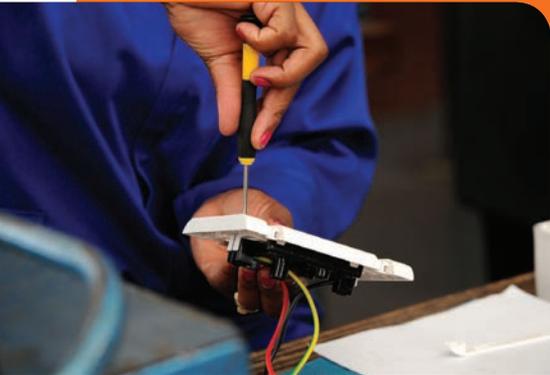


# Energy



The Department of Energy (DoE) places emphasis on broadening electricity supply technologies to include gas and imports, as well as nuclear, biomass and renewable energy resources (wind, solar and hydro), to meet the country's future electricity needs and reduce its carbon-dioxide (CO<sub>2</sub>) emissions.

In 2013, Cabinet approved the new Household Electrification Strategy, which will ensure that electricity is supplied to all households. New installations will take the form of renewables, with 220 000 grid connections and 215 000 non-grid connections planned for 2013.

Goals beyond 2020 include contracting more than 20 000 megawatts (MW) of renewable energy, including an increasing share from regional hydro-electricity.

About 11 000 MW of Eskom's older coal-powered stations will be decommissioned, but close to 6 000 MW of new coal capacity will be contracted – part of it from other southern African countries.

South Africa has committed to attain substantial reductions in CO<sub>2</sub> emissions by 2025. The country supports research, technology development and special measures aimed at environmentally sustainable economic growth.

## Legislation and policies

The DoE derives its mandate from the *White Paper on Energy Policy, 1998*, the *White Paper on Renewable Energy, 2003*, and the National Energy Efficiency Strategy.

The following legislation regulates the energy sector:

- The National Energy Act, 2008 (Act 34 of 2008) ensures that diverse energy resources are available in sustainable quantities and at affordable prices in South Africa. In addition, the Act provides for the increased use of renewable energies, contingency energy supplies, the holding of strategic energy feedstock and carriers, and adequate investment in energy infrastructure.
- The Electricity Regulation Act, 2006 (Act 4 of 2006) establishes a national regulatory framework for the electricity supply industry to be enforced by the National Energy Regulator of South Africa (Nersa). The Minister of Energy is empowered to make determinations for the establishment of independent power producers (IPPs) to increase the supply of electricity.
- The Petroleum Products Act, 1977 (Act 120 of 1977), as amended, provides for measures to save petroleum products and the economy in distribution costs, the maintenance and control of price, the furnishing of certain information

regarding petroleum products and the rendering of service. It further provides for the licensing of people involved in the manufacturing, wholesale and retailing of prescribed petroleum products.

- The Central Energy Fund (CEF) Act, 1977 (Act 38 of 1977), as amended, provides for the determination of state levies.
- The Nuclear Energy Act, 1999 (Act 46 of 1999) provides for the establishment of the National Energy Corporation of South Africa (Necsa) and defines its functions, powers, financial and operational accountability, governance and management. It also regulates the acquisition and possession of nuclear fuel, nuclear and related material and equipment, and the import and export thereof.

Other relevant legislation includes the:

- National Nuclear Regulator (NNR) Act, 1999 (Act 47 of 1999)
- National Radioactive Waste Disposal Institute Act, 2008 (Act 53 of 2008)
- Petroleum Pipelines Act, 2003 (Act 60 of 2003)
- Petroleum Pipelines Levies Act, 2004 (Act 28 of 2004)
- Gas Act, 2001 (Act 48 of 2001)
- Gas Regulator Levies Act, 2002 (Act 75 of 2002)
- National Energy Regulator Act, 2004 (Act 40 of 2004)
- Electricity Act, 1987 (Act 41 of 1987), as amended
- National Environmental Management Act, 1999 (Act 107 of 1999)
- Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002)
- Electricity Regulation Amendment Act, 2007 (Act 28 of 2007).

### National Energy Efficiency Strategy

The National Development Plan envisages that by 2030 South Africa will have an adequate supply of electricity and liquid fuels to ensure that economic activity and welfare are not disrupted, and that at least 95% of the population will have access to grid or off-grid electricity.

The plan proposes that gas and other renewable resources such as wind, solar and hydro-electricity will be viable alternatives to coal and will supply at least 20 000 MW of the additional 29 000 MW of electricity needed by 2030.

Other recommendations in the plan include diversifying power sources and ownership in the electricity sector, supporting cleaner coal technologies, and investing in human and physical capital in the 12 largest electricity distributors.

The department will continue to address these proposals through a combination of new and existing programmes.

Funds will continue to be allocated to the South African National Energy Development Institute (Sanedi) for research and development into a carbon capture and storage project, and for a hydraulic fracturing pilot to assess the potential for shale gas.

The department aims to bring IPPs into the market when the Independent System and Market Operator Bill of 2012 is signed into law.

The department will also continue implementing the pilot approach to the distribution asset management programme, by providing capital subsidies to nine municipalities to address maintenance, refurbishment and backlog concerns to improve the quality of electricity supply.

The objectives of the revised energy efficiency strategy are to:

- promote and develop energy efficiency practices, norms and standards in different energy sectors, including industries, commercial buildings, households, transport and agriculture
- develop energy efficiency policies and guidelines
- facilitate information awareness, and capacity-building campaigns concerning energy efficiency and environmental issues
- promote energy for sustainable development
- mitigate negative impacts of energy use on the environment
- promote energy efficiency technologies and clean energy technologies, including environmentally sound energy technologies
- promote and facilitate international collaboration and cooperation
- ensure the DoE's participation at international forums on energy efficiency and the environment, including the United Nations (UN) Commission on Sustainable Development, the Kyoto Protocol and the UN Framework Convention on Climate Change.

The strategy includes Eskom's demand-side management (DSM). When a utility or local authority that supplies electricity influences the way it is used by customers, this activity is known as DSM. Municipalities are also implementing their own energy efficiency strategies.

In addition, 32 large companies have joined forces with the DoE and Eskom by signing an energy efficiency accord, committing themselves to targets contained in the strategy.

To assist households in becoming more energy efficient, the DoE initiated an appliance-labelling campaign. Labels on household appliances

inform consumers of the energy efficiency of the appliances.

The DoE, in collaboration with the Department of Public Works and Eskom, is retrofitting government buildings to make them more energy efficient. This contributes a saving of about R600 000 in electricity bills a year.

Eskom concluded 11 power buy-back deals with ferrochrome and alloys producers for the period 1 December 2012 to 31 March 2013 to create a demand-side cushion for its summer maintenance programme.

The utility secured buy-backs of up to 950 MW. The buy-backs were funded through an existing allocation for demand-management programmes and were expected to have no impact on the tariff.

### National building standards

Energy-efficient regulations for new buildings form part of the deliverables of South Africa's National Energy Strategy to strengthen standards and regulations for energy efficiency.

The energy-efficient regulations apply to residential and commercial buildings, places of learning and worship, certain medical clinics and other categories of building.

The regulations 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. This will save energy significantly, which will relieve pressure on the electricity supply grid.

In addition to temperature regulations, all buildings will also have to be fitted with renewable-energy water-heating systems such as solar systems, which also have to comply with the South African national standards.

### National Strategic Fuels Stock Policy

The Energy Security Master Plan for Liquid Fuel identified a number of capacity constraints and challenges faced by the petroleum sector in meeting the energy demand. In response to these, the National Strategic Fuels Stock Policy was finalised and published for comments in 2013.

It sets out the framework for the storage of fuel stock by government and the industry. It aims to ensure uninterrupted supply of petroleum products throughout South Africa by providing adequate strategic stocks and infrastructure such as storage facilities and pipeline capacity. Strategic stocks are to be used during declared emergencies. The Minister of Energy will have the power to decide when a shortage of fuel and oil is at such a level to warrant an emergency.

### National Liquid Petroleum Gas (LPG) Strategy

LPG is commonly used in mines to power smelting furnaces that are processing materials, such as platinum and vanadium, as well as domestically for cooking.

The strategy's main objectives are to provide access to safe, cleaner, efficient, portable, environmentally friendly and affordable thermal fuel for all households, and to switch low-income households away from the use of coal, paraffin and biomass to LPG.

The strategy highlights strategic options that could be adopted for the orderly development of the LPG industry in South Africa to make LPG an energy carrier of choice for thermal applications.

The domestic LPG price is regulated through the DoE by the Minister of Energy.

### Budget and funding

Over the medium term, infrastructure spending is expected to increase to R5,7 billion in 2015/16. In 2013/14, some 200 000 households were electrified; 18 new bulk substations were built; and 30 substations were upgraded. Eskom was allocated R3,5 billion over the medium term to fund the installation of high and low-pressure solar water geysers. Municipalities received an allocation of R538 million over the medium term to install energy - efficient lighting and technologies.

Necsa derives its revenue from the sale of nuclear technology products, chemical products, nuclear engineering services and transfer payments received from government to fund the operation of specific activities, namely the decommissioning of strategic plants, the production and conversion of low-enriched uranium fuel and security.

The increase in expenditure in 2013/14 is due to an additional once-off allocation of R33,5 million to assist with the research outputs and development facilities attached to the Safari-1 reactor.

The corporation's spending focus over the medium term will be on six items: radioisotope production, radiation applications, research and development, specialised nuclear manufacturing, the nuclear fuel cycle and nuclear power generation support.

The first three are priority focus areas and aimed at expanding research and development programmes in support of the corporation's core activities and contributing to the national system of innovation strengthening the NTP Radioisotopes' position in the global market for medical radioisotopes. NTP Radioisotopes SOC Ltd, a subsidiary of the Necsa, conducts its sophis-

ticated operations from the Pelindaba nuclear facility near Pretoria. NTP exports its products to nearly 60 countries on five continents and maintains world-class quality (ISO 9001:2008), safety and regulatory compliance systems and performance. NTP is a world leader in the production and supply of radiochemicals, in particular I-131 and Mo-99, the latter being the most important isotope for devices used in the practice of diagnostic nuclear medicine. The last three are aligned with the integrated resource plan for electricity 2010 to 2030, and requirements for the building of new nuclear power reactors. These requirements include the manufacturing of specialised components and the commercial exploitation of the corporation's strategic fluorine technology platform.

- Nersa's budget for 2013/14 was R252,8 million
- NNR's budget was R168,7 million
- Sanedi's budget was R206,1 million.

## Role players

### National Energy Regulator of South Africa

Nersa is the regulatory authority for electricity, gas and petroleum. In March 2013, Nersa granted Eskom an 8% tariff increase annually over a period of five years while also welcoming the differentiated increase that will cushion the poor.

### National Nuclear Regulator

The NNR is responsible for the protection of people, property and the environment against nuclear damage.

### Nuclear Energy Corporation of South Africa

Necsa is a wholly state-owned company. Its functions are to:

- undertake and promote research into nuclear energy and radiation sciences and technology
- process source, special nuclear and restricted material including uranium enrichment
- collaborate with other entities.

The Nuclear Energy Act of 1999 provides for the commercialisation of nuclear and related products and services, and delegates specific responsibilities to Necsa, including the implementation and execution of national safeguards and other international obligations. The Nuclear Energy Policy of 2008 elaborated on Necsa's mandate relating to research and development and nuclear fuel-cycle responsibilities.

Necsa's main function is to serve as the anchor for nuclear energy research and development, and innovation in South Africa. The research focuses mainly on nuclear technology applications such as:

- the production of medical isotopes
- applied chemistry with an emphasis on uranium chemistry
- the application of radiation and nuclear technologies
- aspects of the nuclear fuel cycle, including waste.

The corporation is also responsible for:

- operating the Safari-1 research reactor to undertake nuclear science research and development and to provide irradiation services for the production of medical radioisotopes
- decommissioning and decontaminating nuclear facilities
- implementing the Nuclear Non-Proliferation Treaty and the Comprehensive Safeguards Agreement with the International Atomic Energy Agency (IAEA); the Africa Regional Cooperative Agreement for Research, Development and Training related to Nuclear Science and Technology; and the Pelindaba Treaty.

In the medium term, Necsa will focus on:

- radiation research, products and services
- nuclear fuel research and development in relation to low-enriched uranium research-reactor production facilities
- nuclear component manufacturing to support future nuclear programmes and future power reactors
- contributing to higher industrial manufacturing standards and sustainable job creation.

### South African National Energy Development Institute

Sanedi is mandated to stimulate innovation in energy research and development, transform the gender and race profile of researchers in the sector, and improve South Africa's competitiveness in energy research internationally.

### Central Energy Fund

The CEF's spending focus over the medium term is on accelerating spending on infrastructure, as well as the development of renewable and alternative energy sources. Projects incorporated over the medium term include Ikhwezi, with a total approved budget of R11,2 billion; Sabre Oil and Gas in the Jubilee Production Field, with a total budget of R4 billion; and Irene and other downstream acquisitions, with a total estimated cost of R14 billion.

South Africa's Koeberg nuclear plant is the only nuclear power-generating facility on the African continent. The government plans to build new plants in the country with a total capacity of 9 gigawatts (GW) and it is expected to be 9,6 GW by 2035.

Other projects to be undertaken are Project Mthombo, and projects in Venezuela and Equatorial Guinea. Project Mthombo is a PetroSA initiative to build a world-class crude refinery in the Coega Industrial Development Zone (IDZ) in the Eastern Cape.

The initiative in Equatorial Guinea is a drilling project, while the project in Venezuela relates to the acquisition of a mature field opportunity.

This accounts for the strong growth in acquisition of assets over the medium term.

The CEF researches, finances, develops and exploits appropriate energy solutions across the spectrum of energy sources to meet South Africa's future energy needs.

It is also mandated to manage the Equalisation Fund, which collects levies from the retail sales of petroleum products to eliminate unnecessary fluctuations in the retail price of liquid fuel and to give tariff protection to the synthetic fuel industry.

The objectives of the CEF are to:

- manage the energy business for the benefit of all South Africans
- play an active role in the governance and planning of all its subsidiaries and coordinating the long-term future of the group
- improve security of energy supply by diversifying sources, and building and managing strategic energy stocks and energy infrastructure
- develop and invest in renewable and alternative energy sources and in energy efficiency
- develop human capacity and invest in relevant research and development
- manage and optimally exploit local strategic energy and related resources
- mitigate against environmental impacts and maximise sustainable development.

In August 2013, Russia's State Nuclear Power Corporation, Rosatom, which is planning to bid for the construction of nuclear power plants in South Africa, decided to start training nuclear industry specialists for South Africa.

Rosatom signed a memorandum of cooperation with the North-West University, the only school of higher learning that offers training in nuclear technologies. The intention is to explore the potential for future collaboration, ranging from education to specific technical projects in nuclear engineering, hydrogen technologies and energy.

The memorandum promotes the development of technical education in South Africa and the possibility to find out more about modern Russian technologies. Joint research and scientific developments will provide a solid foundation for the development of Rosatom's business relations in South Africa. At the end of December 2013, Rosatom signed a memorandum of understanding with South Africa to provide end-to-end nuclear plant delivery and operation.

### Integrated energy centres (IECs)

Government has identified access to energy for people in areas of greatest need as an urgent requirement to facilitate socio-economic development. One of the many approaches that the DoE has developed to address energy poverty through deliberate interventions in the second economy is the IECs programme.

The department is partnering with relevant stakeholders, the private sector, municipalities and communities in establishing the IECs. As a result, this is a public-private partnership venture.

An IEC is a one-stop energy supplier, owned and operated by the community cooperative and organised as a community project. It provides energy solutions to communities; access to affordable, safe and sustainable energy services; information and awareness on how to handle and use energy services such as paraffin and LPG and small, medium and micro enterprise development through partnerships with key stakeholders, such as the National Development Agency and the Department of Trade and Industry.

The six IECs are: Kgalagadi and Moshaweng in Kuruman, Northern Cape; Eshane in Greytown, KwaZulu-Natal; Caba Mdeni in Matatiele and Mbizana, Eastern Cape; Mutale in Thohoyandou, Limpopo; and Ratlou in Makgobistad, North West.

### Sasol

Sasol is an international integrated energy and chemical company that leverages the talent and expertise of more than 34 000 people working in 37 countries. The company develops and commercialises technologies, and builds and operates world-scale facilities to produce a range of product streams, including liquid fuels, high-value chemicals and low-carbon electricity.

Sasol is expanding internationally based on a unique value proposition. The company is listed on the JSE Limited in South Africa and on the New York Stock Exchange in the United States of America (USA).

The company is one of the world's largest producers of synthetic fuels. It mines coal in South Africa and produces natural gas and condensate in Mozambique, oil in Gabon and shale gas in Canada.

Sasol continues to advance its upstream oil and gas activities in West and southern Africa, the Asia Pacific region and Canada. In South Africa, Sasol refines imported crude oil and sells retail liquid fuels through its network of some 400 service stations and supplies gas to industrial customers. It also supplies fuels to other licensed wholesalers in the region.

Through Sasol Synfuels International, Sasol is pursuing international opportunities to commercialise its gas-to-liquids (GTL) and coal-to-liquids (CTL) technology.

Sasol's energy cluster focuses on the manufacturing, refining and marketing of automotive and industrial fuels, oils and gas.

With partners in China, the company launched a feasibility study into a CTL plant with a potential capacity of around 80 000 barrels per day.

End products include petrol; diesel; jet fuel; fuel oil; illuminating paraffin; liquefied petroleum gas; pipeline gas; lubricants and greases; bitumen and naphtha.

Sasol's local energy cluster comprises the following:

- Sasol Oil, which handles crude oil refining activities as well as the blending and marketing of liquid fuels and lubricants.
- Sasol Gas, which supplies pipeline gas to industrial and commercial customers.
- Sasol Mining, which produces about 40 million tons (Mt) of saleable coal a year.
- Sasol Synfuels, which operates the coal-based synfuels manufacturing facility at Secunda, in Mpumalanga.

## Eskom

Eskom generates, transmits and distributes electricity to industrial, mining, commercial, agricultural and residential customers and redistributors.

Additional power stations and major power lines are being built to meet rising electricity demand in South Africa.

Eskom will continue to focus on improving and strengthening its core business of electricity generation, transmission, trading and distribution.

Eskom buys electricity from and sells it to the countries of the Southern African Development Community (SADC). Future involvement in African markets outside South Africa – the SADC countries connected to the South African grid and the rest of Africa – is limited to those projects that have a direct impact on ensuring security of supply for South Africa.

In September 2013, President Jacob Zuma officially re-opened Eskom's Grootvlei power station, which will contribute towards meeting the country's energy demand requirements by providing maintenance space for other power stations.

## National Nuclear Energy Executive Coordination Committee (NNEECC)

The DoE undertook study tours to a number of key nuclear-energy jurisdictions ahead of a final

nuclear decision, which government was intent on making before the end of 2013/14.

South Africa has opted for a phased decision-making approach under the direction of the NNEECC, which is chaired by President Zuma. It was previously overseen by the Deputy President.

The Minister of Energy said China, France, Korea and the USA would be visited to assist in determining South Africa's approach to the introduction of new nuclear energy capacity, over and above that which already exists at Koeberg, in the Western Cape.

The NNEECC includes the ministers of energy, public enterprises, economic development, trade and industry, water affairs and environment, finance and mineral resources, with the DoE serving as a secretariat.

A nuclear energy technical committee, led by the relevant directors-general, reports to the ministers. Senior officials lead a nuclear energy working group incorporating various working subgroups.

They have the task of examining everything from finance and funding to security and safety.

## Southern African Power Pool (SAPP)

The SAPP allows 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 SAPP has made it possible for members to delay capital expenditure on new plants due to the existence of interconnections and a power pool in the region.

SAPP member countries are Angola, Botswana, the Democratic Republic of Congo (DRC), Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe.

## Other role players

- iGas is the official state agency for the development of the hydrocarbon gas industry in southern Africa.
- PetroSA is a government-owned oil and gas company mandated by Cabinet to lead developments in gas infrastructure in the Western Cape.
- The Petroleum Agency of South Africa promotes the exploration and exploitation of natural oil and gas, both onshore and offshore, in South Africa and undertakes the necessary marketing, promotion and monitoring of operations.

- Petronet owns, operates, manages and maintains a network of 3 000 km of high-pressure petroleum and gas pipelines on behalf of government.

## Energy resources

South Africa produces about 5% of its fuel needs from gas, about 35% from coal and about 50% from local crude oil refineries. About 10% is imported from refineries elsewhere in the world. The country has a sizeable capital stock and management capacity to produce fuel from gas. The DoE's Hydrocarbons and Energy Planning Branch is responsible for coal, gas, liquid fuels, energy efficiency, renewable energy and energy planning, including the energy database.

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.

## Liquid fuels

The recommendations made in the Energy, Security Master Plan for Liquid Fuels, approved by Cabinet in 2007, continue to be implemented, with the focus primarily on addressing short to medium-term infrastructural constraints within the liquid fuels sector.

South Africa faces a number of specific challenges in the liquid fuels sector:

Gas stocks for the existing gas-to-liquids plant from offshore fields are declining. South Africa should source sufficient feedstocks to support and increase production.

The best option to secure feedstocks would be to invest in gas fields close or adjacent to existing fields in the southern Cape, as marginal costs are lower and it will allow for further exploitation of existing fields, maximising use of existing capital.

PetroSA is best placed to lead this petroleum refinery investment, given its existing capital and management experience.

In the longer term, the Mossel Bay Refinery could use either liquefied natural gas imports or Karoo shale gas, if it becomes available. Refining capacity has run out and South Africa now has to import a share of its refined fuel needs. There are five options to deal with this, namely:

- building a new oil-to-liquid refinery (such as the proposed Mthombo Project in Coega)
- building a new CTL refinery

- upgrading the existing refineries; allowing significant expansion of one or more of the existing refineries
- importing refined products
- building a refinery in Angola or Nigeria and buying a share of the product of that refinery.

The least risky and most cost-effective option is to continue importing a share of refined products until the country reaches a stage where it can absorb the output of either a new refinery or a major upgrade of an existing refinery. South Africa will, therefore, continue to import, taking a decision on the next step by 2016/17. Timing is important, given lead-time requirements to develop a new refinery (estimated at about eight to 10 years) that would be expected to produce output by 2025 to 2028 (if no other options are implemented).

Other issues related to liquid fuels include:

- clean fuel standards
- vehicle carbon tax
- electric vehicles
- use of public transport.

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

A key feature of the South African liquid-fuels sector is that most transport fuel is produced in the coastal areas, about 68% of which is consumed in Gauteng. This requires investments in storage and distribution facilities for the supply of petroleum products at the point of need.

The construction of the new multi-product pipeline, which was funded under the department through Transnet, was completed. The new 555-km pipeline, which has a 70-year design life, runs from Durban to Gauteng. It can transport jet fuel, 93-grade and 95-grade unleaded petrol, low-sulphur diesel and ultra-low-sulphur diesel.

The trunk pipeline, with pump stations, terminals and a 160-km inland pipeline network, came into operation at the end of 2013, increasing capacity from the existing 4,4 billion litres to 8,4 billion litres.

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

## Oil and natural gas

South Africa has very limited oil reserves. About 60% of its crude oil requirements are met by imports from the Middle East and Africa.

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).

South Africans achieved an average of 629 MW reduction in their electricity usage during Earth Hour in March 2013. The campaign encourages individuals and businesses to lead energy-smart lifestyles, to save power, save the planet and save their pockets.

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.

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.

The department views natural gas as an evolving energy source, despite the country's limited gas reserves. There are projects underway to explore the potential of importing natural gas, both as liquid natural gas and compressed natural gas.

To this end, the Integrated Resources Plan (IRP) was developed, which incorporates gas among alternative energy sources for electricity generation. The IRP presents a 20-year view on South Africa's energy mix that seeks to balance growth in demand with South Africa's commitments to reduce its dependence on coal and to lower climate-changing emissions.

The IRP aims to:

- improve the country's global competitiveness
- support job creation
- improve the management of natural resources
- reduce and mitigate greenhouse gas (GHG) emissions in line with reduction targets.

Global energy company GDF Suez announced in June 2013 that it would be proceeding with two open-cycle gas-turbines in South Africa.

GDF Suez holds a 43% equity interest in the project, Investec, 34,5%, and Kagiso Tiso Holdings, 20%, with the remaining 2,5% to be allocated to a community trust. In addition to investing equity in the project, Investec, jointly with Nedbank, has underwritten about R1,5 billion in debt required for the development of the wind farm.

In August 2013, South Africa's state-owned oil and gas company PetroSA launched a R15-million geoscience collaboration, visualisation and technology centre, which will prove a boost to gas exploration and drilling. Geoscientists, engineers and technical officials will be able to collaborate in the Ulwazi (Knowledge) Collaboration and Visualisation Centre, which is equipped with various screens and computers that can display 3D imaging of subsurface formations. This will make it possible to take better informed and faster decisions when drilling for gas.

The centre can also be used daily to monitor and guide drilling operations for PetroSA's gas drilling project Ikhwezi located off the East Coast to sustain its GTL refinery in Mossel Bay.

Using data fed back from drilling bits on such things as sand or rock type or the resistivity of the substance being drilled, officials will also be able to adjust where exactly to drill, compare data from old drilling sites and make changes to the angle or direction of its active drill bits.

This is particularly useful to the Ikhwezi project where horizontal drilling is taking place 1,5 km along the basin at a depth of four kilometres from the surface.

### Alternative gas resources

Experiments are underway to assess the potential for mining coal-bed methane gas, although the overall potential of this resource for producing electricity in South Africa is probably less than previously thought.

Underground coal gassification technology is also being developed.

According to the USA Energy Information Administration, technically recoverable shale-gas resources in South Africa form the fifth largest reserve globally. Drilling more wells is necessary to confirm recoverable reserves.

Even if economically recoverable resources are much lower than currently estimated, shale gas as a transitional fuel has the potential to contribute a very large proportion of South Africa's electricity needs.

In investigating the potential for accessing shale gas in the Karoo Basin in the Northern Cape, Cabinet decided that only normal exploration would take place until a proper and relevant regulatory framework had been put in place, and until government was satisfied that it could deal adequately with the consequences of the technique known as hydraulic fracturing.

Cabinet established a task team to evaluate the use of a hydraulic fracturing technique in the extraction of shale gas. This task team comprised representatives from the departments of environmental affairs, water affairs, science and technology, energy, mineral resources, the Petroleum Agency of South Africa, the Council for Geoscience, Square Kilometre Array South Africa, the Water Research Commission and Eskom.

The task team appointed a working group of experts that brought on board technical advisers and academics from the universities of the Free State and of the Western Cape, who served as a reference group.

This team was tasked with evaluating the potential environmental risks posed by the use of hydraulic fracturing as a method of extracting

shale gas, and the negative and positive social and economic impacts of shale gas exploitation as identified in the Karoo Basin.

Cabinet approved the task team's report and lifted the moratorium on processing applications for exploration in the Karoo Basin on condition of the appropriate regulations, controls and coordination systems being established, which were in place by the end of 2013.

There will be ongoing research, facilitated by relevant institutions, to develop and enhance scientific knowledge, including but not limited to the geo-hydrology of the prospective areas, methodologies for hydraulic fracturing in South Africa and environmental impact.

### Electricity

By 2013, nearly 88% of the population had access to electricity.

However, electricity demand is expected to double over the next 20 years as government implements its Programme of Action, including the Infrastructure Development Programme, to put the country's economy onto a higher growth path.

To this end, more than R340 billion will be spent on Eskom's New Build Programme. This will bring on line a further 11 641 MW of new capacity in the short term, adding to Eskom's existing 40 000 MW of capacity.

Government's goal is to ensure that 92% of all South African households have 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 total fuel consumption of the world's electricity production.

By international standards, South Africa's coal deposits are relatively shallow with thick seams, making them easier and cheaper to mine. At the present production rate, it is estimated that there more than 50 years of coal supply left.

Coal provides for about 65% of South Africa's primary energy needs. This is unlikely to change significantly in the next two decades, owing to the relative lack of suitable alternatives to coal as an energy source. Many of the 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, about 28% of South Africa's production is exported, mainly through the Richards Bay Coal Terminal, making South Africa the fourth largest coal exporting country in the world.

South Africa's coal is obtained from collieries that range from among the largest in the world to small-scale producers.

About 51% of South African coal mining is done underground, while the rest is produced by open-cast methods.

The coal-mining industry is highly concentrated, with five companies accounting for 85% of saleable coal production.

Production is concentrated in large mines, with 11 mines accounting for 70% 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 every year.

About 21% of the run-of-mine coal produced is exported, and 21% is used locally (excluding power-station coal). The rest is not saleable and is discarded.

The remainder of South Africa's coal production feeds the various local industries:

- 62% is used for electricity generation
- 23% for petrochemical industries (Sasol)
- 8% for general industry
- 4% for the metallurgical industry (Mittal)
- 4% is purchased by merchants and sold locally or exported.

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

### Renewable and alternative fuels

The DoE has the sole mandate to promote the use of renewable energy, initiate projects to advance the use of renewable energy and annually monitor the precise quantity of energy produced from renewable energy.

The *White Paper on Renewable Energy (2003)* has set a target of 10 000 GWh of energy to be produced from renewable energy sources (mainly from biomass, wind, solar and small-scale hydro) by 2013.

Following Cabinet approval of the White Paper, the DoE proceeded with the development of its renewable energy strategy.

The White Paper's target of 10 000 GWh renewable energy contribution to final energy consumption by 2013 was confirmed to be economically viable with subsidies and carbon financing.

Achieving the target will:

- add about 1 667 MW of new renewable energy capacity, with a nett impact on gross domestic product as high as R1,071 billion a year

- create additional government revenue of R299 million
- stimulate additional income that will flow to low-income households by as much as R128 million, creating just over 20 000 new jobs
- contribute to water savings of 16,5 million kilolitres, which translates into a R26,6 million saving.

Renewable energy sources, other than biomass (the energy from plants and plant-derived materials) have not yet been exploited optimally in South Africa.

The vision of the DoE is to make adequate and affordable energy available to developing communities through a mix of providing alternative energy resources at a reasonable cost. The aim is to satisfy the basic needs of the developing sector and at the same time promote the effective use of South Africa's vast alternative energy sources.

To monitor progress towards the White Paper's target of producing 10 000 GWh of energy from renewable energy sources by 2013, a monitoring and evaluation project has been set up.

Every year, the department collects data on renewable energy contributions from relevant stakeholders to assess or evaluate progress towards this goal.

The target can be achieved mainly from the production of renewable energy by grid, off-grid (a source of energy not connected to a grid) and biofuel facilities. This renewable energy will be used for power generation to the grid and for water heating purposes.

The 10 000 GWh 2013 target is equivalent to about 5% of all electricity produced in South Africa at present. This is equivalent to replacing two 660-MW units of Eskom's combined coal-fired power stations.

## Biofuel

The biofuel sector has grown rapidly internationally. However, South Africa has remained only a peripheral participant in the sector's growth. There are several reasons for this:

- Being a relatively new sector, there are various complex regulatory barriers to be finalised.
- The global economic crisis and the resultant reduction in oil prices reduced the commercial viability of some investments and negatively affected investor sentiment.
- National debates focus on food-versus-fuel arguments and the potential to create biofuels using crop surpluses.

South Africa has significant potential to develop a commercially viable biofuels sector, notwithstanding the country'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 sustainably.

Government has committed to a 2% blend target for biofuels inclusion in the national fuel supply. If South Africa increased its blending target to 10%, some 125 000 direct jobs could be created, many of which would be based in rural areas, where poverty is widespread.

South Africa set the beginning of October 2015 as the date from which fuel producers would have to blend diesel and petrol with biofuels.

Fuel producers would be required to blend a minimum of 5% biodiesel in diesel and between 2% and 10% of bioethanol in petrol.

Biofuels are expected to reduce the country's reliance on imported fuel.

The biofuels industry in South Africa, the continent's biggest agricultural producer, has been held back by an inadequate regulatory regime and concerns that biofuels would hurt food security and affect food prices.

Canola, sunflower and soya are feedstock for biodiesel, while sugarcane and sugar beet are feedstock for ethanol.

The Government said maize, South Africa's staple food, could not be used in the production of biofuels to ensure food security and control high prices.

## Hydropower

Energy from water can be generated from waves, tides, waterfalls and rivers and will never be depleted as long as water is available. South Africa has a mix of small hydroelectricity stations and pumped-water storage schemes.

Pumping uses some electricity, but this is done in off-peak periods. During peak hours, when extra electricity is needed, the water is released through a turbine that drives an electric generator. Peak hours are usually from 06:00 to 08:00 and 18:00 to 20:00.

South Africa used to import electricity from the Cahora Bassa hydropower station in Mozambique and will do so again once the transmission line is repaired. There is also the potential to import more hydropower from countries such as Zambia, Zimbabwe and DR Congo. If this happens, South Africa could become less dependent on coal-fired power stations.

However, the generation of hydro-electricity is not without environmental effects; for example, large areas of land may be flooded when dams are built, which will disrupt wildlife habitats and residential and farming areas.

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

The Eastern Cape and KwaZulu-Natal are endowed with the best potential for the development of small, i.e. less than 1 MW, hydropower plants. These plants can either be stand-alones or 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.

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 being harnessed is that there is no existing reliable technology for generating electricity from the sea.

Eskom is continuing 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.

The Bramhoek and Bedford dams have both been completed and the R23-billion Ingula Pumped Storage Scheme was implemented during 2013/14. By the end of 2013, some 2 400 MW of capacity had been awarded to renewable projects.

According to the IRP's 20-year projection on electricity supply and demand, about 6% of electricity generated in the country will be required to come from hydro resources.

### Solar power

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 kWh/m<sup>2</sup> 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 USA, and about 100 W/m<sup>2</sup> for Europe.

This makes the local resource one of the largest in the world. The solar resource is the most readily accessible in South Africa. It lends itself to a number of potential uses.

The launch of the solar energy farm, the first renewable energy project in North West took place in May 2013. Located at Buffelspoort, RustMo1 Solar Farm is a 7 MW solar photovoltaic (PV) power-generation facility, which will supply power to the Eskom grid.

The project includes the installation of 11 inverters and 29 808 PV solar modules, with a step-up transformer to connect to the 88kV substation. The farm will produce 244 643 MWh of energy over the 20-year contract period. Commercial operations at the farm started in November 2013.

The development of the farm was awarded to Momentous Energy, a South African black-owned development company.

Fifteen projects are being developed under the IPPPP programme with the RustMo1 solar PV plant being the first to be approved.

By the start of 2014, other solar PV projects ranging from five to 340 MW earmarked for Brits; Christiana; Taung; Rustenburg; Vryburg; Mahikeng; Tswaing and Orkney were at various stages of the bidding and planning process for implementation.

In August 2013, Spanish renewable energy group Abengoa completed construction of the tower section of South Africa's first concentrating solar power (CSP) plant, one of three such plants under development in the semi-desert Northern Cape that will add 200 MW of renewable energy to the country's national grid.

Abengoa is one of 28 IPPs that signed contracts with the South African Government late in 2012. The first round of a programme will see an initial 1 400 MW of renewable energy being added to South Africa's energy mix, while bringing an estimated R47 billion in new investment into the country.

The DoE aims to bring 17 800 MW from renewable sources online by 2030.

Abengoa, in partnership with the IDC and community trusts in Upington and Pofadder, is building Khi Solar One, a 50-MW solar tower plant near Upington, and KaXu Solar One, a 100-MW parabolic trough solar plant near Pofadder. According to the Southern Africa Solar Thermal and Electricity Association, the two power stations will leverage investment of over

R10 billion and together will generate almost 500 GWh clean solar electricity a year.

According to Abengoa, the two plants will reduce South Africa's CO<sub>2</sub> emissions by about 498 000 t a year, while creating between 1 400 and 2 000 construction jobs and about 70 permanent operation jobs, as well as numerous indirect jobs to fulfil the needs required by the plant and its construction.

Gauteng plans to spend R11 billion installing solar panels on all its state-owned buildings in the near future.

In September 2013, Norway-based Scatec Solar announced that it had completed its 75-MW solar PV power plant in Kalkbult in the Northern Cape three months ahead of schedule, making it the first project under South Africa's renewable energy programme for IPPs to be connected to the grid and operational.

Scatec Solar was also one of 28 IPPs that signed contracts with government in the first round of a programme that would see an initial 1 400 MW of renewable energy being added to South Africa's energy mix, while bringing an estimated R47 billion in new investment into the country.

The DoE aims to bring 17 800 MW from renewable sources online by 2030.

Scatec Solar has been awarded three projects with a total capacity of 190 MW. Construction of its next two projects, located in the Northern and Eastern Cape, was to be finished by mid-2014.

The completed Kalkbult plant consists of more than 312 000 solar panels mounted on 156 km of substructure, inverters, transformers and a substation.

Kalkbult's electricity will be sold to Eskom through a 20-year purchase agreement. According to Scatec Solar, the annual production of 135-million kWh will cover the electricity demand of 33 000 households, while reducing the country's CO<sub>2</sub> emissions by almost 115 000 tons per year.

South Africa has some of the best conditions for solar power in the world, and the Kalkbult plant's output of 135-million kWh a year will benefit both the region and the local community, in which it operates.

The De Aar Solar Power Project installed the last of around 160 000 solar panels in September 2013. The project employed some 500 people, mostly from the De Aar community and the staff installed around 3 000 panels per day during the peak construction phase. The De Aar plant, which will produce 45,6 MW of energy, is meant to begin operations by April 2014, but it is ahead of schedule and was expected to come online before the target date.

## Wind power

The Darling Wind Farm in the Western Cape has four wind turbines, which can supply 5,2 MW. All the electricity produced will be sold to 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 can produce 1,3 MW, bringing the total output of the wind farm to 5,2 MW.

In November 2013, construction of the wind turbine manufacturing facility was well on its way to being completed at the Coega IDZ.

The Wind Tower Factory Project, which was more than 60% complete by the start of 2014, is a joint initiative between the DCD Group, the IDC and the Coega Development Corporation.

Construction of the facility, located in Zone 3 of the Coega IDZ, started in March 2013, and was expected to be completed before the end of February 2014. It would be a first of its kind for the Eastern Cape.

Once completed, the DCD wind tower manufacturing facility will produce complete tubular steel towers, which will entail manufacturing the round steel tower sections from flat steel, welding flanges and assembling the inner parts of the towers. The wind turbine towers will vary in size, ranging between 80 and 120 metres, with individual sections weighing 40 to 60 t. According to Coega the project has created 250 temporary jobs, with more than 90% of the workers coming from the Nelson Mandela Bay region.

## Hybrid systems

Hybrid energy systems are a combination of two or more renewable energy sources such as photovoltaic, wind, micro-hydro, storage batteries and fuel-powered generator sets to provide a reliable off-grid supply.

There are two pilot hybrid systems in the Eastern Cape at the Hluleka Nature Reserve on the Wild Coast and at the neighbouring Lucingweni community.

The Hluleka hybrid mini-grid system consists of two proven 2,5-kW wind generators and three Shell solar PV module arrays fitted with 56 100-watt PV modules wired in series (total 10,6 kW). An integrated design approach, which resulted in a joint energy, water purification and telecommunication system, was followed. The energy system uses renewable energy, solar water heaters and LPG. One diesel generator is retained for back-up supply. The Hluleka system has been in operation since June 2002.

The Lucingweni hybrid system consists of 50-kW solar PV panels and 36-kW wind

generators serving 220 dwellings (four lights per dwelling, radio, television, mobile phone charger, street lighting, telecommunications and water pumping).

### Tradable renewables

The *White Paper on Renewable Energy Policy* proposed that tradable renewable energy certificates be investigated to find out whether these could be one of the funding streams to support the implementation of the renewable energy programme in South Africa. This would be in addition to other funding options, i.e. sale of physical electrical power through a power purchase agreement into the electrical grid at prevailing electricity market prices and certified emission reductions trading through the clean development mechanism (CDM), a UN framework mechanism that encourages developing countries to implement emission-reduction projects to earn certified emission reductions.

A tradable renewable energy certificate is an electronic record that verifies the origin of energy by a registered renewable energy entity. It is also referred to as a green certificate or green tag. Tradable renewable energy certificates are based on separating the various attributes of renewable resource-based energy provision from the physical energy carrier, electric or otherwise. It is another revenue stream for renewable energy IPPs and its major advantage is that, apart from potential extra income, certificates can be traded worldwide and separately from the electricity grid infrastructure.

### Nuclear

Nuclear energy is set to play a vital role in South Africa's IRP implementation process. The success and deployment of nuclear power requires public acceptance, and public education is the most important topic surrounding nuclear energy.

Proper safety measures were put in place and overseen by the appropriate expert authorities. As a member of the IAEA, South Africa is obliged to comply with the relevant guidelines and safeguards on nuclear plants.

The nuclear sector in South Africa is mainly governed by the Nuclear Energy Act, 1999 (Act 46 of 1999) and the NNR Act of 1999. The DoE administers these Acts.

The Department of Health administers the Hazardous Substances Act, 1973 (Act 15 of 1973), related to Group 3 and Group 4 hazardous substances.

Skills development strategies and acquisition and retention of the relevant skills to support the nuclear programme will be addressed in the following categories:

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

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

- securing 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 main organisations directly involved in the nuclear sector fulfil the following functions:

- The Department of Health's Directorate: Radiation Control issues licences for Group 3 hazardous substances (electronic product-generating X-rays, other ionising beams, electrons, neutrons or other particle radiation or non-ionising radiation) and Group 4 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 and is owned by Eskom.
- 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.
- The Nuclear Fuels Corporation of South Africa is responsible for uranium-ore refinement and export.

### Programmes and projects

The department participates in the Women in Nuclear South Africa 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 the Women in Nuclear South Africa Programme to promote the industry among historically disadvantaged people.

## Wind Resource Map

The DoE launched the country's first Large Scale High Resolution (250 m) Wind Resource Map in July 2013. It is expected that the map is going to be a useful instrument in government's planning for the efficient use of the country's wind resources.

The data is based on the Verified Numerical Wind Atlas for South Africa (WASA), which was launched in March 2012. It includes important information such as ground surface terrain effects that determine the local wind climate and, in turn, can be used to identify high-yielding wind development zones; and the estimation of available wind energy and capacity which can be used by prospective wind farm developers of all sizes in their planning process.

The Wind Resource Map offers important benefits for planners, policy makers and industry. These benefits include cost and timing savings as the viability, in terms of wind speed, of a potential site can be predicted with known and traceable accuracy, while it also levels the playing field between small or large industry players to identify and develop project sites for wind farms.

It will also assist government in calculating the potential yield of wind energy resources, among other things.

The Large Scale High Resolution Wind Resource Map is available to the public from the WASA's online portal <http://wasadata.csir.co.za/wasa1/WASAData>.

The purpose of the WASA is to improve knowledge and the quality of resource assessment methods and tools, to make available this knowledge and tools free of charge for planning and development of wind farms and off-grid electrification, and to build capacity of local institutions to do wind resource measurements.

## Integrated Resources Plan

At the Africa Energy Indaba in February 2013, the Minister of Energy said South Africa intended to introduce nuclear power to help lower carbon emissions.

The IRP 2010 to 2030 envisages 9 600 MW additional nuclear capacity by 2030. The IRP is a 20-year projection on electricity supply and demand.

Following the Fukushima nuclear accident, South Africa, through the NNR, needed to find assurance in terms of the safety of existing installations. The safety of the Safari-1 research reactor and Koeberg nuclear power station were reassessed. In June 2013, the NNR announced that the country's nuclear installations could withstand natural events.

South Africa is a member of the IAEA and had signed up for stress tests to ascertain whether

its reactors were vulnerable to natural causes like tsunamis. As a member of the agency, the country had to meet several milestones.

In February 2013, the agency ended the peer review mission to South Africa. The agency had never before visited a country with an existing nuclear programme.

In September 2013, the DoE launched the public-consultation phase for the formulation of an Integrated Energy Plan (IEP) for South Africa, which it says should be published during the course of 2014.

In July 2013, Cabinet endorsed a draft Integrated Energy Planning Report, which provides the basis for the current set of consultations.

The publication of an IEP is a requirement of the National Energy Act of 2008, but South Africa has hitherto not had a fully consulted IEP as envisaged in the legislation, despite having published an Integrated Resource Plan for electricity early in 2011.

## Renewable Energy Independent Power Producer Procurement (REIPPP) Bidding Programme

This programme is an indication that government wants to create space for IPPs to also generate electricity in the country. By 2014, under the REIPPP the department is expected to enter Window 3 having already selected bidders for a total of 2 614 MW to be added to the country's power grid by 2016.

South Africa wants to procure 3 625 MW of renewable energy through this process.

According to the IRP 2010, about 42% of electricity generated in South Africa has to come from renewable resources.

By March 2013, the department had installed 335 000 solar water systems out of a target of one million by the end of 2014.

By May 2013, South Africa had signed agreements with preferred bidders in Window 2 of the REIPPP that would contribute to the country's energy mix and job creation.

The department signed implementation agreements and direct agreements with each bidder, while power parastatal Eskom signed power purchase agreements with the bidders. Eskom is committed to the diversification of the country's energy resources.

Of the 19 bidders, nine were selected for the solar PV technology taking up 417,1 MW, seven for wind, two for small hydro and one for concentrated solar thermal (CSP). For solar PV, 417 MW was taken up by bidders with the maximum MW allocated for round two at 450; for wind, 562,5 MW was taken up with the maximum allocation at 650 MW. For small hydro, 13,3 MW was taken up from a maximum

allocated for round two at 75 MW, while for CSP the allocated maximum 50 MW was taken up. In the second window, bidders took up 1 0439 MW. The preferred bidders in this window are located in the Eastern Cape, Free State, Northern Cape and Western Cape.

The IRP 2010 lays specific emphasis on broadening electricity supply technologies to include gas, imports, nuclear, biomass, and renewables (wind, solar and hydro) in response to the country's future electricity needs as well as the necessity to reduce its CO<sub>2</sub> emissions.

South Africa wants to procure 3 725 MW of renewable energy through this process. According to the IRP 2010, projection on electricity supply and demand, about 42% of electricity generated in South Africa has to come from renewable resources.

Job opportunities, local content and community development are the essential ingredients of the programme.

Localisation needs constant emphasis because in its design and implementation, the REIPPP is biased toward the economic development of the country with bidders being subjected to local content assessment.

Progress is being made with the construction of 28 Window 1 projects announced in 2011. The total financial injection in all these projects amounts to R28 billion for a net generation capacity of 1 043 MW.

Lessons learnt from Window 1 and 2 will be taken into account. The IRP envisages 17 800 MW. The first three determinations amount to 2 755 MW. Because of the size of renewable energy there will be other windows not necessarily related to this determination.

In May 2013, the department issued a request for proposals (RFP) for the third bid window of the programme. The improvements to the RFP for Window 3 were made available on the IPP website.

The REIPPP won the Green Infrastructure Project of the Year Award at the 6th Global Infrastructure Leadership Forum held in New York.

In November 2013, the DoE informed another 17 renewable-energy developers that they had been appointed as preferred bidders, following

In July 2013, the Minister of International Relations and Cooperation attended the International Conference on Nuclear Security in Vienna, Austria. Organised by the International Atomic Energy Agency (IAEA), the summit adopted a declaration emphasising that while the responsibility for nuclear security rests entirely with individual member states, the IAEA plays a central role in strengthening the nuclear security framework globally and in leading coordination of international activities in nuclear security.

the conclusion of the third bid-submission round under the REIPPP.

### Integrated National Electrification Programme (Inep)

Between 1994 and 2013/14, just under 5,7 million households had been electrified under the programme, while in the period from 2002 to 2013/14, some 68 115 households in the Eastern Cape, KwaZulu-Natal and Limpopo had been supplied with non-grid technology (solar panels and renewable energy). A total of 181 004 connections had been made during 2013/14, which was just ahead of Inep's target of 180 000. This could be attributed to improved efficiencies as a result of being more involved in the operational activities of implementers and good cooperation from Eskom and municipalities.

There were still 3,3 million households without electricity, with 75% of these in the Eskom supply area, and 25% in municipal supply areas.

The total number of planned connections for 2013/14 was 276 703. The department received an increase of R400 million in its funding allocation, which accounted for the higher number of connections projected. The total allocation for 2013/14 was R3 547 billion.

The socio-economic impact of the electrification programme was significant in the area of job creation, where one permanent job was created for every R800 000 to R1 million spent. There had also been training, with 700 interns having been trained at Inep and at local government level. There had been community upliftment, poverty alleviation and access to basic services.

### New Build Programme

Eskom's New Build Programme was launched in 2005 with the aim of adding more than 17 000 MW to the national electricity grid by 2018. As part of the programme, Eskom has spent R20,5 billion on recommissioning three power stations that have been out of service for over 20 years: Camden, Komati and Grootvlei, all in Mpumalanga. Together, the stations can produce an estimated 3 800 MW, which equals that of a new power station.

The cost of recommissioning the retired stations is estimated at almost R100 billion less than the cost of constructing a new station, with the electricity available sooner. Camden was reopened in 2010, with work progressing on Komati and Grootvlei. All three were operational by 2013.

Two new coal power stations are under construction – the 4 800-MW Medupi Power Station near Lephalale in Limpopo and Kusile in

Mpumalanga, which is also expected to have an output of 4 800 MW.

Medupi is scheduled for full commercial operation by 2015 and Kusile by 2018, although individual units will be brought online earlier as they are completed.

### 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 as follows:

- A preliminary investigation was undertaken by the Council for Scientific and Industrial Research for the then Department of Minerals and Energy to ascertain whether South Africa had potential capturable CO<sub>2</sub> sources and storage sites. The results of that investigation, released in 2004, showed that South Africa had capturable emissions and potential storage sites. Preliminary investigation identified that the synfuel industry in South Africa produced 30 Mt per year of 95% concentration CO<sub>2</sub>.
- 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 developed to locate a storage site suitable for a test injection. Pre-atlas knowledge had identified four possible CO<sub>2</sub> geological storage basins:
  - Orange Basin (offshore of the west coast)
  - Outeniqua Basin (offshore 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 most 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 CO<sub>2</sub> could be stored in these less favourable formations.

The Karoo Basin is the closest to the current major sources of CO<sub>2</sub> emissions.

- The CO<sub>2</sub> Test Injection Experiment of safely injecting CO<sub>2</sub> into South African reservoirs is essential to understanding the suitability of the local geology as a storage medium. It is also necessary to ascertain the dispersion and transformation reactions of CO<sub>2</sub> in the storage medium and its 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 form an essential link between feasibility trials and a full-scale commercial plant. This phase will demonstrate the safe injection of CO<sub>2</sub> into South African geological formations. The magnitude of the demonstration plant is in the order of hundreds of thousands of tons of CO<sub>2</sub> per year.
- If positive outcomes of the demonstration plant ensue, a full-scale commercial plant is envisaged. This phase will depend on the outputs of the previous phases.

### Working for Energy Programme

The Working for Energy Programme is a social programme mainly intended to provide energy services derived from renewable resources to rural and urban low-income houses. In this manner it facilitates job creation, skills development, community-based enterprise development and the emancipation of youth, women and people with disabilities. It thereby creating sustainable livelihoods. It is an integral part of the Expanded Public Works Programme.

The programme was conceived in 2008/09 and transferred by the DoE to Saneri.

The major focus area is the provision of sustainable energy solutions (supply side) with special emphasis on the youth, women and people with disabilities in rural areas and low-income urban communities in terms of:

- labour-intensive options, targeting short-term employment opportunities
- sustainable employment opportunities, and enhancing stimulated local economic activity
- community development initiatives and cross-cutting human capital development.

### Designated National Authority (DNA) for Clean Development Mechanism

The DoE is mandated to regulate and promote the implementation of a CDM in South Africa.

This is done to make sure that South Africa complies with its obligations under the Kyoto Protocol and the UN Framework Convention on Climate Change.

As custodian of the CDM, the DNA is responsible for ensuring that CDM investments are in line with sustainable development objectives and that South Africa benefits from the CDM.

By November 2013, 347 CDM projects had been submitted to the DNA – 209 Project Idea Notes (PINs) and 138 Project Design Documents (PDDs). Out of 138 PDDs, 80 were registered (27 PoAs) by the CDM Executive Board as CDM projects (12 issued with CERs), and 58 were at different stages of the project cycle – DNA approval, validation stage and/or request for review. The projects submitted to the DNA for initial review and approval cover the following types: biofuels; energy efficiency; waste management; cogeneration; fuel switching and hydropower, and cover sectors like manufacturing, mining, agriculture, energy, waste management, housing, transport and residential.

At its 73rd meeting in May 2013, the CDM Executive Board adopted the SAPP Grid Emission Factor as a standardised baseline for the SAPP. This implies that all the member countries listed in the report will from now on use only one value as the emission factor as outlined in the report.

As part of addressing some of the identified challenges to CDM Development in South Africa, the DNA hosted a waste-to-energy workshop in July 2013. The aim of the workshop was to discuss and provide capacity-building to municipalities with respect to the interpretation of the Municipal Finance Management Act and any other related legislature that ought to be taken into account when implementing waste-to-energy projects from inception to implementation including monitoring and evaluation.

### Liquid Fuels Roadmap

As a result of identified constraints throughout the liquid-fuels supply chain, the DoE embarked on a process to develop a liquid-fuels infrastructure roadmap. A key objective of this roadmap is to ensure that South Africa has access to reliable, affordable, clean, sufficient and sustainable sources of energy to meet the country's liquid fuel demand.

### The 20-Year Liquid Fuels Infrastructure Plan

The 20-Year Liquid Fuels Infrastructure Plan will form the basis for the implementation of the Presidential Infrastructure Coordinating Commission Strategic Implementation Project

regarding refinery upgrades and development, and will make recommendations on the future of the refinery infrastructure in the country.

As a further response to the global situation and domestic development imperatives, the department decided to strengthen the Strategic Fuels Fund (SFF), a subsidiary of the CEF. The DoE will position the SFF to improve the country's strategic petroleum reserves and enable the country to better respond to catastrophic global events that impact on the petroleum trade.

### Renewable energy programmes from Eskom

Eskom 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 commercially viable. The two most advanced areas under investigation are wind-generated and concentrated solar thermal power.

Eskom's renewable energy journey has been affected by several factors, including the changing nature of power generation, environmental concerns and procuring loans that will fund solar and wind-electricity generation.

### Sere Wind Farm

Eskom has awarded technology group Siemens the contract to supply 46 wind turbines to its 100 MW Sere wind farm project being developed on a 3 700-ha site near Vredendal in the Western Cape. The R2,4-billion renewable-energy project was scheduled to begin feeding electricity into the grid by the first half of 2014.

The turbine contract comprises about 65% of the project's total capital expenditure, with the other main contract being for the supply, installation and commissioning of a 132-kV transmission line and a substation close to the project site.

Sere is receiving some of its funding from the World Bank's US\$3,75-billion Eskom Investment Support Project, approved in 2010 primarily to support the Medupi coal-fired power station. Additional funding was secured from the African Development Bank (AfDB), the French development agency, Agence Française de Développement (AFD), and the Clean Technology Fund.

In total, the World Bank component comprises 32,4% of the overall funding plan for Sere, situated about 300 km north of Cape Town. The AFD component, meanwhile, is 36,7%, while the

AfDB component comprises 26,8%. Eskom is carrying the development costs.

Each turbine has a height of 115 m, a rotor diameter of 108 m and a power output of 2,3 MW.

The turbine order was the second for Siemens in South Africa, with the first having been awarded by the developers of the 138-MW Jeffreys Bay wind farm.

The Eastern Cape wind project secured a power purchase agreement following the first bidding round under South Africa's Renewable Energy Independent Power Producer Procurement Programme.

Mainstream Renewable Power, Globelec, Thebe Investments, Enzani and Usizo constructed the project.

### Ingula Pumped Storage Scheme

The Ingula Pumped Storage Scheme near Van Reenen in KwaZulu-Natal, consists of an upper and a lower dam; both with the capacity to hold about 22 million cubic metres of water capacity.

The dams, 4,6 km apart, are connected by underground waterways, through an underground powerhouse accommodating 4 x 333-MW pump turbines.

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 came on line during 2013/14.

### Underground coal gassification

Eskom also has an underground coal gassification project in the pilot stage, with a test plant next to Majuba Power Station in Mpumalanga. The gas produced is co-fired with coal in Majuba's Unit Four, and contributes 3 MW to the station's output.

The process entails using coal seams that cannot be mined for various reasons – they may be too deep, fractured, or of poor quality – and turns the coal into clean gas on site. With the region's substantial coal reserves, there is potential in this source of power. Eskom has developed a 10-year transmission development plan which includes renewable energy integration.

### Concentrated solar power

A solar park is a concentrated zone of solar plants that are built in clusters, sharing common transmission and infrastructure. Together, these clusters generate thousands of megawatts of electricity. The types of technology used are solar PV and concentrated PV, which operate with semiconductors and solar panels, as well

as concentrated solar power, which uses mirrors to reflect the sun's rays.

PV systems make a direct conversion into electricity, and are ideal to use at peak load times. However, there is no cost-effective way to store this power.

Concentrated solar power, on the other hand, captures the sun as heat and turns it into steam to power turbines, which in turn generate electricity – much like coal-fired plants. Its advantage is that it is cheap and efficient to store heat, so power can be supplied around the clock.

### International cooperation

In March 2013, Denmark committed to help South Africa meet its future goals of having a low-carbon economy and reducing the growth of GHGs by deploying low-carbon technologies.

An agreement signed between the two governments will see Denmark providing financial support to South Africa to invest in wind-based electricity generations while the Danish will also give technical support to Eskom to integrate renewable energy into the electricity supply.

Danish International Development Assistance will make available an interim grant of DKK40 million to South Africa. Some of the money will be used to further develop the WASA for the country to pursue and invest in wind-based electricity as opposed to power obtained from fossil fuels.

In October 2012, the government of Denmark launched a new strategy for South Africa aimed at improving relations between the two countries.

In October 2013, Eskom and Agence Française de Développement (AFD) signed a R1,3 billion loan agreement.

The loan will go towards funding the 50-MW CSP plant near Upington, Northern Cape.

The CSP project is expected to deliver an annual energy production of 525 GWh and will be sufficient to power 200 000 homes.

CSP comprises technologies that concentrate the sun's energy through large mirrors and utilise that concentrated thermal energy to produce steam to drive a conventional steam turbine for electricity generation. The technologies are similar to conventional power plants in that steam is used to power a turbine and generator, but the fossil fuel combustion is replaced with free, non-polluting solar energy.

### Sustainable development in Africa

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 hydro-electric energy obtained from the Inga

rapids site in the DRC to ensure the security of supply in the SADC.

The participating utilities are those of Angola, Botswana, the DRC, Namibia and South Africa. 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 Angola, Botswana, the DRC, Namibia and South Africa. Westcor will tap into some of the potential in the DRC. Inga III, a 3 500-MW hydro plant on the Congo River, will be the first of these projects.

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).

### Energy and the global environment

South Africa is among the top 20 emitters of GHGs in the world and the largest emitter in Africa, largely because of the economy's dependence on fossil fuels. It emits more than 400 Mt of CO<sub>2</sub> 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 Minister of Energy addressed the sixth Annual Bloomberg New Energy Finance (BNEF) 2013 Summit held in New York City as part of a working visit to the United States, in April 2013. The summit is a leading discussion forum for decision-makers in the clean energy sector. The BNEF is an invitation-only forum providing a platform for engagement at the intersection of energy markets, industry, finance and policy.

The DoE 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.

The South African economy depends greatly on fossil fuels for energy generation and consumption, and is therefore, a significant emitter due to relatively high values being derived from emission intensity and emissions per capita.

Therefore, South Africa is proactively moving the economy towards becoming less carbon-intensive, with the DoE playing a prominent role. The department has introduced systems to access investment through the CDM of the Kyoto Protocol. It 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.

The Grand I MoU signed with the DRC is an important milestone in working towards sustainable African partnerships aimed at developing strategies for low-carbon economies and interconnected energy systems.

The Tete-Maputo Power Transmission Line, also known as the Centre-South Project (Cesul), in Mozambique, will improve the ability to evacuate power from the projects in the northern Mozambique complex, particularly releasing the hydropower potential relating to Mpanda Nkuwa and Cahora Bassa.

The South African Renewables Initiative secures international financing partnerships in investment in deploying renewable energy; and develops renewable supply chains through securing a critical mass of renewable energy, without imposing undue burden on the fiscus or the South African consumer.

In line with this objective, the DoE has signed a Declaration of Intent with Germany, the United Kingdom, Denmark, Norway and the European Investment Bank. This agreement will lead to the establishment of a fund to assist in the deployment of renewable energy.

Further, the department participates in structures such as the:

- International Renewable Energy Agency
- International Energy Forum
- International Partnership for Energy Efficiency Cooperation
- UN Industrial Development Organisation
- Clean Energy Ministerial
- African Union-European Union Energy Partnership.

### 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 has risen 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, due 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, Lesotho, Namibia and Swaziland.

At bilateral level, the DoE signed seven agreements/declarations of intent with Denmark, the DRC, Ghana, the International Energy Agency, Korea, Lesotho and the Swiss Confederation. These agreements cover access to capacity-building, funding, technology, exchange of information and the development of energy infrastructure on the continent, with the objective of increasing generation capacity.

