ENERGY
CATALYST

Country Guide: South Africa

June 2020

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The Republic of South Africa is a large country at the southern tip of the African continent. South Africa has a coastline that stretches more than 3,000 km from the southern tip of Namibia in the west to the southern tip of Mozambique in the east. South Africa has many climatic zones ranging from the tropical east, which receives over 1,000 mm of rainfall, to the arid western regions which receive less than 200 mm. Inland temperatures in South Africa are lower than countries of similar latitudes due to the country's relief. The Great Escarpment is a continuous mountain belt which runs 60-240 km inland from the eastern coastline and separates the interior plateau from the east coast. The high elevation of the interior plateau ranges from 1,500 m to 3,482 m in the KwaZulu-Natal Drakensberg, and is responsible for keeping the average summer temperatures in Johannesburg and other inland regions below 30˚C.

Political context

South Africa, like almost all African countries, was colonised by European powers, starting in 1652 by the Dutch. In 1795, the Dutch surrendered the Cape Colony to the British, later precipitating the Great Trek where Dutch settlers (Boers) travelled into and settled in South Africa's interior from 1836. British efforts to expand control in South Africa led to a long period of conflict between the British and the Boers, including the First and Second Anglo-Boer Wars, and between the British and the indigenous Xhosa and Zulu nations, including most of the nine Xhosa Wars between 1779 and 1879 and the Anglo-Zulu War of 1879. Following the defeat of the Boers in 1902, the various colonies and free Boer sovereign states of South Africa were incorporated into a South African Union in 1910, effectively a self-governing dominion of the British Empire which remained until 1961, when, through referendum, South Africa became an independent republic. However, the pro-Afrikaans,

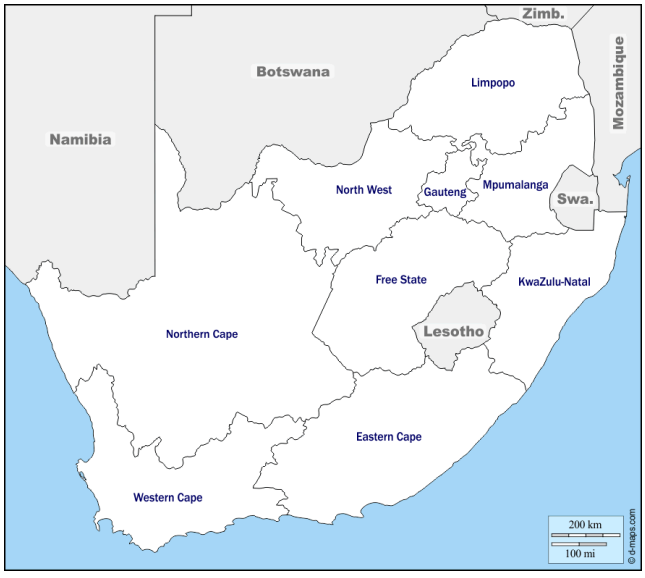

Figure 1 Map of South Africa. Source: d-maps

far-right National Party had been in power since 1948, winning a series of national elections, non-democratic though they were. This ushered in the increasingly oppressive Apartheid era which endured until the country held its first democratic elections in 1994.

Under the Apartheid regime, the white minority population seized control of the country's wealth and systematically oppressed the non-white populations by denying them basic human rights and excluding them from enjoying the same economic privileges as those enjoyed by the white population. This resulted in severe inequality between the white and mostly black populations; to this day, income inequality in South Africa ranks amongst the highest in the world, as evidenced by a Gini coefficient of 0.63.

South Africa's first democratic election took place in 1994 and saw Nelson Mandela become the president of South Africa with his party, the African National Congress (ANC), obtaining an outright majority. The South African constitution, implemented shortly thereafter, was and remains one of the world's most progressive constitutions, guaranteeing equal rights for all and enshrining the values of dignity, equality and freedom for South African citizens. The ANC has retained power since, though their majority has diminished from the 66% achieved in 1999 to 57.5% in 2019.

South Africa has strong, well-functioning democratic institutions which have made tremendous progress in reconciling the inequalities of the past and delivering the constitutional rights to those that were previously disadvantaged. These institutions were, however, eroded during President Jacob Zuma's administration, which ran from 2009 to 2018, as state departments and state-owned enterprises were marred by corruption and poor governance, a process referred to as 'state capture'. President Cyril Ramaphosa succeeded President Zuma in 2018, vowing to tackle corruption, improve governance and implement economic reforms to restore confidence in the country's institutions and promote a business-friendly environment.

In the two years since, however, progress has been slow, although key actions include replacing the board of Eskom, the state-owned electricity utility, and the establishment of the "BizPortal" online platform to streamline the process of registering and obtaining the necessary certifications to open a business in the country.

Table 1: South Africa at a glance

Capital	Pretoria
Total Area	1,219,090 km^2
Population	58.8 million (2019)
Official languages	IsiZulu, isiXhosa, Afrikaans, English, sePedi, Setswana, seSotho, Xitsonga, siSwati, tshiVenda,, South-Ndebele
Rural Population	33.65% (2018)
GDP	US$ 350 Billion (2019)
GDP Per Capita	US$ 7,433 (2019)
Currency	South African Rand (ZAR)
Exchange rate 01/03/2020	1 GBP = 20.04 ZAR
Exchange rate 01/03/2018	1 GBP = 16.32 ZAR
Access to Electricity	84.4% (2017)
Urban electricity access	93.48% (2017)
Rural electricity access	66.89% (2017)

Economy

South Africa is said to have a 'dual economy', characterised by having elements of both a developed economy and a developing economy. In major metropolitan areas, such as Johannesburg and Cape Town, the economy is as advanced as developed economies in Europe, North America and East Asia, having world-class infrastructure (roads and information and communications technology (ICT) networks), banking and financial services and high living standards. The townships and informal settlements, of which there are around 2,700 that house over 18 million people, are conversely typical of developing economies and suffer from poor service delivery, poverty and limited infrastructure. As a legacy of the

Apartheid regime, these townships and informal settlements are disconnected from both rural and urban economies, socially and structurally, and contribute little to the high-value outputs of the South African economy.

The economy as a whole is well-diversified and industrialised, and is the second largest (in nominal terms using US $) in Africa. As such, the country is classified as an upper-middle income country and has substantial influence and importance in Southern Africa. The service sector is the most dominant in the economy, accounting for 61% of GDP in 2016 and has been increasing its share of the economy steadily since 1980 when it accounted for 53% of the GDP. This increase has come at the expense of industry, which has dropped from 40% in 1980 to 19% of GDP in 2016.

Broken down further, in 2016 the finance, real estate and business services sector was the greatest contributor to national GDP at 20.2%, followed by government services (17.3%), trade, catering and accommodation (15.2%), manufacturing (12%), transport, storage and communication (10%), mining (7%), tourism (2.8%), and agriculture (2.2%).

Despite the relatively low share of GDP, South Africa is a top producer of mined raw and processed minerals such as gold, platinum-group metals, coal, and diamonds, and has major automotive, food and beverage, chemical and textile industries which are important contributors to its exports.

GDP growth in the 2000s, before the 2008 recession, was strong, averaging around 5%. This coincided with the commodity boom, and continued at around 3% for the five years following the boost from the 2010 FIFA World Cup. Since 2015, however, growth has slowed to below 2% per year. 2018 saw the GDP growth slow to just 0.8%, and South Africa slipped into a technical recession in the last two quarters of 2019 and posted just 0.3% growth for the 2019 year, while unemployment reached 29%.

The competitiveness of the South African economy has improved from 67th out of 140 countries in 2018 to 60th out of 141 countries in 2019. A key strength of the South African economy is the well-developed financial sector, excellent government budget transparency (ranked 1st globally), advanced transport infrastructure, and a sizable consumer market. Despite years of political uncertainty, corruption and poor governance under President Zuma's administration, 2019 saw improvements in institutional capacity, administrative efficiency and the balance of powers across state entities. However, this was not enough to prevent the country's sovereign credit rating being downgraded to junk by Moody's in March 2020, resulting in all three major ratings agencies classifying South African government debt as junk, or sub-investment grade. The major hindrances to the country's competitiveness are security issues, due to persistent violence, restrictive labour regulations and difficulties in bringing in skilled foreign labour.

In terms of the ease of doing business in 2020, as measured by the World Bank in their annual survey via a comparison of business regulation in 190 economies, South Africa ranked 84th globally with a score of 67. Figure 2 below illustrates that South Africa is ranked in the top 100 countries for dealing with construction permits, getting credit, protecting minority investors, paying taxes and in resolving insolvency. The cost of trading across borders and the time it takes for export documentation to be processed and approved are major challenges to doing business in the country, as well as the number of days (40) and procedures that need to be followed to start a business. These are the country's lowest-performing business areas.

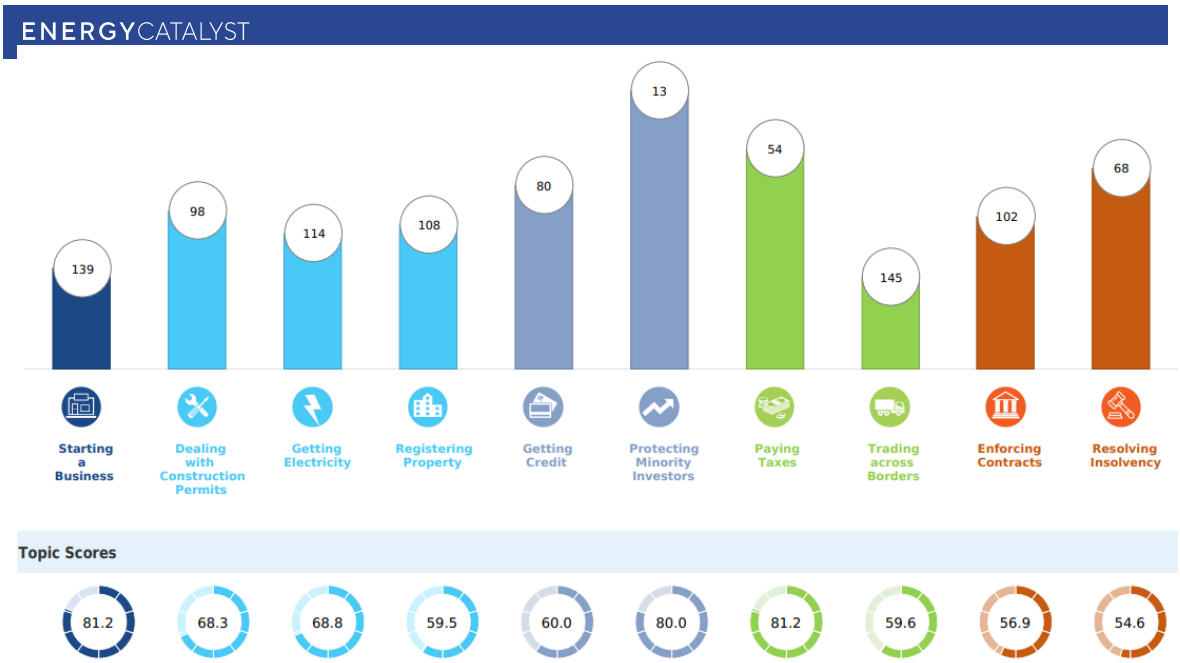

Figure 2 Doing Business 2020 global rankings and scores for various 'Doing Business' topics. Source: World Bank Group, 2020

The energy sector in South Africa

An abundance of cheap and accessible coal in South Africa has resulted in the energy sector being largely coal driven; 71% of the country's primary energy consumption was driven by coal in 2018, followed by oil (including diesel) at 22%. Total primary energy consumption was 5,087 PJ in 2018, which was more than a quarter of the total primary consumption of the entire African continent. South Africa imports almost all (90%) of its oil and gas, while electricity is traded between South Africa and its neighbours through the Southern Africa Power Pool (SAPP). South Africa imports electricity from Mozambique and exports power primarily to Namibia, Botswana, Lesotho, Eswatini and Zimbabwe.

In terms of the energy use, 23% of the total final consumption is consumed as electricity, 35% as oil products (petroleum, diesel, paraffin and liquified petroleum gas (LPG)) and 24% as coal for heating and industrial applications. The South African economy is extremely energy-intensive by international standards as a result of the heavy manufacturing and mining industries, which consume over 60% of the country's electricity, and due to these industries' energy inefficiencies after many years of low electricity and labour costs. South Africa's electricity capacity, which reached 54 GW in 2018, is dominated by the state-owned electricity utility, Eskom, which controls 48 GW of capacity. Electricity shortages have been a recurring issue in South Africa since 2007, when Eskom had to resort to planned, rolling black-outs, known as load-shedding.

The energy sector in South Africa is guided by a road mapping document called the Integrated Energy Plan (IEP), which iteratively plans future infrastructural investments and policy development to ensure the energy needs of the country are satisfied. The IEP predicts future energy demands based on economic growth and consumption trends and develops a corresponding roadmap for the energy sector to supply this demand. These are the Integrated Resource Plan (IRP) for the electricity sector and the awaited Gas Utilisation Master Plan (GUMP) for the oil and gas sector.

The refined crude oil products sector, for which the IEP is also responsible, is more open and privatised regarding supply, distribution and sales, which makes it more adaptable, resulting in a high security of supply. The electricity sector is dominated by the vertically-integrated Eskom, which, before the introduction of

independent power producers (IPPs) in 2011, had a near monopoly over electricity generation. Eskom owns and controls the country's transmission infrastructure and distribution is done either directly by Eskom or through municipalities that have licenses to distribute electricity to end-users. (It should be noted that distributing municipalities are not able to purchase electricity from anyone but Eskom at present, despite requests from some metropolitans).

Table 2: IRP Capacity Mix

Technology	2018 Capacity (MW)	2030 Capacity (MW)
Coal	39,126	33,847
Nuclear	1,860	1,860
Hydro	2,196	4,696
Pumped Storage	2,912	2,912
Solar PV	1,474	7,958
Wind	1,980	11,442
Concentrating Solar Power (CSP)	300	600
Gas/Diesel	3,830	11,930
Other (co-gen, biomass, landfill)	499	499
Embedded Generation	Unknown	2,600

One of the key objectives of the IEP is security of supply and minimising the cost of energy, which can largely be said to be unsuccessful for the electricity sector to date due to the persistent shortages experienced and the 263% increase in the electricity price between 2010 and 2018. In its fourth iteration of the multi-year price determination (MYPD), the National Energy Regulator of South Africa (NERSA) permitted Eskom to increase the electricity tariff a further 9.4% in 2019/2020, 8.1% in 2020/2021, and 5.2% in 2021/2022. Eskom is contesting these allowances and is hoping to increase the tariffs by higher rates to be able to start paying down its considerable debt and return to profitability.

However, Eskom reportedly needs prices to increase by approx. 30% in order to be cost-reflective. A 30% price increase would assist the utility to service the R30 billion annual interest (17% of annual revenue in 2019 and 90% of earnings before interest, depreciation and amortisation) on its debt, which has ballooned to R450 billion as a result of cost overruns on new-build projects, increasing fuel costs, overstaffing and poor management and corruption. This is not the only issue facing Eskom, however, as the utility's ageing coal fleet is suffering from performance issues. The fleet has an availability factor of less than 70%, and the much-anticipated new Medupi and Kusile coal-fired power plants have proven to be far from the rescuers they were touted to be, suffering from poor design and technical issues, and are well over budget.

Fed by the IEP, the Integrated Resource Plan (IRP) is the strategic document for the electricity sector. The IRP considers the national economic, environmental, and social objectives that apply to the electricity sector and formulates the future supply and demand scenarios that are most suitable for the country. To date, there have been three iterations of the IRP, though only the 2011 IRP and the 2019 IRP were officially gazetted by the government.

The IRP estimates the country's future demand in multiple scenarios based on economic growth and energy efficiency considerations. The 2019 IRP anticipates the following changes to the electricity mix by 2030.

As can be seen in Table 2, the coal capacity is to diminish substantially in the coming decade, with 10,500 MW of capacity being due for decommissioning by 2030. Eskom has recently sent out a request for expression of interest and proposals for repurposing these power plants that are due to be decommissioned in the coming years. This is centred around extending the usable life of these assets and reducing capital costs for new projects by converting these power plants to gas-fired power and/or using the surrounding mined areas for solar PV and wind power generation.

The Koeberg power station near Cape Town is the only nuclear power station in Africa and will reach its end-of-design life in 2024; however, under the IRP the design life will be extended to maintain nuclear capacity for the foreseeable future. New nuclear capacity is considered to be costly and has some of the longest lead times of all technologies considered in the IRP, thereby limiting the allocation given to this

technology in the IRP 2019. This is after President Zuma proposed nearly 10 GW of nuclear capacity to be developed under his administration, which received considerable pushback from industry experts and the public due to corruption concerns.

Eskom is in the process of legally separating the utility into three independent entities, namely generation, transmission, and distribution. However, the current CEO asserts that this complex process is likely a "few" years from being realised. In the meantime, municipalities, spearheaded by the City of Cape Town, have applied to the courts to be able to purchase power directly from IPPs without having to seek permission from the mineral resources and energy ministry. The court case is being heard at the time of writing and could pave the way for a more competitive electricity industry in the country.

Renewable energy

South Africa has committed to the global climate change response through numerous pledges made and policies implemented over the past two decades. South Africa is a signatory of the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol of 1997 and its subsequent Doha Amendment. President Zuma, ahead of the Copenhagen Accord in 2009, pledged a 34% reduction in emissions (relative to the business as usual case) by 2020 and a 42% reduction by 2025. In 2016, South Africa ratified the Paris Agreement by translating its Intended Nationally Determined Contributions (INDCs) into Nationally Determined Contributions (NDCs), to limit greenhouse gas emissions to between 398 and 614 $MtCO_2eq$ between 2025 and 2030, which is aligned with the Copenhagen Accord pledge made in 2009.

Three policy documents were instrumental in enabling renewable energy development in South Africa, namely the White Paper on Energy Policy (1998), the White Paper on Renewable Energy (2003), and the National Climate Change Response Policy White Paper (2011). The White Paper on Energy Policy pledged "government support for the development, demonstration and implementation of renewable energy resources for both small and large-scale applications". Importantly, this document identified the potential of renewable energy to become the least-cost energy source in the future.

However, renewable energy procurement in South Africa did not get much traction until the launch of the Renewable Energy Independent Power Producers Procurement Programme (REIPPPP) in 2011, meaning that the country failed to meet the renewable energy target of 10,000 GWh (cumulatively) by 2013, as stipulated in the White Paper on Renewable Energy.

The REIPPPP is a competitive auction programme whereby the government allocates the various renewable energy technologies a capacity limit in bidding rounds. Private companies and consortia then submit proposals to the IPP Office, an independent entity to Eskom, which then assesses the proposed projects based on price (70% weighting) and socio-economic commitments (30%) such as job creation, local procurement, community ownership and enterprise development and socio-economic development funding. Ultimately, Eskom is the sole off-taker of the electricity produced by these renewable energy projects, and the project developers sign a 20-year power purchase agreement (PPA) with Eskom.

The REIPPPP has, to date, held six bidding rounds that have procured 6,327 MW of renewable energy from solar PV, wind, CSP, hydropower, biomass and landfill gas projects. Rounds 1, 2, 3, 4, and 4b were open to all of these technologies; however, rounds 3 and 5 were purely dedicated to CSP. These six rounds attracted R210 billion in private sector investment in the industry. Furthermore, R42 billion of this total private sector investment came as foreign direct investment and it is estimated to have created 48,334 jobs and saved nearly 45 $MtCO_2$ since inception.

One of the major costs and sources of delay associated with developing these projects is the environmental impact assessments (EIAs) that are required before commencing construction. To

address these issues, and to fast-track the development of future renewable energy projects in South Africa, the Council for Scientific and Industrial Research (CSIR) and the Department of Environment, Forestry and Fisheries (DEFF) conducted strategic environmental assessments (SEAs) across the country to identify renewable energy development zones (REDZ), as shown in Figure 3. The Phase 1 REDZs have been officially gazetted (in 2016) and the Phase 2 REDZs have been proposed for gazetting. These areas were noted as having substantial renewable energy resources and are located along existing transmission infrastructure corridors, making these appealing areas for potential renewable energy projects.

The major benefit of these REDZs for renewable energy developers is that, rather than a full EIA, a time and cost-efficient Basic Assessment can be undertaken for developments in REDZs. This reduces the approval time for environmental authorisation by 50 days.

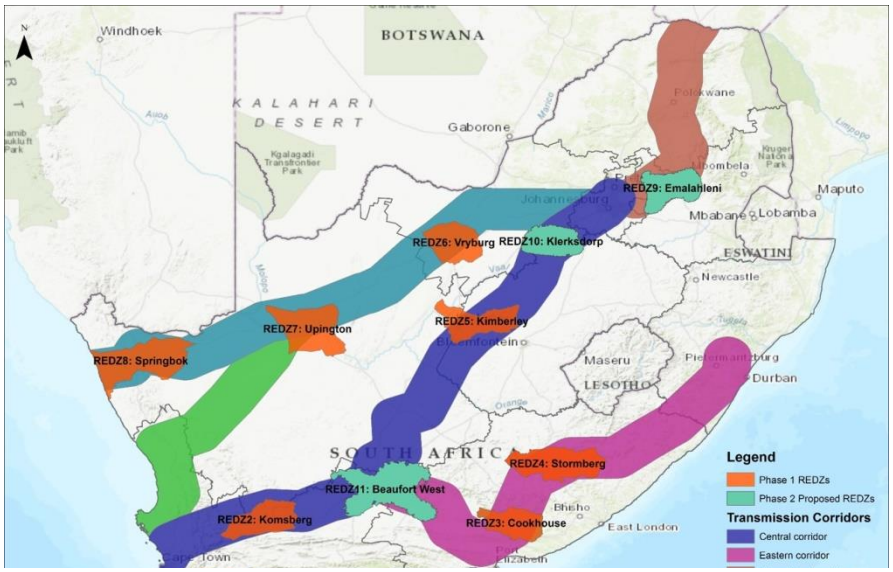

Figure 3: Phase 1 and Phase 2 Renewable Energy Development Zones (REDZ). Source: CSIR and DEFF, 2019

The REIPPPP stalled between 2015 and 2018 due to Eskom refusing to sign PPAs with the IPPs having been selected in rounds 4 and 4b. In April, 2018 Eskom signed PPAs with the remaining 27 IPPs. The industry is awaiting announcements from the Department of Mineral Resources and Energy (DMRE) regarding round 5 of the programme and the ministerial determinations for renewable energy in the country going forward.

In 2020 the DMRE submitted two ministerial determinations, which are statements issued by the minister of the DMRE authorising new generation capacity to be built by a specified date - one to address the immediate electricity supply shortages with 2,000 MW before 2022, and the second to procure 11,813 MW apportioned between renewables (6,800 MW of solar PV and wind), storage (513 MW of battery, hydrogen fuel cells, compressed-air and others), gas (3,000 MW of natural gas and diesel), and coal (1,500 MW). These ministerial determinations are now with NERSA for public consultation before being officially approved.

Oil and gas

Oil and natural gas are regulated under the Mineral and Petroleum Resources Act, which recognises these resources as belonging to the state. As such, the Minister of the DMRE is responsible for regulating and promoting the development of oil and gas resources in South Africa. Permits and exploration and production rights are granted to entities in licensing rounds by the Petroleum Agency of South Africa (PASA). If the applicant is successful in obtaining exploration and production rights, the government has the option to acquire 10% of the participating interest, however, in the recent amendment to the regulations, it is proposed that the state be granted 20% free carry interest in new exploration and production rights and that a further 10% be designated for black-owned enterprises, according to the country's Broad-Based Black Economic Empowerment (BBBEE) regulations. Additionally, royalties are

payable on the value of oil and gas resources extracted to a maximum of 5% for refined resources and 7% for unrefined resources.

Oil and gas resources are relatively undeveloped in South Africa, historically due to the country's small discovered resource endowment. South Africa did, however, consume 1,120 PJ of oil and gas in 2018. 90% of this was imported from Saudi Arabia, Angola and Nigeria, and the remaining 10% was supplied by the limited offshore natural gas capacity in the Western Cape and the Sasol coal-to-liquids (CTL) facility.

The Petroleum Oil and Gas Corporation of South Africa (PetroSA), the state-owned entity charged with exploiting its reserves and upstream and midstream oil and gas assets in the Western Cape, produced 2.1 million barrels of crude oil/condensate and produced 22.15 billion cubic feet (Bcf) of natural gas in 2019. The gas-to-liquids (GTL) refinery in Mossel Bay, which is also owned by PetroSA, is running below its nameplate capacity (36,000 barrels per day) as a result of shortages in supply from the Oribi and Oryx gas fields offshore. It is anticipated that this facility will run out of natural gas supply by December 2020 and will have to be closed. However, PetroSA is running on negative cash flow and does not have enough cash on hand to close the facility.

The country's conventional reserves are relatively insignificant, located in three offshore basins: the Orange Basin off the west coast, the Bredasdorp Basin off the south coast, and the Tugela Basin off the east coast. The Bredasdorp Basin, where the PetroSA assets are located, had a reserve of 1 trillion cubic feet (tcf) when the production wells were commissioned. In 2019, however, Total SA discovered up to 5.5 tcf of gas-condensate in the Brulpadda discovery in the Outeniqua Basin, 175 km off the southern coast. There are still many steps before this find is brought into production and the deep waters make it a technically challenging field to extract from. Coupled with the current extremely low oil and gas prices, which are below USD $30 per barrel of crude oil and around US $2 per million British thermal units (MMBtu) for natural gas (as a result of the COVID-19 pandemic and the price war between Saudi Arabia and Russia), the development of this field may be years from realisation.

Unconventional reserves could be much greater through a combination of coal-bed methane (CBM) and shale gas. Some estimates of the technically recoverable shale gas resource in the country are as high as 390 tcf; however, the recoverable resource is likely to be less than 15 tcf. The shale gas reserves are located in the Karoo Basin, which is an inland area in the Western Cape, Eastern Cape and Northern Cape provinces. To date, no hydraulic fracturing (fracking) has been authorised to extract these resources but exploration rights have been granted to private companies. Shale gas is an issue of contention in South Africa, with many activists and environmental groups opposing the establishment of fracking wells in the Karoo region. The CBM resource is estimated at between 20 and 30 tcf ranking it 12th in the world for CBM potential.

In terms of midstream and downstream oil and gas production, South Africa has the second-largest refinery capacity in Africa, behind Egypt. South Africa's refinery capacity processes 718,000 barrels per day through six refineries. Two of the refineries produce synthetic fuels from coal (Sasol) and gas (PetroSA), with the remaining four refining crude oil into petroleum products. These refineries produce enough petroleum and synthetic products to satisfy 72% of the country's demand with the balance being imported.

Gas for electricity generation, as per the IRP 2019, is predicted to increase notably from current capacity. Current power plants that use gas or diesel power include the Acacia (171 MW) and Ankerlig (1,338 MW) power plants around Cape Town; Port Rex (171 MW) near East London; Avon (670 MW) in Salt Rock; Dedisa (335 MW) in Coega; and Gourikwa (746 MW) in Mossel Bay. Avon and Dedisa are both IPPs, and the rest are owned by Eskom. Ankerlig and Gourikwa have both been converted to dual fuel plants which can be powered by diesel or natural gas, since Eskom was instructed by the DMRE to convert all their diesel open-cycle gas turbines (OCGTs) to natural gas for cost and environmental reasons. 11,930 MW of gas-fired power capacity, as envisaged in the IRP 2019, would demand around 6 tcf of natural gas supply.

Natural gas is also currently imported from Mozambique via a pipeline connecting the Pande and Temane gas fields to Sasol's Secunda refinery in South Africa's Mpumalanga province. The pipeline is capable of transporting 240 million GJ of natural gas per annum; however, only 120 million GJ is used annually by the Secunda refinery. The remaining gas is distributed in the 2000+ km gas pipeline network in the Free State, Gauteng, Mpumalanga and KwaZulu-Natal to industrial and commercial users.

These gas fields are predicted to start tapering off production from 2023, which would result in a shortfall of natural gas supply for South Africa from 2023. A possible solution to this shortfall is to use liquified natural gas (LNG) to meet these demands as and when the Temane and Pande fields begin tapering off. A proposed LNG terminal in Coega has been earmarked for development but it is still in early development.

Hydropower

South Africa, being a semi-arid country with below-average rainfall and no navigable rivers, has limited hydropower potential. The western regions in the country are particularly dry and are predicted to be increasingly susceptible to droughts as a result of climate change. The eastern regions, particularly the Eastern Cape and KwaZulu-Natal provinces, experience the highest rainfall and have many perennial rivers that could offer limited hydropower potential.

There is an estimated 247 MW of potential for small-scale hydropower in the Eastern Cape, KwaZulu-Natal, Mpumalanga and Free State, primarily using run-of-river projects. There are numerous community-owned and mining hydroelectric projects in the country, but these are micro-scale and generally for self-consumption. The bulk of the country's hydropower potential lies in regional hydropower projects where the electricity will be imported through the Southern African Power Pool (SAPP).

Eskom uses pumped storage hydropower to meet the evening and morning electricity demand peaks. These pumped storage schemes are located in KwaZulu-Natal, with the Drakensberg (1,000 MW) plant and the Ingula (1,332 MW) plant, and in the Western Cape with the Palmiet (400 MW) plant. Cape Town also owns and operates a pumped storage facility called Steenbras, which has a capacity of 160 MW.

In addition to these pumped storage plants, Eskom owns and operates two large hydropower stations and four small stations in the Eastern Cape. The large hydropower stations are the Gariep (360 MW) and the Vanderkloof (240 MW) stations, both of which were built in the 1970 and are used by the utility as peaking stations. The four small hydropower stations in the Eastern Cape are Colley Wobbles (42 MW), First Falls (6 MW), Ncora (2) and Second Falls (11 MW). Combined, the two large hydropower stations and the four smaller units generated 1,029 GWh of electricity in 2019.

Outside of Eskom's hydropower capacity, two hydro IPP projects have been operationalised to date under the REIPPPP: the Stortemelk Hydro project (4.3 MW) in Clarens, Free State and the Neusberg Hydro Electric project (10 MW) in Kalkamas, Northern Cape, both procured in the REIPPPP round 2. There have also been private sector hydro projects that have been operationalised in South Africa. The Bethlehem Hydro power project in the Free State consists of a 4 MW run-of-river Merino plant on the As River and a 3 MW site on the Sol Plaatje Dam. In Mbombela, the Friedenheim Irrigation Board owns and operates the Friedenheim (3 MW), which produces electricity for self-consumption but exports the majority to the grid at prices below the Eskom tariff to the city. Lastly, the Bakenkop hydropower plant in Piet Retief commissioned in 1950 is still providing electricity with an installed capacity of 0.8 MW.

There are estimated to be numerous pico-scale hydropower plants in South Africa which produce electricity for self-consumption on farms, especially in the Eastern Cape and KwaZulu-Natal. There are also existing plants that have been mothballed or are in a state of disrepair that could be brought back

into service, including the Lydenburg (2.6 MW), Clanwilliam (0.3 MW), Belvedere (2.1 MW), Ceres (1 MW), Hartbeespoort (5.7 MW), Teebus (7 MW) and many other micro-scale plants.

Regionally, South Africa imports hydropower from the Cahora Bassa Dam (HCB) hydropower plant in Mozambique to the tune of 1,700 MW. Additionally, South Africa has entered into a treaty for 2,500 MW of hydropower to be procured from the Grand Inga Hydropower Project on the Democratic Republic of Congo's Congo River. This will be transmitted through Zambia, Zimbabwe/Botswana to South Africa via a high voltage transmission network. There have been delays, however, and the viability of transmitting the electricity from this power plant to South Africa has been brought into question.

Table 3 Overview of the main stakeholders in the energy sector in South Africa	
Institution	**Role**
Department of Mineral Resources and Energy (DMRE)	The DMRE exercises oversight of the energy and mining sectors, which influences the decisions and operations of the country's energy regulators and energy-related state-owned Entities (SOEs) such as Eskom and PetroSA. These state-owned entities, however, must report to the Department of Public Enterprises which are their effective shareholders. The DMRE also formulates energy policies and procurement determinations for additional electricity capacity and authorising resource exploration and production in South Africa.
Department of Environment, Forestry and Fisheries (DEFF)	DEFF provides leadership in environmental management, conservation and protection of the country's natural resources. DEFF is responsible for environmental policy development, setting environmental management regulations and ensuring that the country progresses towards the climate change targets set out under the Nationally Determined Contributions (NDCs) and other pledges made.
National Energy Regulator of South Africa (NERSA)	NERSA's mandate is to regulate the electricity, piped-gas and petroleum pipelines industries according to the Electricity Regulation Act, 2006, the Gas Act, 2001 and the Petroleum Pipelines Act, 2003. NERSA is responsible for setting electricity, liquid and gaseous fuels tariffs and for issuing licenses for energy production, transmission and distribution. Additionally, NERSA sets the rules, standards and guidelines that regulate the energy sector as well as solving disputes between actors in the industries.
Central Energy Fund (CEF)	CEF is a state-owned diversified energy company reporting to the Department of Mineral Resources and Energy. The objective of the CEF is to contribute to the security of energy supply of South Africa and Southern Africa through exploration, acquisition, development, marketing and strategic partnerships in the energy sector. The CEF is informed by the policies and plans laid out by the DMRE and acts to implement these policies and reduce the dependence of the country's energy needs on multinational (foreign) companies.
Development Bank of Southern Africa (DBSA)	The DBSA seeks to play a pivotal role in delivering developmental infrastructure in South Africa and the rest of Africa through the provision of financing and sustainable development solutions, including project management support, design and construction management support and operations and maintenance support, to public sector players and private businesses looking to invest in fixed capital.
Industrial Development Corporation (IDC)	The IDC is a national development finance institution established for the promotion of economic growth and industrialisation in South Africa. It is guided by the Department of Trade Industry and Competition. The IDC is an implementing agency that identifies sector development opportunities aligned with policy objectives and develops projects in partnership with stakeholders.
Petroleum Agency of South Africa (PASA)	The Petroleum Agency of South Africa was established to promote the exploration and exploitation of natural oil and gas, both onshore and offshore, in South Africa and to undertake the necessary marketing, promotion and monitoring of operations.
South African National Energy Development Institute (SANEDI)	SANEDI was established in 2011 to direct, monitor and conduct energy research and development, promote energy research and technology innovation as well as undertake measures to promote energy efficiency throughout the economy. SANEDI has developed and implemented two overarching programmes, Applied Energy Research, Development and Innovation and the national Energy Efficiency programme, which both have multiple sub-programmes within them and are active in progressing the energy sector towards cleaner, more efficient practices and technologies.

ENERGYCATALYST	
Petroleum Oil and Gas Corporation of South Africa (PetroSA)	PetroSA is a state-owned entity that owns a portfolio of oil and gas assets including off-shore gas fields (Oribi and Oryx fields) and the gas-to-liquids refinery in Mossel Bay. The company aims to be a leading provider of hydrocarbons in South Africa.
Eskom Holdings	A state-owned enterprise that is responsible for 90% of the country's electricity generation and owns and operates the transmission and distribution grids. Eskom is in the process of unbundling into three separate legal entities for generation, transmission and distribution to encourage more competition in the generation market.
IPPPP Office	The IPPPP Office was established as part of the REIPPPP to administer the programme, receive and determine the successful bidders for each technology group, and facilitate the PPAs between the IPPs and Eskom (the off-taker). Once IPPs have been procured the IPPPP Office then provides monitoring, evaluation and contract management services to ensure IPPs uphold their commitments. The IPPPP Office was established by the DMRE, National Treasury and the DBSA but operates separately to Eskom to give impartiality to the procurement process. The IPPPP Office also assists IPPs through the provision of professional advisory services
Sasol	Sasol is a multinational energy and chemicals company established in South Africa in 1955 as a state-owned company. It was privatised in 1979 and is now listed on the country's Johannesburg Stock Exchange. Sasol operates and has equity in oil and gas refineries in the country and has invested in the gas pipeline that imports natural gas from Mozambique into South Africa for refining in its Secunda GTL refinery.

Solar energy

South Africa's solar energy potential is immense, with the country averaging more than 2,500 sunshine hours per year and an average direct normal irradiance (DNI) of between 4.5-6.5 KWh/m^2 per day. The Northern Cape, as shown in Figure 4, has some of the highest solar resources in the world. This solar resource, coupled with the large areas of cheap, available land make the solar electricity resources in South Africa some of the most attractive in the world.

The Solar Energy Technology Roadmap (STERM), a joint initiative between government departments and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), estimated that 40 GW of solar PV and 30 GW of CSP could be deployed by 2050.

Almost all of the solar power capacity, in the form of solar PV and CSP, is being supplied by IPPs that were procured under the REIPPPP. According to the ministerial determinations during the REIPPPP, CSP was to be allocated 1,200 MW of power and solar PV 6,225 MW. The procurement of solar PV in South Africa has gone as follows, noting that the electricity tariffs are quoted in 2019 Rands (which adjusts the successfully procured electricity tariff for inflation to bring them to current rates):

- Round 1: 627 MW at an average electricity price of R4.22/kWh
- Round 2: 417 MW at an average electricity price of R2.52/kWh
- Round 3: 435 MW at an average price of R1.35/kWh
- Round 4: 813 MW at an average price of R1.06/kWh
- Total procured: 2,292 MW at an average price of R2.15/kWh

Of the 2,292 MW of solar PV procured, 1,474 MW are currently operational as of 2019. The average price of solar PV from the first round of the REIPPPP in 2011 decreased by 75% by round four in 2015, a substantial drop in just five years. It is anticipated that solar PV could be the cheapest form of electricity in the country going forward as a result of the price decreases for solar PV components internationally and the abundance of solar resources in South Africa.

The IRP has allocated an additional 5,670 MW of capacity to solar PV up to 2030, which is broadly in line with the ministerial determinations made in 2012.

600 MW of CSP has been procured to date, with 500 MW operational. The procurement of CSP under the REIPPPP has seen the following, again in 2019 Rands:

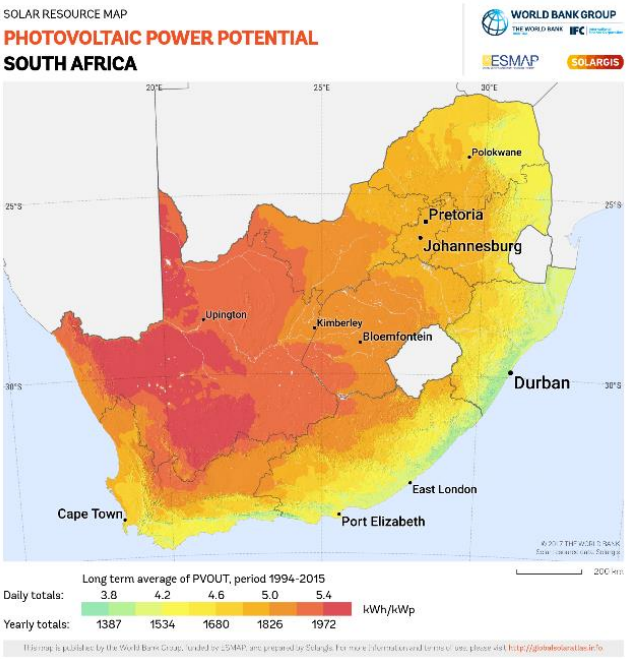

Figure 4: Solar resource South Africa. (2019 The World Bank, Source: Global Solar Atlas 2.0, Solar resource data: Solargis)

- Round 1: 150 MW at an average price of R4.11/KWh
- Round 2: 50 MW at an average price of R3.84/KWh
- Round 3: 200 MW at an average price of R2.24/KWh
- Round 3.5: 200 MW at an average price of R2.08/KWh
- Total procured: 600 MW at an average price of R2.96/KWh

According to the IRP 2019, no further capacity for CSP has been allocated until 2030. The price of CSP has not dropped as notably as solar PV but it has the added advantage of being able to store electricity and therefore supply power to the grid during the peak demand times (especially in the evenings in South Africa), which solar PV projects are not able to do.

Biomass energy

South Africa has limited bioenergy potential, due to the below-average rainfall and aridity of many areas in the country. Managing the biomass resources in the country will thus need to consider the impacts on food security, as the amount of arable land (10% of the land area) available for energy crops is limited. Waste and residue utilisation is therefore seen as a promising solution for bioenergy in the country.

According to the Bioenergy Atlas of South Africa, the bioenergy resource potential is as follows:

- Urban domestic waste, in the form of municipal solid waste and wastewater, could contribute 1,400 MW of electricity
- Rural anaerobic digestors supplied with cattle and other residues could contribute 250 MW of electrical power
- Invasive alien species, bagasse, agricultural residues and forestry biomass resources could supply enough fuel for 1,300 MW of bio-electric capacity
- Energy crops such as groundnut and sunflower could provide electrical energy and biofuels to the tune of 235 MW and 570 million litres per annum (5% of current diesel consumption), respectively

Landfill gas is currently in use by metropolitan municipalities in South Africa. In Gauteng, the metros of Ekurhuleni and Johannesburg have developed landfill gas to electricity projects on seven landfill sites (two in Ekurhuleni and five in Johannesburg). The Ekurhuleni project has a capacity of 1 MW and is owned and operated by the metro. The Johannesburg project has a potential capacity of 18 MW, although only 7.56 MW from three sites are operational, and has 13 MW of landfill gas power procured under the REIPPPP round 3. This project is operated by a private sector company but received funding from the City of Johannesburg for its development. The eThekwini metro has also developed landfill gas to electricity projects at the Marianhill and Bisasar Road landfills, with a combined capacity of 7.5 MW which is fed to the municipal grid.

Current bioenergy capacity in South Africa is limited, with just two projects being procured under the REIPPPP. The Mkuze project in KwaZulu-Natal was procured in round 3 but has not been brought to operation to date and there is currently no construction underway. The 25 MW Ngodwana Biomass Power Station in Mpumalanga is under construction and is expected to be operational by July 2020. The fuel for the Ngodwana project is the residues that will be recovered from the forestry and lumber mill operations by Sappi (a private company listed on the stock exchange).

Outside of these REIPPPP projects, there have been private sector developments using biogas for electricity generation. The first commercial biogas project in South Africa was developed in 2015 by Bio2Watt in Bronkhurstpruit with a capacity of 4.6 MW. The biodigesters feedstock is manure from the adjacent beef farm and the electricity generated is sold to the BMW Rosslyn facility. In the Western Cape, the Uilenkraal dairy farm has also installed an anaerobic biodigester with a 0.6 MW capacity, although currently only 0.24 MW is utilised by the farm.

Wastewater to energy projects have also been developed, although there is still much potential for development. The Northern Works wastewater treatment plant has been retrofitted to generate electricity and heat from a combined heat and power (CHP) with 1.1 MW of electrical capacity. This site is undergoing development and the capacity could be expanded to 4.5 MW which could meet more than half of the wastewater treatment plant's electricity consumption. By using a CHP, the overall efficiency of this bioenergy plant is increased to 80%, as the heat is used to pre-treat the sludge before entering the biodigesters.

In February 2020, the DMRE published the South African Biofuels Regulatory Framework and National Biofuels Feedstock Protocol (under development for 14 years) which, together with the Blending of Biofuels with Petrol and Diesel Mandate tabled in 2015, seeks to introduce biofuels into the national liquid fuels mix at concentrations of up to 4.5% - though it is unclear how the biofuels will be supplied, as the regulations do not detail how the biofuels industry will be developed to support this blending mandate.

The current biodiesel manufacturing capacity in South Africa is limited. An initiative called Project Solaris was launched in 2014 to grow 50 hectares of nicotine-free tobacco in South Africa to produce sustainable jet fuel, and in 2016, South African Airways took its first flight fuelled by biofuels supplied by Project Solaris. At a larger scale, iLive has a biodiesel manufacturing plant in Benoni, Gauteng that has demonstrated a capacity of 300,000 litres of biodiesel in compliance with SANS 1935 standards (suitable for use in vehicles, not just for heating).

A biofuels producer called Neutral Fuels, however, is planning on establishing a biodiesel facility in South Africa later in 2020 with a production capacity of 4,700 tonnes per annum. This volume is a start, but is insufficient to meet the requirements of the blending mandate and considerably more investment will be needed into biofuels production and refining to meet this quota under current fuel demands.

Wind energy

The South African has fairly abundant wind resources, especially around the coastline and along the Great Escarpment in the Western Cape and Eastern Cape.

In the peak coastal and inland regions, there are wind speeds 8-10 m/second at a height of 100 m above ground level. This is near-optimal for wind energy and, as with the solar resource, is located in areas of abundant land. The major benefit of wind energy is that it is compatible with livestock farming, which is one of the main agricultural activities in South Africa's windy regions.

The majority of the 1,980 MW of operational capacity in South Africa is provided by IPPs, with Eskom providing only 100 MW of capacity through its Sere Wind Farm in the Western Cape. According to the IPP Office, wind energy procurement under the REIPPPP amounted to (in 2019 Rands):

- Round 1: 649 MW at an average price of R1.75/KWh
- Round 2: 559 MW at an average price of R1.37/KWh
- Round 3: 787 MW at an average price of R1.01/KWh
- Round 4: 1,363 MW at an average price of R0.88/KWh
- Total procured: 3,357 MW at an average price of R1.13/KWh

The IRP 2019 envisages that the majority of future renewable power capacity will come from wind energy. 8,100 MW of additional wind energy has been proposed by 2030 under the 2019 IRP. The IRP determines the future capacities allocated to each technology with a heavy weighting on the price of electricity and also on the lead times, carbon intensity, dispatchability of the electricity and other social considerations. Wind energy in South Africa has been the cheapest form of renewable energy and has a capacity factor of 39%. This is high by international wind energy standards and makes this technology more appealing than solar PV, which has been more expensive (although the price has been dropping more aggressively) and achieved a capacity factor of 25%.

Importantly for the South African wind sector, GRI Renewable Industries, a Spanish wind turbine tower manufacturer, resumed operations in 2019 following a shut down after the REIPPPP was stalled between 2015 and 2019 due to Eskom's refusal to sign new PPAs with round 4 successful bidders. Manufacturing capacity and local content has been encouraged through the REIPPPP, giving project weighting based on the value of components that were locally procured, which has helped to build the business case for facilities such as this. The GRI facility is located in Atlantis, Western Cape which has been designated as a Green Technology Special Economic Zone (SEZ) to bolster manufacturing capacity and attract investment into the green technology manufacturing sector.

Embedded generation

Alongside the REIPPPP, which was successfully deploying utility-scale renewable energy projects in South Africa, the embedded generation sector has also seeing significant deployment. Much of the embedded generation in South Africa has been solar PV installations on residential, commercial and industrial sites. Estimates for the installed embedded generation solar PV capacity in South Africa as of 2019 are 850 MW, exceeding 1 GW by the end of 2019.

When the REIPPPP stalled between 2015 and 2019, the cost of solar PV components continued seeing reductions, which made small-scale systems attractive to households and businesses as the levelised cost of electricity from solar PV was competitive with the electricity prices from the grid. Looking forward, the industry could add 500 MW annually, which would see embedded generation from solar PV exceed 7.5 GW by 2035, significantly more than the 2.6 GW allocated to embedded generation in the IRP 2019.

The current regulatory environment for embedded generation in South Africa is noted as being restrictive and uncertain. With no clear annual allocations given under the IRP 2019, industry is concerned that NERSA lacks guidance on the capacity that could be approved without these allocations. Under current regulations, installations of greater than 1 MW capacity are required to undergo licensing and approval from NERSA and obtain environmental and land use permits (requiring a public participation process), which are costly and cumbersome.

Industry has been requesting the DMRE to allow installations of up to 10 MW to go ahead without needing a generation license from NERSA. If the regulations were more conducive, the mining industry could reportedly bring 869 MW of solar PV capacity and 800 MW of 'conventional' power online within four years.

Hydrogen

The IRP recognises hydrogen fuel cells and batteries as storage technologies that could contribute to the future energy mix of South Africa. With increased allocations towards renewable energy technologies, the need for flexible generation and back-up systems such as hydrogen fuel cells and batteries will become increasingly important for stable, reliable electricity supply. Due to the abundance of solar and wind resources in the country, the ability to produce green hydrogen through electrolysis is seen as a promising technology option for South Africa.

Green hydrogen is receiving a lot of attention in South Africa due to the multitude of applications that this fuel has for industry, energy, chemicals and transport. HySA is an initiative to develop and guide innovation along the value chain of hydrogen and fuel cell technologies in South Africa. South Africa is a major producer of platinum group metals (PGMs) and metals that feed into hydrogen electrolysers and fuel cells, and there is interest in stimulating green hydrogen supply to drive demand for these commodities.

There is substantial potential for green hydrogen as a sustainable alternative to liquid fuels like diesel and petroleum in South Africa. Importation of crude oil and petroleum products is a considerable portion (14%) of total imports and a drain on foreign exchange reserves. Establishing a domestic green hydrogen sector that displaces the need for imported crude oil and petroleum products would have economic, environmental and social benefits through the localisation of the industry and the associated job creation.

Taiwanese Chung-Hsin Electric and Machinery Manufacturing (CHEM) has supplied Vodacom, one of the country's major telecommunications companies, with 300 fuel cells since 2011 for backup power at its cellular towers. In September 2019, CHEM committed to building a fuel cell factory in the Dube TradePort SEZ north of Durban, the country's first.

In terms of hydrogen generation, Hydrox Holdings, a South African engineering firm focussing on hydrogen electrolyser technologies, has designed and patented a membrane-less electrolyser which operates at a higher efficiency to conventional electrolysers and has a reduced upfront cost and fewer working components. The company aims to produce hydrogen for less than R100/kg (£5/kg) to bring it to parity levels with petroleum, at least before the 2020 oil price crash.

The country has extensive experience with synfuels and hydrogen fuels through Sasol, which has world-class Fischer-Tropsch and Haber process facilities, which use hydrogen-rich gases (derived from coal and natural gas) to produce liquid fuels, chemicals and fertilisers. There is a significant opportunity to use these skills and potentially capture the emissions from these processes to produce blue hydrogen in South Africa.

Mini grid development

South Africa is atypical in Sub-Saharan Africa, with a rural electricity access rate of 67% compared to the average of 17% and a national grid that has reached further into rural areas than is typical for the region. Still, the need for off-grid generation remains. The South African National Energy Development Institute (SANEDI) estimates that over three million people remain without electricity in rural areas. There is therefore still a significant need for rural electrification in South Africa, a proportion of which mini grids will be best placed to address. Indeed, the New Household Electrification Strategy, initiated by the

Department of Energy in 2011, states that a 90% grid electrified target is possible, but that the rest will need to be off-grid.

Grid congestion, and increasing grid connection costs, is a major challenge for South Africa. There are serious capacity constraints on the network, with around 50% of feeders in thermal overload. Eskom has been unable to secure a sufficiently high tariff with the regulator, NERSA, to make the necessary grid upgrades to relieve all grid congestion in the country. Therefore, many potential generators and consumers are not able to connect to the grid, including IPPs and key industries such as those found in South Africa's Industrial Development Zones.

The use of mini grids to increase the electrification in remote areas and to alleviate the grid congestion is noted as being cost-effective and well suited to meet the power demands of these currently unelectrified areas. That said, there are challenges to overcome for mini-grids to be deployed at scale in South Africa, including:

- Capacity gaps in public energy institutions such as municipalities and utilities
- A lack of understanding about which electrification strategy is best deployed for unserved communities in the long term
- A lack of practical, tailored guidance for local governments, municipalities, project developers and communities in South Africa on how mini-grids can easily be adapted for different locations, and the best ownership models and financial models to use
- A centralised utility thinking concentrated historically on grid extension for electrification, including the policy environment and national funding streams
- An internal skills gap and/or an inability to mobilise funding and manage project developers and the supply chain
- Inexperience in accessing international funding for clean energy projects and feasibility studies
- Perceived threats to the public sector revenue model, whereby the introduction of new models, especially those moving away from local government ownership could threaten much needed revenues
- Few successful mini grid precedent projects from which to take learnings

Pilot projects were developed by the government to explore the potential of mini grids for poverty alleviation, and to demonstrate the technology. These projects were the Lucingweni project and the Hluleka project. For Lucingweni the timeframes imposed on the project's development phase meant there was insufficient community engagement prior to the start of the project. Crucially, the neighbouring villages were also not engaged, and they felt that it was unfair for the host settlement to be getting free electricity. This led to recurrent vandalism which forced the village to store the equipment in the control house, dismantling the system. In Hluleka, which served a nature reserve, the management organisation failed to prevent visitors and locals coming to the site and doing household tasks such as ironing. This led to inefficient operation from overuse of the system, including use of its backup diesel generators.

The business model employed for mini grid development has a major impact on the success or failure of the projects and for the South African context, a public-private partnership (PPP) has been predicted to be the most optimal for mini grid development. Under these PPPs, the municipalities would be the driver of the projects and would coordinate with supply chain agents for technical assistance, construction and operation. The benefits of a PPP model versus alternatives for South African mini grids are numerous:

- Municipalities, or Eskom, are responsible for electricity distribution and the connection of customers, so are already the driver of electrification in their region. The municipalities may therefore also have greater access to communities and data than private developers.
- The PPP model is preferred as municipalities don't have the capacity to deliver mini grids without the support of stakeholders like implementing technical organisations.

- Community models are not seen as viable currently in South Africa due to a mixture of factors, including the poor perception of renewable energy and mini grids by the users, the expectation of future grid connection and a lack of technical capacity and understanding of regulations, funding and relevant stakeholders.
- Specific public funding for electrification is available, notably through the Integrated National Electrification Programme (INEP) administered by the MNRE, that may be accessed by municipalities (and passed through to private sector operators) for off-grid projects once the business model is demonstrated and projects form part of Integrated Development Plans (IDPs)
- Municipal or local government support would help unlock international funding for mini grid schemes. This funding is available due to mini grids' potential role in poverty alleviation and rural development.

A PPP model for rural electrification in South Africa addresses many of the challenges to off-grid electrification but, as experienced from the Lucingweni and the Hluleka pilots, there needs to be bottom-up, stakeholder engagement prior to the deployment of the mini grid to inform the local context and manage expectations to foster buy-in from the end-users.

Table 4: Active support programmes in South Africa

Programme	Main activities
Africa Clean Energy Corridor	The ACEC is the result of discussions and engagement between more than 30 governments, organisation, development partners and financial institutions. It aims to address Africa's rapidly expanding electricity needs with a larger share of clean, indigenous, practical, cost-effective, and sustainable renewable energy options. The objectives of the programme are to accelerate the development of renewable energy resources in the Southern African Power Pool (SAPP) and the East African Power Pool (EAPP), to coordinate planning and develop regional electricity infrastructure to create a North-South corridor and to ultimately establish a regional interconnected grid powered by renewable energies.
Renewable Energy Independent Power Producers Procurement Programme (REIPPPP)	The REIPPPP is the national electricity procurement programme under which the country's current renewable energy capacity was procured by Eskom. The programme operates independently to Eskom and is operated as a competitive auction with multiple bidding rounds, with technologies capped in accordance with ministerial determinations in each round. The IPP Office administers the programme and is responsible for adjudicating the applications and facilitating the PPAs with Eskom.
renewAfrica Initiative	The renewAfrica Initiative aims to gather a working group of experts from the European Commission, think tanks and academia, development, commercial and multilateral banks and industrial players to create a one-stop-shop for renewable energy support in Africa. This will promote dialogue between public and private institutions, facilitate finance through project de-risking and the provision of support guarantees and insurances, provide technical assistance and standardised project documentation for developers and build capacity through knowledge and skills transfers at all levels.
Clean Cooking Alliance	South Africa is a partner country in the Global Alliance for Clean Cookstoves under the UN. The programme aims to strengthen the supply of efficient, clean cookstoves and fuels for cooking through capacity building and direct investment. It also seeks to enhance demand for clean and efficient cookstoves and fuels through both behavioural change campaigns and research and knowledge dissemination.
Power Africa	Power Africa through USAID aims to electrify 60 million households and businesses on and off the grid and add 30 GW of clean, efficient electricity generation capacity throughout Africa. South Africa is a member country of the programme, and the focus has mainly been directed towards off-grid electrification.
Cleaner Fossil Fuels programme	Directed by SANEDI, the Cleaner Fossil Fuels programme's mission is to improve the efficient use of the country's finite resources in an environmentally suitable manner. The goal is to achieve this through clean coal technologies and carbon capture and storage, the latter of which has been named as one of the flagship national priority programmes in the National Climate Change Response White Paper.

ENERGYCATALYST	
Climate Change Response Public Works Flagship Programme	This programme is made up of many sub-programmes which together aim to protect, restore and preserve the country's physical environment, promote green economic initiatives, and integrate sustainable rural development and urban renewal. The programme is implemented by the government and implementing agents, including public entities and community-based organisations.
Energy Efficiency and Energy Demand Management Near-Term Priority Flagship Programme (EEEDM)	Giving effect to the National Energy Efficiency Strategy (NEES), which guides the development and implementation of energy efficiency practices in South Africa, the EEEDM seeks to reduce the energy intensity of the industrial, transportation, mining and buildings sectors of South Africa.
The Waste Management Flagship Programme	This programme aims to mitigate emissions from these sources by addressing barriers to the implementation of mitigation projects in the waste sector, demonstrating real-world approaches to project implementation and attracting investment in the sector. Waste-to-energy is a key component in the waste management programme as a means to reduce GHG emissions and attract investment into this field.
South African Smart Grids Initiative (SASGI)	Established by SANEDI, the SASGI was developed to coordinate and facilitate the smart grid vision for South Africa, establish working groups and think tanks to share and develop knowledge about smart grids, assess the opportunities for smart grid supply options as integrated with the current supply system, and engage with public and key stakeholders on the development of off-grid/smart grid projects.
Public Private Infrastructure Advisory Facility (PPIAF)	The PPIAF aims to improve the enabling environment for investment in infrastructure projects through creating a conducive political, legal and regulatory environment, and building institutional and government capacity that would attract private investment. Funding is sourced from multilateral and donor finance institutions and international development banks. South Africa is a priority middle-income country for this programme.
Energy and Environment Partnership Trust Fund (EEP Africa)	EEP Africa is a clean energy financing facility hosted and managed by the Nordic Development Fund (NDF) with funding from Austria, Finland and NDF. It provides early-stage grant and catalytic financing to clean energy projects, technologies and businesses. In South Africa, EEP Africa has funded over 40 projects and is currently funding a waste-to-energy project taking the wastewater from the fast-moving consumer goods (FMCG) sector to generate electricity and improve water use efficiency, as well as a hybrid renewable energy study in Cape Town.

Industry associations

South African Petroleum Industry Association (SAPIA) works with the petroleum industry to promote inclusive social and economic growth of the sector. It aims to further the role of the oil and gas sector through strategic partnerships with industry stakeholders, participating in regulatory discussions and sharing knowledge and resources between members.

Electric Vehicle Industry Association (EVIA) has been established under the SANEDI Cleaner Mobility programme to create awareness about EVs in South Africa, promote e-mobility through policy and regulatory framework development and enhance cooperation between the private and public sectors.

South Africa Wind Energy Association (SAWEA) represents the interests of the wind industry in South Africa and has members from the public and private sector, as well as international organisations across the value chain. SAWEA is active in the research, policy and regulatory environment to create a conducive environment for the wind industry and reduce the barriers to developing wind projects.

South Africa PV Industry Association (SAPVIA) promotes the growth of South Africa's solar PV market, provides representation of the solar PV to provincial and national governments, and is active in policy and regulation discussions. SAPVIA has members across the value chain from developers, manufacturers and service providers for utility and the small-scale.

Southern African Solar Thermal and Electricity Association (SASTELA) promotes the deployment and development of CSP and solar thermal technologies in the SADC region and seeks to achieve localisation and industrialisation of the CSP components in the SADC region.

South African Independent Power Producers Association (SAIPPA) promotes the interest of IPPs across all forms of energy generation and represents the industry's interests.

Southern Africa Biogas Industry Association (SABIA) represents the players in the biogas industry, promotes the needs of industry stakeholders and facilitates the development of a prosperous biogas industry in Southern Africa.

South African Local Government Association (SALGA) is an autonomous association of all 257 South African local governments with a mandate to support local government through representation within the system of government and helping local governments achieve their developmental obligations.

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https://www.gov.uk/foreign-travel-advice/south-africa

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