

SOUTH AFRICA YEARBOOK 2017/18

Energy



The Department of Energy (DoE) is mandated to ensure the secure and sustainable provision of energy for socio-economic development. This is achieved by developing an Integrated Energy Plan (IEP), regulating the energy industries, and promoting investment in accordance with the integrated resource plan.

The department's strategic goals are to:

- ensure that energy supply is secure and demand is well managed
- facilitate an efficient, competitive and responsive energy infrastructure network
- ensure that there is improved energy regulation and competition
- ensure that there is an efficient and diverse energy mix for universal access within a transformed energy sector
- ensure that environmental assets and natural resources are protected and continually enhanced by cleaner energy technologies
- implement policies that adapt to and mitigate the effects of climate change
- implement good corporate governance for effective and efficient service delivery.

The 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 emissions.

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

South Africa has committed to attain substantial reductions in carbon dioxide 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:
- The National Nuclear Regulator (NNR) Act, 1999 (Act 47 of 1999).
 - The National Radioactive Waste Disposal Institute Act, 2008 (Act 53 of 2008).
 - The Petroleum Pipelines Act, 2003 (Act 60 of 2003).
 - The Petroleum Pipelines Levies Act, 2004 (Act 28 of 2004).
 - The Gas Act, 2001 (Act 48 of 2001).
 - The Gas Regulator Levies Act, 2002 (Act 75 of 2002).
 - The National Energy Regulator Act, 2004 (Act 40 of 2004).
 - The Electricity Act, 1987 (Act 41 of 1987), as amended.
 - The National Environmental Management Act, 1999 (Act 107 of 1999).
 - The Mineral and Petroleum Resources Development Act (MPRDA), 2002 (Act 28 of 2002).
 - The Electricity Regulation Amendment Act, 2007 (Act 28 of 2007).
- In 2016, the DoE submitted the following legislation as well as amendments to existing legislation for consideration by parliament. It was either to be introduced or concluded in the upcoming financial year.
- Amendment of the National Energy Regulation Act: A new proposed structure will create a two-tier energy regulatory structure, to enable the appeal of regulatory decisions through a body that is not conflicted by having participated in making the regulatory decision in the first instance. The Review Board will create such a body.
 - Gas Amendment Bill: The Bill will largely introduce a mechanism that allows the Minister of Energy to direct the development of new gas infrastructure, including pipelines, storage and regasification technology for imported liquefied natural gas. The Bill will encompass the midstream elements of the gas value chain, whereas the upstream will be covered under amendments to the MPRDA of 2002. The plan involves separating from the mineral regulatory framework those elements that relate to the petroleum value chain.
 - Upstream Gas Bill: The Gas Amendment Upstream elements of the gas value chain, including the exploration and concessioning of conventional and unconventional gas will fall under the purview of the Upstream Gas Bill, the legislation which will be derived from the MPRDA of 2002 separation process.
 - Petroleum Agency of South Africa Establishment Bill: Seeks to establish the upstream gas regulator separately from its incumbent CEF state-owned company location. This will conclude the regulatory and institutional arrangements that are necessary to facilitate the concessioning, licensing and exploitation of the shale gas resource that offers so much potential for South Africa.
 - The Petroleum Products Amendment Bill seeks to improve

the enforcement elements in the licensing framework for wholesalers and retailers in the liquid fuels sector.

- IPP Office Establishment Bill: The IPP Office Establishment Bill will formally create the IPP Office and define its role and mandate in regard to private-public sector programmes in the power sector.

Budget and funding

The department's budget allocation for the 2017/18 financial year was R8.1 billion.

Role players

National Energy Regulator of South Africa

NERSA was established in terms of Section 3 of the National Energy Regulator Act of 2004. NERSA's mandate is to regulate the electricity, piped-gas and petroleum pipelines industries in terms of the Electricity Regulation Act of 2006, the Gas Act of 2001 and the Petroleum Pipelines Act of 2003.

Revenue is generated from levies paid by the regulated industries. All costs of NERSA are shared between the electricity, piped-gas and petroleum pipelines industries using a ringfencing methodology.

NERSA has formulated the following five strategic outcome-oriented goals to support sustainable socio-economic development in South Africa:

- facilitate investment in infrastructure in the energy industry
- promote competitive and efficient functioning of the energy industry
- facilitate affordability and accessibility in the energy industry to balance the socio-economic interests of all stakeholders
- facilitate security of supply of energy resources
- position and establish NERSA as a credible and reliable regulator to create regulatory certainty.

NERSA's total budget for 2016/17 was R295,4 million.

National Nuclear Regulator

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

Nuclear Energy Corporation of South Africa

The Nuclear Energy Act of 1999 provides for the establishment of the South African Nuclear Energy Corporation (Necsa) and defines its functions, powers, financial and operational accountabilities, governance and management.

Necsa is a wholly SOE reporting to the National Department of Energy.

Necsa is mandated to conduct R&D in nuclear energy and radiation sciences, acquire and process nuclear materials, perform decommissioning and decontamination as well as manage radioactive waste. On behalf of the South African government, Necsa discharges South Africa's international nuclear obligations such as the Nuclear Non-Proliferation Treaty and the Comprehensive Safeguards Agreement under the auspices of the International Atomic Energy Agency.

Necsa undertakes the commercialisation of nuclear related products and services while cooperating with other institutions, locally and abroad. The company's Pelchem subsidiary produces fluorochemicals while, NTP Radioisotopes markets a range of medical and industrial radiochemicals. Through its NTP subsidiary, the corporation contributes to the national health priority as its medical radioisotopes are used to diagnose diseases such as cancer.

Ongoing research focuses mainly on applications in radiopharmaceuticals, waste management, neutron beamlines as well as uranium and fluorine chemistry.

The centrepiece of Necsa's Pelindaba facility in the scenic landscape of the Magieliesberg is the SAFARI-1 research reactor. Since 1965 this reactor has been the premier nuclear research installation in Africa welcoming researchers from all over the world. In addition, it is intensively used for providing irradiation services in the production of medical radioisotopes.

- 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 is responsible for research on nuclear energy and radiation science, the development and innovation of nuclear-related products in South Africa, and the execution of nuclear fuel cycle activities. Subsidiaries include Pelchem and Nuclear Technology Products (NTP) Radioisotopes.

Necsa's main function is to serve as the anchor for nuclear energy research and development, as well as 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
- providing 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.

The corporation contributes to the health component of the NDP's priorities through NTP Radioisotopes, which produces medical radioisotopes, some of which are used in South Africa's health system for diagnostic studies and cancer treatments. This accounts for the largest proportion of spending within the corporation, with the radiation products and services programme expected to grow from R1,2 billion in 2015/16 to R1,5 billion in 2018/19 at an average annual rate of 7%. This will allow the SAFARI-1 reactor to be operationally available for 287 days per year, and will allow the corporation to maintain performance

safeguards and radiation doses within acceptable limits.

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.

International Nuclear Cooperation

South Africa has been a member of the International Atomic Energy Agency (IAEA) and permanent member of its Board of Governors for decades and has been both a recipient and provider of services emanating from the agency. Through its active participation in nuclear energy, safety, technology, security and disarmament, South Africa has contributed to efforts of ensuring that nuclear energy is used only for peaceful purposes like power generation as well as medical, industrial and agricultural initiatives. [CONTRIBUTOR]

National Radioactive Waste Disposal Institute (NRWDI)

The National Radioactive Waste Disposal Institute Act of 2008 provides for the establishment of the NRWDI to manage radioactive waste disposal on a national basis.

In addition to radioactive waste management and disposal, one of the NRWDI's major activities is to plan, design, construct, operate, manage and monitor any new radioactive waste disposal facilities.

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.

Operations includes:

- undertaking measures to promote energy efficiency throughout the economy

- ensuring uninterrupted supply of energy to the country
 - promoting diversity of supply of energy sources
 - facilitating effective management of energy demand and its conservation
 - promoting energy research
 - promoting appropriate standards and specifications for the equipment, system and processes used to produce, consume and supply energy
 - providing for certain safety, health and environmental matters that pertain to energy
 - facilitating energy access to improve the quality of life of the South African people
 - commercialising energy-related technologies
 - ensuring effective planning of energy, supply, transportation and consumption, and contributing to the sustainability of development of the South African economy.
- Sanedi's total budget for 2016/17 was R191,2 million.

Central Energy Fund

The CEF is listed in the Public Finance Management Act, 1999 (Act 1 of 1999) and is governed by the CEF Act of 1977 and and the Companies Act, 2008 (Act 71 Of 2008). Its mandate is to research, finance, develop and exploit appropriate energy solutions across the spectrum of energy sources to meet South Africa's future energy needs.

Through its eight operating subsidiaries, the fund is also mandated to finance and promote the acquisition of coal; exploit coal deposits; manufacture liquid fuel, oil and other products from coal; and market these products. It is also mandated to acquire, generate, manufacture, market, distribute or research any other form of energy.

The CEF's subsidiaries are: the Petroleum Oil and Gas Corporation of South Africa, the South African Gas Development Company, the Petroleum Agency of South Africa, Oil Pollution Control South Africa, the Strategic Fuel Fund Association, African Exploration, ETA Energy and CCE Solutions.

In line with the Presidential Review Commission on SOEs, the CEF has been working towards the review of the composition of the CEF Group of companies. Work in this area includes the strengthening of the entities in the oil and

gas sector and the stated policy objective of the creation of a stand-alone National Oil Company, using PetroSA as a nucleus. This was expected to be finalised by October 2016.

The fund's Vision 2025 strategy was completed in 2014 with the aim of restructuring the organisation.

The stabilisation phase included the following, among other things:

- PetroSA's turnaround project, which aims to steady its financial and operating environment
- tank refurbishment at Milnerton and Saldanha to enable the Strategic Fuel Fund to increase the storage of crude oil in line with Government policy
- the consideration of a gas to power project to divert tail gas to Eskom's Gourikwa power station
- and a condensate project (a process of extracting raw gas and turning it into a liquid state), which seeks to address feedstock challenges.

The lead phase seeks to achieve the long-term objective of making the fund a market leader in the security of energy supply, and to generate investment income from the refinery, gas infrastructure and renewable energy projects.

In particular, the Strategic Fuel Fund, the Petroleum Agency South Africa (PASA), iGas and PetroSA will be involved in increasing storage capacities, holding increased volumes of strategic stocks, and distributing petroleum products.

iGas will be positioned to become an active infrastructure partner for increased gas supply into South Africa, as market indications showed that global demand for gas would grow at about 2,5% per year until 2018. The CEF also aims to comply with the ministerial directive of maintaining 10,3 million barrels of crude oil per year, and to supply the South African market with 4,8 million barrels of liquid fuel per year over the medium term, made possible by the increased coal production at Vlakfontein in Mpumalanga.

Integrated energy centres (IECs)

The DoE, in collaboration with oil companies, have since 2002 been establishing the IECs in poverty nodal areas around the country as part of its mandate to promote access to energy services, such as petroleum products in rural areas where the

volumes of sales are too low for a normal commercial operation to be established.

An IEC is a one-stop energy shop owned and operated by a community co-operative and organised as a community project.

The objectives of the IEC Programme are to:

- provide access to safe and affordable energy resources to poor households
- provide information regarding the safe, efficient and environmentally sustainable use of energy sources and available energy options such as renewable and non-grid energy
- provide information on how to handle and use energy resources, including illuminating paraffin and LPGas
- enable a strong social responsibility aimed at poverty alleviation, job creation and capacity-building
- stimulate the rural economy.

To date there are nine operational IECs across four provinces: The Eastern Cape, Limpopo, KwaZulu-Natal, North West and the Northern Cape.

The DoE has aligned the IEC programme to the Comprehensive Rural Development Programme, which is aimed at improving socio-economic conditions of rural communities.

Sasol

Sasol is a leader in various energy fields, including the Sasol Slurry Phase Distillate Process (SPD process). Through this process, natural gas is transformed into energy and chemical products, including transport fuels, base oils, waxes, paraffin and naphtha.

Sasol 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.

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, Mpumalanga.

Eskom

Eskom began its journey of contributing to the growth and development of the people of South Africa and the country's economy over 90 years ago. Today, the company generates 95% of the electricity used in the country and approximately 45% of electricity in Africa.

More than five million household within Eskom's licensed areas of supply have been electrified since 1990.

Eskom generates approximately 90% of the electricity used in South Africa. The balance is produced by independent power producers and municipalities. Eskom directly provides electricity to about 45% of all end-users in South Africa. The other 55% is resold by redistributors, including municipalities.

Eskom generates, transmits and distributes electricity to about 5,6 million customers in the industrial, mining, commercial, agricultural and residential sectors, and to redistributors.

Eskom sells electricity directly to about 3 000 industrial customers, 1 000 mining customers, 50 000 commercial customers, 82 000 agricultural customers and more than 5,5 million residential customers (of whom the majority are

prepaid customers). Most of the sales are in South Africa, with other southern African countries accounting for a small percentage.

The power utility is also building new power stations and high-voltage power lines to meet South Africa's growing energy demand. The capacity expansion programme is expected to be completed in 2022.

Recent successes have been the commercialisation of Unit 6 of the Medupi Power Station, which was commissioned in August 2015, adding nominal capacity of 720 MW to the national grid. All the units at the new Ingula pumped storage scheme, totalling 1 332 MW, have been synchronised to the grid.

Eskom maintains approximately 377 287 km of power lines and substations with a cumulative capacity of about 244 637 MVA.

Job creation, social development

Eskom contributes to job creation, skills development, transformation and broad-based black economic empowerment in support of the National Development Plan. The company is involved in stimulating the small and medium enterprise sector, particularly black-owned, black-women-owned and black-youth-owned companies through the creation of opportunities for entrepreneurs to become suppliers or contractors for Eskom and other industries.

The company supports socio-economic programmes by targeting communities where Eskom operates. It continues to address specific development needs, including enterprise development in the economic sector, education, health care, energy and environment, rural school infrastructure development, and welfare in the social sector. This is done through initiatives such as:

In an effort to boost enterprise development, the Eskom Development Foundation has been running the annual Eskom Business Investment Competition (BIC) since 2008. The BIC provides a great platform for South African owners of SMEs to become part of a community of like-minded entrepreneurs as they look to build on their businesses' solid foundation and realise their true potential.

Simama Ranta School Entrepreneurship Education

Competition

“Simama Ranta” means empowering the South African economy through entrepreneurship education. The competition aims to identify, honour and showcase those South African secondary schools that are exemplars in entrepreneurship education.

The competition encourages learners to consider entrepreneurship as a career choice, taking charge of their career path by becoming job creators rather than job seekers. It is managed by Education With Enterprise Trust (EWET) – a non-profit organisation that has devoted their knowledge, skills and talent to enhance enterprise education in high schools over a number of years. They work in over 800 schools throughout South Africa, empowering educators to promote entrepreneurship and enhance teaching and learning in economic and management sciences.

In addition, the Eskom Contractors’ Academy trains emerging and suppliers on fundamental business skills over an month period. This is in support of government’s initiative to create jobs, develop skills alleviate poverty. Students are trained in finance, project management, safety, and people management. The programme is run in all provinces but the focus are is around Eskom’s new build sites.

The initiative has resulted in R2,3 billion worth of contracts being awarded to contractors who graduated from the academy in a period of five years, between 2010 and 2015. In 2017, 150 prospective entrepreneurs graduated from the academy.

Eskom also gives priority to rural infrastructure and food security aimed at addressing inadequate infrastructure by contributing to the building of schools, the renovation and construction of multipurpose centres, the construction of access roads and food markets among others.

The Eskom Development Foundation runs four mobile health clinics that provide health care to approximately 15 000 rural school children per year.

Eskom is making significant strides in promoting maths and science fields and making them exciting and popular among learners. In this regards, 55 353 learners and teachers benefited from the company’s maths and science programmes. Furthermore, through the Eskom Expo for young scientists, R4

million worth of prizes, including bursaries were awarded to learners at the International Science Fair (IFS) held in October 2017.

Through its vertically integrated business model of generation, transmission and distribution, Eskom significantly plays a role as an employer, job creator and skills developer. The company provides direct employment to over 47 000 employees. The company also created an enabling environment for further 39 277 job opportunities through its capacity expansion programme at Medupi, Kusile and Ingula new build sites and power delivery projects as at end of March 2017.

Environment

While coal will always be part of the Eskom energy mix, the company is active in the global efforts to identify and mitigate the impact of climate change. The company is committed to use cleaner ways with less environmental impact when burning coal. It prioritises reducing its carbon print and greenhouse gas emissions. The company is also implementing pioneering technologies to generate electricity using cleaner coal technology.

Southern African Power Pool (SAPP)

The SAPP allows the free trading of electricity between Southern African Development Community (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 the 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.

To meet the country’s future energy requirements, Government is implementing an energy mix which comprises coal, solar, wind, hydro, gas and nuclear energy. In future, biomass, wind power, solar power and hydro-power will contribute 11,4 GW of renewable energy to the grid.

Biomass for energy is restricted due to water availability in South Africa, but energy from waste, using the estimated 60 million m³ to 70 million m³ of waste generated annually, is more readily available and exploitable.

The DoE is developing a gas utilisation master plan, which will take a 30-year view of the gas industry from a regulatory, economic and social perspective.

The integrated resource plan targets new gas-fired power generation capacity, plus the supply of gas for converting gas to liquid petroleum products at the plant of the state-owned company, the Mossel Bay Petroleum Oil and Gas Corporation of South Africa.

The department has designed a programme to procure 3 126 MW of electricity produced from gas from selected providers, and a request for information for gas to electricity was expected to be released by the end of April 2016.

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.
- 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.

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 a multi-product pipeline, which was funded under the DoE through Transnet, was completed. The 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).

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 DoE 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.

The IRP's development and update processes aim to balance security of supply, cost of electricity, job creation and localisation, minimal negative environmental impact, minimal water usage, to diversity of supply sources (energy mix) and promotion of energy access.

Against these objectives, the DoE set four key milestones:

- settling the key assumptions
- developing a base-case
- modelling and analysing the scenarios and sensitivities
- developing the final plan taking into account the various scenarios and policy positions.

The first and second milestones have been completed and are the basis of the planned public consultation process. The third milestone, which involves testing various scenarios and sensitivities was implemented in 2016/17, and the fourth milestone that relates to policy adjustment will follow once public consultations and scenario analysis are done.

Alternative gas resources

Experiments are underway to assess the potential for mining coal-bed methane gas.

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.

Since the publication of draft regulations on shale gas development, substantive inputs have been received from interested and affected stakeholders.

The Department of Mineral Resources first halted new applications for exploration rights in 2011 to investigate the impact that the process would have on the environment, and an interdepartmental task team was set up to head this process.

Government is clear that shale gas will form a part of the energy mix going forward.

Following the gazetting of Regulations for Petroleum

Exploration and Production, the Department of Mineral Resources has instituted research on shale gas. Research will be carried out with the objective to enhance current knowledge on shale gas as well as identify other unknown shale gas occurrences.

The sensitive nature of the process, possible negative environmental impacts associated with the process and lack of information and knowledge on technical aspects of the hydraulic fracturing process in South Africa will be taken into consideration.

This plan will see the Department of Mineral Resources in partnership with its SOEs, namely the Council for Geoscience (CGS) and the PASA undertaking a research programme on petroleum exploration and exploitation of shale gas resources during the MTEF period.

A shale gas workshop was held with both the CGS and PASA to finalise a shale gas development plan considering the budget allocation sitting under the Department of Mineral Resources and the CGS. In implementing the plan, PASA hosted a training session on the Development of Unconventional Gas and Gas to Liquids Projects course offered by a leading international trainer in January 2016.

The Department of Mineral Resources, together with the two institutions, underwent a visit to Canada to formalise bilateral cooperation in the area of shale gas development, since Canada is a well-established authority on this area.

The research element of the plan is still ongoing and on track with a water-sampling process being undertaken. The Department of Mineral Resources also held a shale gas imbizo with the community of Cradock as well as a business session in Cape Town in January 2016.

The Department of Mineral Resources, in conjunction with the Government Communication and Information System and other stakeholders, will conduct a communication and marketing campaign planned for 2017 to generate and popularise awareness of shale gas and hydraulic fracturing.

The strategic aim is to inform, educate and create an understanding among South Africans of the potential of the energy resource to contribute to realising the objectives of the NDP, as well as the Nine-Point Plan aimed at growing an

inclusive economy.

Electricity

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.

The DoE has procured private peaker stations to the capacity of nearly 1 000 MW that can be used when there is a larger demand than what the Eskom generators can produce. The Avon plant in Eastern Cape was completed in September 2015 and can produce 330 MW. The Dedisa plant in KwaZulu-Natal, when completed by the end of 2016, will produce 630 MW. Total projects costs were R8 billion, while 210 permanent jobs and 6 190 temporary jobs were created at both plants.

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.

About 77% of South Africa's primary energy needs are provided by coal. 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. As a result of new entrants, operating collieries increased to 64

during 2004. Of these, a relatively small number of large-scale producers supply coal primarily to electricity and synthetic fuel producers.

About 51% of South African coal mining is done underground and about 49% is produced by open-cast methods. The coal-mining industry is highly concentrated, with five companies accounting for 85% saleable coal production.

These companies are:

- Ingwe Collieries Limited, a BHP Billiton subsidiary
- Anglo Coal
- Sasol
- Eyesizwe
- Kumba Resources Limited, accounting for 85% of the 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.

By international standards, South Africa's coal deposits are relatively shallow with thick seams, which make them easier and, usually, cheaper to mine. At the present production rate, there should be more than 50 years of coal supply left.

The DoE was expected to announce the preferred bidders from the first bid submission for domestic coal projects in July

In April 2017, a R2,4-billion programme for the electrification of 119 informal settlements across Ekurhuleni was announced, with over 16 000 households to be completed by the end of 2016/17.

The five-year programme started in the informal settlements located on state-owned land, while legalities to roll out the programme in privately owned informal settlements is being reviewed.

To date, 9 943 households have been electrified in informal settlements such as Langaville, Inxhweni, Marikana, Winnie Mandela and Ekurhuleni.

The installation of streetlights is currently being rolled out with 2 263 streetlights of the targeted 3 000 and 156 of the targeted 400 high mast lights already installed.

2016. Bids with a combined capacity of 900 MW were received and evaluated. The projected investment commitment from these coal projects is in the region of R45 billion, and will be rolled out over the next four years.

An additional 3 750 MW of power will be generated using coal technology, through cross border projects that will augment the local coal IPP procurement programme. The rationale behind the cross-border coal programme is that it facilitates the construction of the transmission interconnectors between South Africa and its neighbours. Transmission interconnectors are critical if the country is to import power from the hydropower projects in the DRC, the Grand Inga, and in Zambia and Mozambique such as Cahora Bassa North Bank and Mpanda Nkuwa.

This also gives the respective transit countries the necessary comfort that the interconnections are in their national interest and not just for the benefit of South Africa.

Renewable and alternative fuels

South Africa's National Development Plan has stressed the importance of a greater mix of energy sources and a greater diversity of IPPs in South Africa's energy mix.

This has been made a reality through the DoE's Renewable Independent Power Producer Programme (REIPP).

The renewables programme, which is seen as an example for other African countries, has resulted in over 6 000 MW of generation capacity being allocated to bidders across a variety of technologies, principally in wind and solar.

In November 2016, Eskom said it had spent approximately R9,5 billion in IPP renewable energy, while some 2 000 MW is already connected to the grid.

REIPP is aimed at bringing additional megawatts onto the country's electricity system through private sector investment in wind, biomass and small hydro, among others.

The Eastern Cape's renewable energy projects has created 18 132 jobs since its inception. The province was awarded 16 wind farms and one solar energy farm, with a total investment value of R33,7 billion.

The province has been able to reduce loadshedding because it received an additional boost for its energy security when the R3,5 billion, 342 MW DEDISA peaking power station achieved commercial operation in October 2015.

On renewable energy such as solar and wind, the DoE has procured over 3 900 MW of renewable energy with about 1 000 MW already in operation and 1 400 MW planned to come online during 2016.

Work is underway to procure the remaining megawatts in line with the IRP 2010. About 2 500 MW has been allocated for coal programme procurement from IPPs.

Work on the Grand Inga Project to secure 2 500 MW is continuing, while an energy agreement between South Africa and the DRC has been signed.

The agreement, which was signed in September 2014, provides a legal framework for cooperation between the two countries.

Biofuel

The South African Cabinet approved the national Biofuels Industrial Strategy in December 2007. The regulations for mandatory blending of biofuels with petrol and diesel were promulgated in August 2012 and came into effect in October 2016.

The Biofuels Regulatory Framework was submitted to Cabinet during 2016. It outlined how the nascent biofuels industry will be financially supported and how the projects would be selected and supported.

The blending of biofuels reduces the impact of fuel emissions. In addition, the benefits arising from biofuels include:

- the potential for a biofuels manufacturing industry to create a captive market for the agricultural sector, especially for new black or small farmers
- the opportunity of a biofuels industry to create jobs in rural areas
- the reduction in imports of refined liquid transport fuel, which is good for the country's balance of payments savings.

The production of 460 million litres of biofuels can create 15 000 new permanent direct jobs in the biofuels manufacturing plants and agriculture; plus over 3 000 temporary jobs during the 24 months of construction.

A 460 million litres a year, the biofuels industry can immediately improve the country's annual balance of payments by over R2,5 billion at the current crude oil prices and exchange rate.

The Department of Agriculture, Forestry and Fisheries played a key role in designing the biofuels feedstock protocol for mitigating the possible impact of biofuels production on food security. This will prevent the use of staple food crops and land currently used for these crops from being used for biofuels production other than as a result of crop rotation.

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 DRC, which could make South Africa less dependent on coal-fired power stations.

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.

Eskom is continuing resource surveys of the Agulhas Current on the east coast of South Africa and of wave energy, in partnership with the DEA and the Bayworld Centre for Research and Education.

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

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

South Africa boasts one of the best solar regimes in the world. Most areas in the country average more than 2 500 hours of sunshine per year, and average daily solar-radiation levels range between 4,5 kWh/m² and 6,5 kWh/m² in one day. The southern African region, and in fact the whole of Africa, is well endowed with sunshine all year round. The annual 24-hour global solar radiation average is about 220 W/m² for South Africa. The solar resource is the most readily accessible in South Africa. It lends itself to a number of potential uses.

In November 2014, SolarReserve, a global developer of solar power projects and solar thermal technology, announced that the 96 MW photovoltaic (PV) Jasper Solar Power Project was fully operational.

Jasper is located in the Northern Cape in a solar park that also includes the 75 MW Lesedi solar power project, which came online in May 2014.

In addition to helping South Africa meet its electricity needs, the Jasper Project will bring long-lasting economic benefits to

the region.

With over 325 000 PV modules, the Jasper Project will deliver 180 000 MW hours of renewable electricity annually for South African residents.

The power generated is enough to power up to 80 000 households through a 20-year power purchase agreement with Eskom.

The project also marked Google's first renewable energy investment in Africa – the Internet search invested US\$12 million in the solar project.

In August 2014, China-based solar PV giant, Jinko Solar, has officially opened a state-of-the-art factory in Cape Town, creating 250 jobs and producing 1 300 solar PV modules a day.

To boost renewable energy development in South Africa, the DoE, in partnership with the NERSA, aims to generate 1 500 MW from new solar technologies in a Northern Cape Solar Park.

The Solar Park will stimulate investment in new and expanding industrial and manufacturing facilities, the development of local supply chains and entrepreneurial and employment opportunities for South Africans in general and for the people of the Northern Cape in particular.

The Solar Park will be developed in a clustered fashion, sharing common infrastructure and services such as access to land, water supply, feeder lines to electricity transmission system, roads and support industries. The area has been included in one of the newly promulgated Renewable Energy Development Zones.

The Solar Water Heater Programme has been implemented in 2016/17, with contracts placed for the supply of baseline systems under the social programme.

Approximately 9 000 systems have been secured through this programme, in terms of which the local content of these products exceeds 75%.

The next step is to commence with the training of local communities in the installation of the solar water systems, with clear objectives set for skills and enterprise development, job creation and the targeting of the youth, women and other designated groups.

Another priority for the DoE is to address defective installations from the initial solar water heater rollout programme to ensure continued operation of the installed systems and service delivery to the recipients.

This corrective Solar Water Heater Programme has been identified to serve as incubator for suitably skilled and experienced solar water heater installers and installation

businesses. It provides a platform for technical training at different skills levels and an opportunity for work-based experience with respect to all aspects of solar water heater installation; from identifying installation and system defects, to repairs and doing new, replacement installations.

Targets for installing solar water heaters had not been met due to delays in finalising the implementing contract with Eskom and the local content verification outcomes projected by the South African Bureau of Standards.

The Solar Water Heater Programme will now be managed by the DoE. Spending of R1,2 billion over the medium term on 131 146 solar water heaters is projected. The budget for solar water heater service providers is in the Energy Efficiency subprogramme of the Clean Energy programme and is expected to grow at an average annual rate of 49,8% over the medium term.

Wind power

The R3-billion Jeffrey's Bay wind farm, located between the towns of Jeffreys Bay and Humansdorp in the Eastern Cape, was officially inaugurated in July 2014.

Built by a consortium led by British company Globelec, the 138 MW wind farm is one of Africa's biggest – larger than the 120 MW Ashegoda windfarm that was unveiled by Ethiopia in October 2013, though not as big as the Tarfaya wind farm in south-western Morocco, which started producing energy in April and will eventually generate up to 300 MW of electricity.

The Jeffrey's Bay wind farm, comprising sixty 80-metre high turbines spread over 3 700 hectares, will supply enough clean, renewable electricity to power more than 100 000 homes a year, helping South Africa to avoid production of 420 000 tonnes of carbon dioxide annually.

The facility was built under the Government's renewable energy programme for independent power producers, which aims to add 3 725 MW of wind, solar photovoltaic and

i In March 2017, Minister of Energy handed over and launched a number of energy projects in the Vryburg area in the North West.

- The handover the Greening Technologies to Tygerkloof Combined School, including a central water purification system, solar water heaters, a biogas digester,
- A visit to the smart grid intervention project (pilot site) in the Naledi Local Municipality to switch on the Naledi substation. The station will provide electricity to 5 000 households in the area.

concentrating solar power to South Africa's energy mix.

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.

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, 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

South Africa's vision for nuclear power is based on the Nuclear Energy Policy of 2008 that provides a framework within which the following is to take place: prospecting, milling, mining, the use of nuclear materials, and the development and use of nuclear energy for peaceful purposes.

Government has committed itself, by means of its Nuclear Energy Policy and Integrated Resource Plan, to an energy mix consisting of coal, gas, hydro, nuclear, solar and wind in order to meet the country's future electricity needs and reduce its carbon dioxide emissions. [CONTRIBUTOR]

Government remains firmly committed to an open, fair and transparent procurement process with due regard to implementing the programme at a scale and pace that South Africa can afford.

The RFP for the Nuclear New Build Programme (NNBP) of 9 600 MW was released to the market during 2016/17.

A Section 34 Ministerial Determination in terms of the National Energy Regulator Act of 2004 on the NNBP was also gazetted in December 2015.

As part of procurement preparation for the NNBP, the DoE has appointed transaction advisors to conduct an independent assessment of the RFP and other pre-procurement activities to ensure the state of readiness before testing the market.

The national electricity utility company, Eskom, operates the Koeberg Nuclear Power Station near Cape Town, the only nuclear power station in South Africa and the entire African continent, which supplies power to the national grid. By March 2018, the Koeberg Nuclear Power Station was supplying approximately 4,1% of the power (1940 MW) used in South Africa, while adding diversification to the energy mix. [Contributor]

In March 2016, Eskom, the owner and operator of the nuclear plants, as part of the regulatory process submitted a final environmental impact assessment to the Department of Environmental Affairs for approval. In addition, a nuclear installation site licence application had been submitted to the NNR for assessment.

Extensive nuclear skills development and training is taking place both in South Africa and in countries abroad to ensure that the country has a sufficient supply of skills and expertise to meet the human resource needs required by the NNBP.

By March 2017, the Koeberg Nuclear Power Station was supplying approximately 5,6% of the power (1 860 MW) used in South Africa and 50% of Western Cape's energy demand, while adding diversification to the energy mix.

According to KPMG, between 2013 and 2016, Koeberg contributed R29 billion to the GDP of the Western Cape – 1,4% of the provincial Gross Domestic Product (GDP) – and R23 billion to the rest of the South African economy.

The nuclear power station is expected to add R27 billion to the Western Cape provincial GDP and an additional R22 billion to the South African economy between 2016/17 and 2019/20.

Koeberg (and its web of suppliers and service providers) contributed R8 billion to Western Cape provincial revenue between 2012/13 and 2015/16 through direct and indirect tax collection. Koeberg contributed another R9 billion to the fiscus over the same period.

Boiling it down to household level – the coalface of poverty, inequity and unemployment – the Koeberg project added R20 billion to household income between 2012/13 and 2015/16. Some R3 billion (13%) went to low-income households in the Western Cape.

Programmes and projects

National Energy Efficiency Strategy

The National Development Plan (NDP) 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 NDP 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 NDP 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 DoE will continue to address these proposals through a combination of new and existing programmes.

Funds will continue to be allocated to the 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 DoE 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.

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.

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 South African national standards.

An excellent example of the power of energy-efficient buildings and the power-savings they can effect can be found in Bayside Mall in Cape Town.

Bayside Mall is saving 2 200 units of electricity each day due to the installation of renewable energy systems.

As part of its Going Green project, Bayside Mall harvests rainwater and generates solar electricity. Through this system, the mall is reducing the electricity it needs from Eskom by about 2 200 units each day.

The mall had reported significant cost-savings since the installation of its rooftop photovoltaic (PV) system two years ago. The mall's rooftop PV system includes 2 000 solar panels.

Bayside Mall has saved R1 million through its reduced energy savings initiatives and used around 800 000 less kilowatts of energy over the same period. These figures show that energy efficiency is the responsible and moneywise way to operate.

Integrated Energy Plan

The IEP represents the DoE's overarching energy policy and strategy statement that has been under development since 2012, when Cabinet approved the commencement of the public consultation process. The following strategies and programmes all form part of this greater scheme towards energy self-sufficiency and environmentally friendly energy resources.

Integrated Resource Plan (IRP) and the Gas Infrastructure Plan

The IRP 2010 – 2030 envisages 9 600 MW additional nuclear capacity by 2030. The IRP is a 20-year projection on electricity supply and demand. It aimed to reduce South Africa's primary reliance on fossil fuels such as coal and diesel, and diversify the

national energy mix to produce 41,8% from renewable energy sources and a further 6,1% from hydroelectricity within two decades.

The updated IRP process was to be submitted to the economic sector and infrastructure development cluster at the end of 2017.

Similarly, the Gas Infrastructure Plan will take its lead from the IEP regarding gas pipelines, storage and other infrastructure that is necessary for meeting the energy demand through gas supply.

Going forward, it is becoming more and more apparent that future energy demand will be a mix of electricity, gas and liquid fuels and, depending on the relative cost competitiveness of each of these, an equilibrium between the three will be established.

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 LPG 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.

Wind Resource Map

The DoE launched the country's first Large Scale High Resolution (250 m) Wind Resource Map in July 2013. The data is based on the Verified Numerical Wind Atlas for South Africa (WASA).

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.

The country has a reasonable wind energy resource (an average of 8 m/s measured at 80 m) is available in geographically dispersed locations, allowing for security of supply.

Renewable Energy Independent Power Producer Procurement Programme

The REIPPPP is a flagship programme of the DoE and falls under the mandate of the Electricity Regulation Act of 2006.

The DoE, National Treasury and the Development Bank of Southern Africa established the independent power producer procurement programme at the end of 2010 to secure electrical energy generated from renewable and non-renewable sources from the private sector. The programme is designed to be self-funding through revenue derived from development fees paid by bidders and investors.

By December 2015, the department had procured 6 377 MW of renewable energy through the programme and connected 44 projects with a capacity of 2 021 MW to the national grid. The energy contribution of independent power producers was expected to grow to approximately 7 000 MW with the first 47 renewable energy independent power producers fully

operational by mid-2016.

The programme also seeks to procure energy from small-scale independent power producers, with projects that generate between 1 MW and 5 MW of energy from solar, wind, biomass and landfill gas projects.

Additional funding of R200 million in the Nuclear Energy programme was made available in 2016/17 for a transactional advisors and consulting services for the new nuclear build programme. The advisors were to assist with the call for proposals for procuring nuclear energy and provide transactional advice to the department as a procuring agent for the new nuclear build programme.

Private investment in the programme currently exceeds R194 billion.

The DoE remains on track to meet its national commitment to transition to a low-carbon economy with the target of 17 800 MW of renewable energy power by 2030.

In March 2018, the DoE signed project agreements of 27 Renewable Energy Independent Power Producer Projects (REIPPP), including the power purchase agreements with Eskom. The initiative reconfirms government's commitment to renewable energy and a solid partnership with the private sector in pursuing energy transition objectives in the future. It also creates policy and regulatory certainty, and maintain South Africa's position as an energy investment destination of choice.

The agreements will also will enable R56 billion of new investment in the economy over the next two to three years. It will also have a significant contribution in job creation across the energy value chain including the re-establishment of industrial development and support to the technical training of young people to be absorbed in the labour market.

The usage of different types of energy supply, which includes renewable forms of power generation, is in line with the energy policy. It will also ensure the reduction of carbon emissions, whilst complying with the South African environmental standards.

These programmes will contribute towards competitive market pricing of electricity, both for the household consumer as well as for industrial usage. Lower electricity will assist indigent households to cope with the rising cost of living.

The projects will also provide 61 600 full time jobs of which

95% is for SA citizens, with a focus on youth employment. Northern Cape will have 59% of the jobs created, followed by Eastern Cape with 15% and North West 13% of jobs created.

The Renewable Energy Programme has empowered South Africans to own on average 48% of the equity in all of the Independent Power Producers (IPPs) projects. About 25% of the project equity is owned by foreign investors acting as a catalyst by providing investment and skills transfer to the establishment of the new green economy while enhancing opportunities for economic transformation.

The Renewable Energy Programme is embracing local community development as well as socio-economic and enterprise development. Through the geographic spread of the projects, opportunities are created across the country – mostly in rural areas.

Local community shareholding (equity share) in the 27 projects amounts to 7,1% (R1,6 billion). The local community shareholders for the 27 projects will receive R5,9 billion net dividends over the 20 year lifetime of the projects.

Communities through Community Trusts have full control over how the money will be spent in their areas. The department through the IPP Office will monitor participation by these communities and measure the impact thereof. In addition, the IPPs will enable local communities to further benefit directly from the investments attracted to the areas through the R9,8 billion to be spent on socio-economic development initiatives and R3,4 billion to enterprise development over the 20 year.

Integrated National Electrification Programme

INEP and its implementing agencies – Eskom, municipalities and non-grid service providers – have made remarkable progress in increasing access to electricity in South Africa and have connected over 6,7 million households between 1994 to March 2016.

Access to electricity was at 88% by March 2016. R5,6 billion has been appropriated by 2015/16 on the Electrification Programme, to delivering 260 000 connections using both grid and non-grid technologies.

At the end of March 2016, INEP achieved 231 012 (grid) and 25 076 (non-grid) connections. This results in 256 088 new connections as part of allocations for 2015/16. The target for May

2016 stood at 260 000 new connections.

The Non-Grid Electrification Programme has progressed well in the last financial year and has overachieved its target by achieving 25 076 connections. Since the inception of Non-Grid Electrification Programme, INEP achieved more than 123 379 installations of non-grid systems mainly in the Eastern Cape, KwaZulu-Natal, Northern Cape and Limpopo.

Non-grid systems consisting of solar cells converting sun energy into electrical energy are now also being considered for implementation in urban areas of the country with a view of increasing the basic electricity services in the informal settlements.

The European Union (EU) is also assisting the DoE to develop a sustainable delivery model and sustainable non-grid entities around the country. In addition, INEP has developed the first draft of the Electrification Master Plan to ensure better cooperation between the different implementing entities, as well as different technologies, and grid and non-grid roll-out in unserved areas, to ensure that universal access is reached by 2025/26.

The INEP programme was allocated R5,5 billion in 2016/17 to deliver 235 000 connections for both grid and non-grid. Over the MTEF, an estimated amount of R17,6 billion will be appropriated.

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. Two new coal power stations are the 4 800-MW Medupi Power Station near Lephalale in Limpopo and Kusile in Emalahleni, Mpumalanga, which is also expected to have an output of 4 800 MW.

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 (CCS) 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 mandate of SACCCS is to develop and implement

a roadmap for the commercial application of CCS in South Africa. The first and second phases of the roadmap have been completed and now the preparation for the Pilot Carbon Dioxide Storage Project (PCSP) is the focus for the centre.

SACCCS's role in the South African CCS Roadmap is as follows:

- 2004: Assessment of the potential for CCS in South Africa (completed)
- 2010: Development of a South African Carbon Dioxide Geological Storage Atlas (complete)
- 2017: Commencement of a Pilot Carbon Dioxide Storage Project storing about 10 000 t to 50 000 t carbon dioxide (underway)
- 2020: Facilitate the commencement of a CCS demonstration plant (in the order of 100 000 t carbon dioxide per year)
- 2025: Inform the implementation of commercial CCS deployment (over 1 000 000 t carbon dioxide per year).

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 youths, women and people with disabilities.

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.

The 20-Year Liquid Fuels Infrastructure Plan

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

regarding refinery upgrades and development, and 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, a subsidiary of the CEF. The DoE will position the Strategic Fuels Fund 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.

Underground coal gassification

Eskom also has an underground coal gassification project in the pilot stage, with a test plant next to the 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.

Sere Wind Farm

Eskom's Sere Wind Farm was completed in 2015 and is

delivering 100 MW to the national grid.

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 m³ 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. The synchronisation of the first two units of the Ingula pumped storage scheme was expected to take place in 2016.

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.

Skills development and job creation

The challenges of technical skills required in the Energy Sector have continued to be of concern to the DoE. In response to these challenges; the DoE has developed a Workplace Skills

Development Plan (WSP), based on the training needs of individual employees and their managers.

As part of the implementation of the WSP, a number of training and development interventions have been identified. The DoE has also offered 32 new bursaries to serving employees of the department.

In addition, the department will contribute with the implementation of youth development intervention programmes such as the provision of bursaries to external applicants. Eleven external applicants within the youth programme were offered bursaries sponsored by the Chemical Industries Education and Training Authority, including four integrated learners, 32 interns and 15 people on learnership programmes.

In preparation for the rollout the nuclear build programme, the Nuclear Skills Development and Training programme is underway with various countries including China, the Russian Federation and South Korea.

International cooperation

South Africa is a member of the International Energy Forum (IEF), which aims to foster greater mutual understanding and awareness of common energy interests among its members.

The 74 member countries of the forum are signatories to the IEF Charter, which outlines the framework of the global energy dialogue through this intergovernmental arrangement.

South Africa is a member state of the International Renewable Energy Agency (IRENA). IRENA seeks to make an impact in the world of renewable energy by maintaining a clear and independent position, providing a range of reliable and well-understood services that complement those already offered by the renewable energy community and gather existing, but scattered, activities around a central hub.

The country has been a member of the IAEA for decades and has been both a recipient and provider of services emanating from the agency.

As a member state of the IAEA, permanent member of the board of directors and actively participating in nuclear energy, safety, technology, security and disarmament, South Africa has contributed to efforts of ensuring that nuclear energy is used for peaceful purposes like power generation as well as medical,

industrial and agricultural initiatives.

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 of 1998.

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

In March 2017, Eskom signed a five-year electricity sales agreement with Namibia's national electricity utility, NamPower.

Eskom will supplement generation capacity for South Africa's neighbour with its surplus electricity, providing Namibia with energy security and allowing for economic development and growth.

NamPower has also concluded a number of projects to establish renewable energy projects in Namibia and to enhance its local production.

Eskom and Botswana Power Corporation signed a three-year firm power supply agreement in April 2017.

This is in line with Eskom's plan to increase its electricity exports to South Africa's neighbouring states. Eskom currently has excess capacity of about 4 000 MW, excluding an operating margin.

Import and export of fuel products

The import of refined products is restricted to special cases where local producers cannot meet demand. It is subject to state control 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.

Energy and the global environment

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.

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 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 South African economy depends greatly on fossil fuels for energy generation and consumption, and is subsequently 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 clean development mechanism 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 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-EU Energy Partnership.