 2007, and is developing a GTL plant in Nigeria with Chevron and the Nigerian National Petroleum Corporation.

In May 2010, Sasol approved the construction of a R1,9-billion ethylene purification unit at its Sasol Polymers plant in Sasolburg.

The plant is expected to go on stream in the second half of 2013 and will operate on full capacity by 2015, enabling the company to boost ethylene production by about 48 000 tons per year.

The ethylene will be used in the manufacturing of polyethylene, and will greatly benefit South Africa's plastics conversion industry, which imports large quantities of this raw material.

## Oil and gas

South Africa has very limited oil reserves and about 60% 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)
- CTL and GTL fuels (Sasol)
- natural GTL (PetroSA).

The wholesale and retail markets for petroleum products in South Africa are subject to a set of government controls.

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 rendering 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.

### 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 the Kudu Gas Field.

### 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 sector has grown rapidly internationally. However, South Africa has remained only a peripheral participant in the sector's growth. There are a number of reasons for this: being a relatively new sector there are a variety of complex regulatory barriers which need to be finalised; the global economic crisis and the resultant reduction in oil prices have reduced the commercial viability of some investments and, more generally have negatively affected investor sentiment; and national debates have tended to focus on the food versus fuel arguments and the potential to create biofuels using crop surpluses.

The (then) Department of Minerals and Energy's *National Biofuels Study* (2006) found that South Africa has significant potential to develop a commercially viable biofuels sector notwithstanding South Africa's water-poor status. The Industrial Development Corporation (IDC) and the CEF are the main investors in the sector in South Africa. The IDC in particular is involved in all four of South Africa's current biofuel projects.

The biofuels sector has strong linkages to agriculture, manufacturing and distribution and has the potential to create substantial numbers of labour-intensive jobs in the agriculture sector in particular. In addition, second-generation biofuel technology will also contribute to South Africa meeting its renewable energy targets in a sustainable manner.

Government has already committed to a 2% blend target for biofuels inclusion into the national fuel supply. In addition, a number of other developing countries have set blending targets of 10% for biofuels without any need for significant engine adjustment. Were South Africa to increase its blending target to 10%, some 125 000 direct jobs could be created, many of which would be based in rural areas, where the deepest pockets of poverty occur.

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In October 2010, President Jacob Zuma officially reopened the Camden Power Station in Ermelo, Mpumalanga. The 43-year-old power station was first officially opened in October 1967, and half the station was mothballed in 1988. The last unit was returned to service in July 2008.

Camden is one of three power stations that Eskom is returning to service as part of its capacity expansion programme to address energy challenges in the country.



## Electricity

South Africa is faced with a situation in which the demand for electricity continues to grow within a supply-constrained environment.

The Mass Electrification Programme, which started in the 1990s, as well as the ongoing rapid industrialisation in the country have put enormous strain on energy sources.

The electricity demand is expected to double over the next 20 years as government implements its Programme of Action to take the country's economy on a higher growth path.

Government is ready to spend more than R800 billion on infrastructure in the next few years. This infrastructure programme will demand an enormous supply of energy.

Reliable energy supply is also a critical factor in attracting foreign investment. Also critical and central to the country's developmental agenda, is the electrification of households in both rural and urban areas as part of improving the quality of life of people.

During the State of the Nation Address in 2010, President Jacob Zuma made a commitment that the Government would aim to ensure that all households around the country are electrified by 2012.

## Integrated National Electrification Programme

The Department of Energy began funding the INEP in April 2001. Eskom implements the programme in its licensed areas of supply on the Department of Energy's behalf. Operating costs relating to this electrification programme are incurred by Eskom as the licensed distributor supplying electricity to its consumers.

Since the inception of the electrification programme in 1991, a total of 3 901 054 homes have been electrified.

Funding is currently made available for new connections and infrastructure development projects that are part of the INEP going forward. Eskom expects that the average cost of infrastructure development and the cost per connection will increase as it electrifies communities in more remote rural areas. In addition, technical specifications for network design have been enhanced to better accommodate future growth in electricity demand and to improve the quality and reliability of the electricity supply in these areas.

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In November 2010, Eskom secured a R15-billion loan from the Development Bank of Southern Africa to fund its capital-expansion programme. The loan is a structured facility that will be drawn over five years.

Eskom's capacity-expansion projects will add 12 300 megawatts of additional generating and transmission capacity to South Africa's national grid by 2017, enabling it to keep up with growing demand.

The projects include the Medupi and Kusile coal-fired power stations as well as the Ingula Pump Storage Scheme and associated transmission infrastructure.

## Eskom

Eskom generates, transmits and distributes electricity to industrial, mining, commercial, agricultural and residential customers and redistributors. The majority of sales are in South Africa while other countries of southern Africa account for a small percentage of sales. It generates about 95% of the electricity used in South Africa and about 45% of the electricity used in Africa.

In April 2010, the Government welcomed the decision by the World Bank to grant a \$3,75-billion project loan to Eskom. The maturity is 28,5 years with a grace period of seven years.

The loan will co-finance the Medupi Power Station and the country's first large wind and concentrated solar power (CSP) projects. Medupi's cleaner coal supercritical technology together with the country's first renewable energy projects, is a critical part of South Africa's responsible approach to planning for future energy needs.

In October 2010, government extended guarantees to Eskom by R774 billion to enable it to continue with its Build Programme (responsible for additional power stations and major power lines) through 2017. Eskom has received R30 billion from government to enhance its power grid.

The success of the initiatives contained in the loan (both projects and technical assistance) could defer the need to build by 2017 and allow for the introduction of other cleaner technologies.

The construction of the Medupi Power Station will provide much-needed base-load capacity, which will be commissioned from 2012 onwards. This will ensure that the country's economic development objectives remain on track and that security of electricity supply is restored. Investment in energy remains a cornerstone of government's economic strategy.

South Africa is committed to meeting its long-term climate change mitigation objectives and is pursuing an energy strategy

compatible with commitments made in Copenhagen and the economic development plans.

The generation technologies that Eskom has chosen to use are fully embedded in and informed by the long-term mitigation scenarios (LTMS) adopted by government in 2008. The intention is to ensure that carbon emissions peak during 2020 to 2025, reaching a plateau for a decade and begin declining thereafter.

Since the adoption of the LTMS and its outcomes, there has been sound assurance among various stakeholders within government, civil society and the private sector of implementation actions that are required to meet its objectives.

### Climate change

Mitigating Eskom's contribution to climate change has long been an integral part of its business. Eskom's Climate-Change Strategy, developed in 2005, and its six-point plan on climate change, prove its commitment.

The six-point plan includes:

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

Eskom has been driving the climate-change agenda further through planning, research, pricing studies and training sessions both internally and with key industrial customers.

### Renewable energy

Eskom's renewable energy journey has been impacted on by a number of factors, including the changing nature of power generation, environmental concerns and the World Bank loan, which will fund solar and wind-electricity generation.

The planned Eskom renewable projects, the 100-MW Sere Wind Farm and the 100-MW CSP Project, have been earmarked to receive about \$260 million worth of funding from the International Bank for Reconstruction and Development as part of the \$3,75-billion World Bank loan.

Construction on both projects is expected to begin in 2011.

The utility has an active research programme investigating ways to harness South Africa's renewable energy sources for power generation. Eskom is looking to increase the renewables component of its supply mix.

The long-term Strategic Energy Plan includes a mix of all viable sources, including renewables, to be implemented where they are commercially viable. The two most advanced areas under investigation are wind-generated power and concentrating solar thermal.

Eskom's CSP Project forms part of its South African Bulk Renewable Energy Generation Programme. The research will establish the feasibility of using CSP as a large-scale generation option for Eskom.

If implemented, the proposed plant will be the largest molten salt-type central receiver project in the world, which will represent a significant step in establishing solar power as a major future energy supply option in South Africa.

To confirm government's commitment with regard to the use of renewable energy, the Department of Energy has launched two flagship initiatives:

- a small-scale hydro in Bethlehem in the Free State
- a Waste to Electricity Project at eThekweni in KwaZulu-Natal.

These projects have added 13 MW to the total supply capacity in the country.

### Solar Water-Heating Programme

The Eskom Solar Water-Heating Programme, driven by government, has set a target for renewable energy to contribute 10 000 GWh of final energy consumption by 2013.

Solar water-heating could contribute up to 23% of this target. Eskom is supporting this drive through the large-scale introduction of solar water-heating, one of the most effective renewable-energy sources available.

A substantial increase in the solar water-heater rebates offered by Eskom is set to bring environmentally friendly solar-heated geysers within reach of thousands of South Africans wishing to reduce their home energy costs.

### Compact fluorescent lamp exchange

CFLs offer consumers lighting through lamps that have a longer life and consume considerably less energy than conventional incandescent globes.

As part of its strategy to introduce these globes, Eskom has embarked on a national programme to exchange incandescent globes with CFLs in selected areas. Since the programme began in 2004, more than 35 million CFLs have been exchanged for incandescent globes.

The national programme has reached all the provinces in South Africa, selecting areas of highest electricity constraint and ease of roll-out. The programme has saved in excess of 1 000 MW and will continue to reduce the energy demand from the household sector.

### Power Conservation Programme (PCP)

The PCP aims to create a South Africa that uses electricity much more efficiently on a sustainable basis.

The key components of the programme include energy conservation schemes to reduce energy consumption by 10% and electricity growth management to manage new electrical connections in line with available capacity supply.

In addition, the PCP aims to provide the pricing signal to ensure the uptake on other solutions such as DSM, particularly among the top 500 consumers in the country.

### New Build Programme

In 2010, additional power stations and major power lines were being built on a massive scale to meet rising electricity demand in South Africa. Eskom's capacity expansion budget totals R385 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.

Since the programme started in 2005, an additional 4453,5 MW has been commissioned. The plan is to deliver an additional 16 304 MW in power-station capacity by 2017.

Eskom's Build Programme aims to leave a big legacy. As Eskom builds power stations, it creates thousands of jobs and fully functional infrastructure in those areas, from schools and homes, to water systems and clinics.

Most of the capital expenditure will go towards building three new power stations, namely Medupi, Kusile and Ingula power stations.

Medupi, which is being built in Lephalale, in Limpopo, is a coal-fired power station and will consist of six 800 MW units with total installed capacity of 4 800 MW.

The construction of the power station began in May 2007, with the first of the six units of the power plant planned for commissioning in the first half of 2012. Each of the remaining five units will be commissioned in about nine-month intervals thereafter.

The project is the largest construction in South Africa as well as in the southern hemisphere. The plant will be the 22nd-largest power plant and the fourth-largest coal-fired plant in the world.

The Kusile Power Station will also be coal-fired but will be the first power station in South Africa to have the technology to remove sulphur oxides. The power station will be close to the existing Kendal Power Station in the Delmas municipal area of Mpumalanga.

The station will consist of six units, each with an installed capacity of about 800 MW, giving the power station a total of 4 800 MW. The first unit is planned for commercial operation in 2013.

Other units will be commissioned in about nine-month intervals with the last unit expected to be in commercial operation by 2017.

The Ingula Power Station, which will be straddling the provincial boundary walls of the Free State and KwaZulu-Natal, is different in that it is a pumped storage scheme. The pumped storage scheme, consisting of an upper and a lower dam, will have four 338-MW units with a total installed capacity of 1 352 MW, and is designed to mainly serve peak electricity demand.

During times of peak energy consumption, water will be released from the upper dam through the pump turbines to the lower dam to generate electricity. During times of low energy demand, the pump turbines are used to pump the water from the lower dam back up to the upper dam. The project is scheduled to come on line during 2013, with a unit being commissioned each quarter of that year.

Eskom is also in the process of bringing back to service three previously mothballed



In October 2010, investors were deliberating on a feasibility study into the creation of a mega solar park in Upington, in the Northern Cape, where government envisages that some 5 000 MW of renewable energy could be produced. The venture could also place the country as a leading supplier of various solar solutions and products, leading to more foreign investment and job creation.

Initial estimates put the costs of the solar park at around R150 billion to be split between government and the private sector.



power stations, Camden (1 520 MW), Grootvlei (1 175 MW) and Komati (955 MW).

By mid-2010, two open cycle gas turbine power stations were being built in the Western Cape: Ankerlig, which is in Atlantis and Gourikwa in Mossel Bay.

The Arnot Power Station in Mpumalanga was also in the middle of an expansion project, which will see it with additional capacity of 300 MW.

The life span of Kriel Power Station, also in Mpumalanga, will be extended to enable it to operate until 2028. Matla Power Station in Mpumalanga is going through a refurbishment process to meet the lifespan requirement of 50 years.

Along with power stations being built, refurbished and extended, transmission lines are also receiving attention. Some 1 962 km of high-voltage transmission lines were built in the past four years, as well as numerous new transmission substations and a transmission network upgrade projects.

The construction of the 765-kV ultra high-voltage line to the southern and western Cape is progressing well.

The Apollo Substation refurbishment was completed in May 2008. This increased the availability and maintainability of the Cahora Bassa/Apollo high-voltage direct current interconnection.

## 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<sup>2</sup> 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<sup>2</sup> for South Africa, compared with about 150 W/m<sup>2</sup> for parts of the United States of America (USA), and about 100 W/m<sup>2</sup> 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.

## 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<sup>2</sup> per year. According to the Renewable-Energy Resource Database, the area exceeding the minimum required DNR in South Africa covers about 194 000 km<sup>2</sup>. A 100-MW solar-thermal plant requires roughly 3 km<sup>2</sup> (1 800 kWh/m<sup>2</sup> per year).

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

## 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 2002 to 2005.

During that time, the Klipheuwel Pilot Wind Farm generated more than 12 GWh of electricity, 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 the wind farm will be operated commercially for its anticipated 20-year lifespan as calculated from 2006.

The R75-million national demonstration project in Darling in the Western Cape was 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 would 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 through collaboration between the Darling Independent Power Producer, the Development Bank of Southern Africa and the CEF. The Danish International Development Agency also funded part of the project.

In May 2010, the Minister of Energy, Ms Dipuo Peters, launched the first commercial wind farm at the Coega IDZ, Port Elizabeth, in the Eastern Cape.

The wind farm will have a total power capacity of 57,5 MW, which is about 10% of the Nelson Mandela Bay electricity consumption, and can power about 80 000 homes with green energy.

## Hydro

*The Baseline Study on Hydropower in South Africa*, an assessment conducted by the former Department of Minerals and Energy in 2002, 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, that is, less than 10 MW hydropower plants.

The advantages of these plants are that they can either be stand-alone or 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 2013.

## 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 continues with resource surveys of the Agulhas Current on the east coast of South Africa and of wave energy, in partnership with the Department of Environmental Affairs and the Bayworld Centre for Research and Education.

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

## Sustainable development on the African continent

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

This New Partnership for Africa's Development flagship programme intends to pilot the use of hydroelectric energy of the Inga rapids site in the Democratic Republic of Congo (DRC). It aims to ensure the security

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The Wind Atlas Project is a four-year project covering areas of the Northern, Western and Eastern Cape. It consists of five working packages that will be combined in a wind atlas and database.

In September 2010, the Minister of Energy, Ms Dipuo Peters, launched the wind measurement work package, which consists of 10 wind measurement stations installed over the project area.

The 10 wind measurement stations are in operation and the measured wind data can graphically be viewed and downloaded from <http://wasadata.csir.co.za/wasa1/WASAData>.

The first wind atlas and database will be published within 12 months of wind measurements. It is expected that interim results of the wind atlas could be seen by mid-June 2011. This information will be available to everyone for free and will enable project developers to easily identify hotspots for wind-farm development.

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.

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 would 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 could 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).

### **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:

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

Under the SAPP banner, the countries have pledged to support South Africa in areas of power generation, transmission, customer contributions and DSM.

The SAPP members include *Empresa Nacional de Electricidade* in Angola, Botswana Power Cooperation, *Societe National d'Electricite* in the DRC and the Electricity Supply Commission of Malawi.

Eskom is involved in the SAPP, along with other SADC country utilities, trading energy on a bilateral basis with both utilities and industry as well as mining customers in neighbouring countries.

### **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. It emits more than 400 Mt of carbon dioxide per year.

The National Climate Change Strategy, developed by the former Department of Environmental Affairs and Tourism, requires that government departments collaborate in a coordinated manner to ensure that response measures to climate change are properly directed and carried out with a national focus.

The Department of Energy is expected to respond to and mitigate climate change.

South Africa is classified as 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 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.



## 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.

While the electricity planning process includes technologies that are currently commercially available, Eskom has modelled a number of scenarios to assess the future emission profiles and the potential contribution that near-commercial lower carbon-emitting technologies can make to an emission-reduction target.

The evaluation of these options to provide the required baseload capacity includes an assessment of the risks, challenges and opportunities to fast-track these options to a point where they can be considered to be viable. Examples include underground coal gasification, CSP and hydro imports.

Given the country's abundance of coal reserves and the need to balance emission reductions with the affordability of electricity, Eskom is looking for increasingly efficient ways of utilising coal. From a coal-technology perspective, there are a number of sources that continue to predict the future performance of clean coal technologies, in terms of emissions and costs.

Significant international research and demonstration is aimed at improving the efficiency of all these technologies. The technological advances to achieve these higher efficiencies are expected to mature gradually between 2009 and 2030. The next coal-fired power station (Kusile) will be carbon-capture ready. The engineering design will cater for this requirement.

## Energy and climate change

The former Department of Minerals and Energy developed the Climate Change Strategy for the energy sector in 2009. The document focuses on GHG emissions and will support the department's mitigation activities.

The purpose of the strategy is to assist the department in establishing an effective response to climate change, which takes into consideration the key drivers and challenges for the sector.

The strategy will ensure that the Department of Energy contributes to mitigation efforts, and will position the department to address implications of international climate-change negotiations on the country's energy industry. The strategy will maximise potential benefits and minimise risks where possible, considering technological opportunities in energy efficiency, renewable energy and carbon capture and storage. Possible mitigation measures for the energy industry as a whole will be addressed, not compromising economic growth and development and other environmental objectives.

## 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<sup>3</sup>) 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.

The Department of 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.

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