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A REVIEW OF SOUTH AFRICA'S ELECTRICITY SECTOR

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Report edited by Sheila Barradas, David Shepherd and Ria Theron.

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To subscribe to *Research Channel Africa* or purchase this report contact:

Creamer Media (Pty) Ltd

Tel +27 11 622 3744

Email subscriptions@creamermmedia.co.za

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LIST OF ABBREVIATIONS AND ACRONYMS

AAGR	annual average growth rate
BNEF	BloombergNEF
CER	Centre for Environmental Rights
CBIPPPP	Coal Baseload Independent Power Producer Procurement Programme
CPI	consumer price index
CSIR	Council for Scientific and Industrial Research
CSP	concentrated solar power
DEA	Department of Environmental Affairs
DoE	Department of Energy
EAF	energy availability factor
EIA	US Energy Information Administration
EU	European Union
IPP	independent power producer
IPPPP	independent power producer procurement programme
IRP	Integrated Resource Plan
LCOE	levelised cost of energy
LNG	liquefied natural gas
LNG IPPPP	Liquefied Natural Gas-to-Power Independent Power Producer Procurement Programme
MEMP	municipal energy master plan
MES	minimum emission standards
MYPD	multiyear price determination
Nersa	National Energy Regulator of South Africa
NUM	National Union of Mineworkers
Numsa	National Union of Metalworkers of South Africa
OCGT	open-cycle gas turbine
PPA	power purchase agreement
PV	photovoltaic
RCA	regulatory clearing account
REIPPPP	Renewable Energy Independent Power Producer Procurement Programme
Salga	South African Local Government Association
SGP	strategic grid plan
SSEG	small-scale embedded generation
tcf	trillion cubic feet
TDP	transmission development plan
ToU	time of use
USTDA	US Trade and Development Agency



KEY DEVELOPMENTS

February 2018: Jeff Radebe becomes South Africa's sixth Energy Minister in five years, succeeding David Mahlobo following a Cabinet reshuffle. Pravin Gordhan is appointed new Public Enterprises Minister, succeeding Lynne Brown.

February 2018: Ratings agency Standard & Poor's downgrades State-owned power utility Eskom to CCC+. The ratings agency says the utility is at risk of facing a distressed exchange situation or default, despite securing R30-billion in short-term funding from local and international funders.

March 2018: Energy Minister Jeff Radebe announces that agreements will be concluded with 27 renewable-energy projects selected as preferred bidders in 2015. However, the planned March 13 signing is postponed, owing to a last-minute legal challenge.

March 2018: Ratings agency Moody's Investors Service downgrades power firm Eskom's long-term corporate family rating from B1 to B2 and the zero coupon eurobonds to the same rating. The rating action reflects that, despite a number of improvements at the company pertaining to its corporate governance and liquidity, there is limited visibility about plans for placing Eskom's longer-term business and financial position on a sustainable footing.

April 2018: Energy Minister Jeff Radebe declares a "new dawn" for private renewable-energy projects, as power purchase agreements are concluded with 27 projects that were selected as preferred bidders in the Renewable Energy Independent Power Producer Procurement Programme.

April 2018: President Cyril Ramaphosa refers allegations of mismanagement and graft at State-owned power utility Eskom to the Special Investigating Unit.

April 2018: The National Energy Regulator of South Africa holds public hearings into Eskom's third Multi-Year Price Determination Regulatory Clearing Account applications, through which it aims to recoup R66.60-billion. Several organisations voice their opposition to the applications, which will increase the country's electricity prices.

May 2018: Electricity producer Eskom reverses its policy of not investing in cost-plus coal mines. The group will resume investing in the sustenance of mines that supply it with coal on a cost-plus basis. This forms part of a three-pronged coal procurement strategy. The other two pillars are the selection of bidders to supply an additional 100-million tons of coal over five years and finalising a 60-year coal-supply contract for the Kusile power station, in Mpumalanga.

May 2018: Interim Eskom CEO Phakamani Hadebe is confirmed as CEO of the State-owned utility, ending a string of acting appointments stretching back to 2016.

July 2018: Jan Oberholzer is appointed COO of Eskom in a new position created to help stabilise the organisation. Eskom now has a three-person executive team, comprising a CEO, a CFO and a COO.

July 2018: State-owned power utility Eskom reports a net loss of R2.30-billion for the financial year ended March 31, 2018. This

compares with a profit of R900-million in 2017. The firm also secures a R33-billion loan from the China Development Bank as part of funding for its build programme, with emphasis on the Kusile power station, in Mpumalanga.

August 2018: A three-year wage agreement is reached between Eskom, the National Union of Mineworkers, the National Union of Metalworkers of South Africa and Solidarity. Employees will receive salary adjustments of 7.50% in 2018/19, followed by 7% for each of the following two years.

August 2018: Energy Minister Jeff Radebe releases the much-anticipated draft updated Integrated Resource Plan for a 60-day public comment period, providing insight into South Africa's electricity generation plans until 2030. The document states that the "least-cost plan" for the next 12 years contains only solar photovoltaic, onshore wind, and gas, and, thus, no new nuclear and new coal. Nevertheless, five policy adjustments have been made to the least-cost path.

September 2018: The African Development Bank approves a R2.87-billion loan for Eskom to upgrade and expand its transmission facilities.

October 2018: Ratings agency Fitch Ratings affirms Eskom's long-term local currency issuer default rating and unguaranteed local currency senior unsecured ratings of 'BB-'. It also affirms the government-guaranteed local currency senior unsecured debt ratings at 'BB+', which is in line with the rating of South Africa, at a 'BB+' outlook, and resolves to remove the rating watch negative instituted by it in January 2018.

October 2018: The steam pressure from the boiler at Unit 5 of the Lethabo power station, in Mpumalanga, ruptures, killing one employee and injuring another. The incident renders the unit out of service for a minimum of three months.

October 2018: Unit 2 at the Limpopo-based Medupi coal-fired power station is synchronised to the national grid. The unit produces its first power on October 8.

November 2018: Electricity firm Eskom reports an interim loss of R671-million for the period ended September 2018, compared with R6.30-billion a year earlier. The utility signals that it could record a R15-billion-plus loss for the financial year ending March 31, 2019.

November 2018: Eskom starts implementing load-shedding to prevent the collapse of the power grid, as its generation business suffers from coal shortages and a breakdown of its power plant.

December 2018: President Cyril Ramaphosa appoints the 'Eskom Sustainability Task Team' to advise government on actions to resolve the State-owned power company's operational, structural and financial challenges. The team initially includes Anton Eberhard, Brian Dames, Tsakani Mthombeni, Sy Gourrah, Grové Steyn, Frans Baleni, Mick Davis and Busisiwe Vilakazi, but Dames and Gourrah subsequently stepped down, owing to potential conflicts of interest.



January 2019: The National Energy Regulator of South Africa holds public hearings on Eskom's application to increase electricity tariffs by 15% a year for the next three years. The application receives fierce opposition from various corners. Eskom is bankrupt and says it requires the increase to avoid its debt hitting R600-billion.

February 2019: A consortium of local and international banks agree to lend struggling power company Eskom R15-billion.

February 2019: Power firm Eskom unveils several changes to its sales and production assumptions for the three years covered by the fourth multiyear price determination submission before the National Energy Regulator of South Africa. These changes mean that the utility is seeking yearly hikes of 17.10%, 15.40% and 15.50% for 2019/20, 2022/21 and 2021/22, respectively. Eskom initially sought three hikes of 15% a year.

February 2019: President Cyril Ramaphosa announces that Eskom will be split in three State-owned entities, but denies that it is a precursor to privatisation.

February 2019: South Africa suffers a prolonged period of load-shedding. On February 11, Stage 4 load-shedding was implemented after Eskom lost 40% of its generating capacity with seven generating units tripping. Public Enterprises Minister Pravin Gordhan announces that external engineers and auditors will be hired to get to the bottom of the State-owned group's operational difficulties. President Cyril Ramaphosa establishes a special Cabinet task team to deal with the Eskom crisis and provide him with daily reports on the power grid.

March 2019: The National Energy Regulator of South Africa grants power utility Eskom increases of 9.40% for 2019/20, 8.10% for 2020/21, and 5.20% for 2021/22 in terms of the fourth multiyear price determination period (MYPD). The regulator also approves an additional 4.40% tariff increase in terms of the third MYPD regulatory clearing account application for Year 5, which, in effect, will result in the electricity tariff for 2019/20 increasing by 13.90%. The increases amount to a compounded increase of 9.70% over three years, which is 24% higher than the current electricity tariff.



Picture by Creamer Media

Kelvin coal-fired power station, in Gauteng





Picture by Power Gen and DistributeCH Africa

OVERVIEW

South Africa's electricity industry is in dire straits. The country, at the start of 2019, suffered one of its worst series of power cuts in a decade, conjuring up memories of the 2008 crisis when the grid nearly collapsed, and threatening President Cyril Ramaphosa's government plans to revive the struggling economy.

The main role player is State-owned power utility Eskom. Bloated by debt and severely damaged by years of corruption and maladministration, Eskom is struggling to navigate a magnitude of operational and financial crises.

Operationally, the business is weak. Its fleet performance has deteriorated significantly, owing to a lack of maintenance and refurbishments over the years, greatly compromising security of supply.

The group's new, expensive mega coal-fired power stations are yet to be completed and the units that are operational are prone to tripping. Coal shortages and the supply of substandard coal have compounded the problem.

The electricity provider is also financially bankrupt. Its debt has reached an unsustainable R419-billion and is set to rise further. Eskom is not generating sufficient cash to cover its operating costs, repay interest on its debt and meet its debt obligations. Operating costs have increased sharply, while demand for electricity has been declining.

The utility also requires more tariff hikes to be cost-reflective, despite a sixfold increase in nominal tariffs. The sharp increase in electricity prices has constricted demand growth and has made alternatives more commercially feasible.

Unable to trade itself out of its financial difficulties, Eskom is the most significant risk to South Africa's economy. Ramaphosa has made reforming the ailing business a top priority and announced in his February 2019 State of the Nation address that the utility would be split into three separate State-owned businesses under Eskom Holdings to bring greater transparency to the financial and operational issues confronting generation, transmission and distribution.

The plan arose from a recommendation of a task team established in December 2018, to advise government on Eskom's sustainability. Trade unions are opposing the plan, which they perceive as a precursor to retrenchments and privatisation, but government insists that it is necessary to stabilise Eskom's finances and operations.

Government is also propping up Eskom with a R23-billion-a-year bailout, but the fiscal support is directly tied to a restructuring of the business, with Finance Minister Tito Mboweni arguing that "pouring money into Eskom in its current form is like pouring water into a sieve". The financial support will help Eskom service its debts and meet redemption requirements, while making resources available for urgent operational improvements.

The splitting up of Eskom into separate companies will set the sector on a new path and is in line with the 1998 Energy Policy White Paper, which intended that Eskom be restructured into separate generation and transmission companies and that independent distributors be established.

Government says the unbundling will also position the electricity sector to embrace clean technology, diversify the mix across



a multitude of power producers and provide a platform for contracting least-cost and secure power.

South Africa has already started a partial shift from centralised, coal-based energy production to a more decentralised generation system, through the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP).

Once globally acclaimed, the REIPPPP suffered a protracted period of uncertainty by Eskom's refusal to sign new power purchase

agreements (PPAs) between 2015 and 2018. The REIPPPP was resuscitated in April 2018, when PPAs were signed with 27 independent power producers.

More renewable-energy contracts are expected to be awarded to private companies, once a long-term plan for the country's electricity industry is finalised in March 2019. The draft Integrated Resource Plan, which was gazetted in August 2018, indicates that wind, solar and gas will be the main technologies for new electricity capacity to be procured within the next 12 years.



Picture by Bloomberg

Electricity pylons





Picture by Bloomberg

STATE-OWNED ESKOM

GENERATION PERFORMANCE

Eskom operates 30 power stations with a total nominal capacity of 45 561 MW, of which 37 868 MW are coal-fired stations, 1 860 MW nuclear power, 2 724 MW pumped-storage, 600 MW hydrostations, 2 409 MW gas-fired and 100 MW wind power.

The group's network consists of 381 594 km of high-, medium- and low-voltage power lines and 285 737 MVA substation capacity.

The electricity that Eskom generates, together with imports and that produced by independent power producers (IPPs), is supplied in bulk to municipalities, as well as to industrial, commercial, residential and other customers. In the 2017/18 financial year, Eskom generated 221 936 GWh of electricity and sold 212 190 GWh.

Eskom is operating an ageing fleet and its plant availability – measured by the energy availability factor (EAF) – has steadily declined over the past decade. Owing to capacity and financial limitations, the midlife refurbishment and enhancement projects that are required to maintain and improve technical performance as plants age, have generally not been implemented. Together with high plant utilisation, this has led to a steady decline in the EAF over the past decade.

The EAF was 78% in 2017/18, better than the low point of 72% in 2014/15, but the improvement was short-lived. Load-shedding restarted briefly in June 2018, for the first time since 2015, following sabotage during wage negotiations. Further load-shedding followed in November 2018, owing to an unexpected high number of plant outages. The EAF fell to 66.50% during

South Africa's electricity capacity	
Name of station	Nominal capacity
Nominal capacity of Eskom-owned power stations	45 561 MW
<i>Coal-fired stations</i>	<i>37 868 MW</i>
<i>Nuclear power</i>	<i>1 860 MW</i>
<i>Pumped-storage</i>	<i>2 724 MW</i>
<i>Hydrostations</i>	<i>600 MW</i>
<i>Gas-fired stations</i>	<i>2 409 MW</i>
<i>Sere Wind Farm</i>	<i>100 MW</i>
Independent power producer capacity	4 779 MW
<i>Concentrating solar power</i>	<i>300 MW</i>
<i>Gas/liquid fuel</i>	<i>1 005 MW</i>
<i>Hydroelectric</i>	<i>14 MW</i>
<i>Landfill</i>	<i>8 MW</i>
<i>Solar photovoltaic</i>	<i>1 474 MW</i>
<i>Wind</i>	<i>1 978 MW</i>
Total nominal capacity available to the grid	50 340 MW

Source: Eskom

that month, significantly below the aspirational target of 80%. In February 2019, the system was again under severe pressure, when on February 11, seven generating units tripped in a space of five hours. With 40% of its capacity offline, Eskom resorted to implementing Stage 4 load-shedding, which calls for 4 000 MW to be rotationally shed nationally.

Contributing to the low EAF is the underperformance of the much-delayed new generation capacity in which Eskom has invested. Between April and December 2018, the Medupi coal-fired power



station's EAF was below 70%. Unit 1 of the station was shut for repairs for three months from the start of September to the end of November 2018.

Pressure on the system was compounded by a fatal incident at the Lethabo power station, in Mpumalanga, in October 2018. The live steam pressure from the boiler in Unit 5 ruptured, resulting in the power station being out of service for about three months. Lethabo is one of Eskom's most cost-effective generators with adequate access to a steady coal supply.

The deterioration of the operational performance of the group's coal fleet coincided with an acute coal shortage, which at one point left ten Eskom stations with stockholdings below the 20 days stipulated by South Africa's Grid Code. Of those, five had less than ten days of stock.

A tight supply-demand balance not only forced Eskom to implement power cuts, but also to rely more on the expensive diesel-fuelled open-cycle gas turbines (OCGT). The utility is budgeting to spend between R750-million and R1-billion more on diesel in the 2018/19 financial year, although the group had to resort to burning R100-million a day worth of diesel during the February electricity supply crisis.

Eskom announced a nine-point recovery plan in November 2018 to return the EAF to 75% by November 2019, although it subsequently indicated to the National Energy Regulator of South Africa that its EAF will hover at about 72% until 2022.

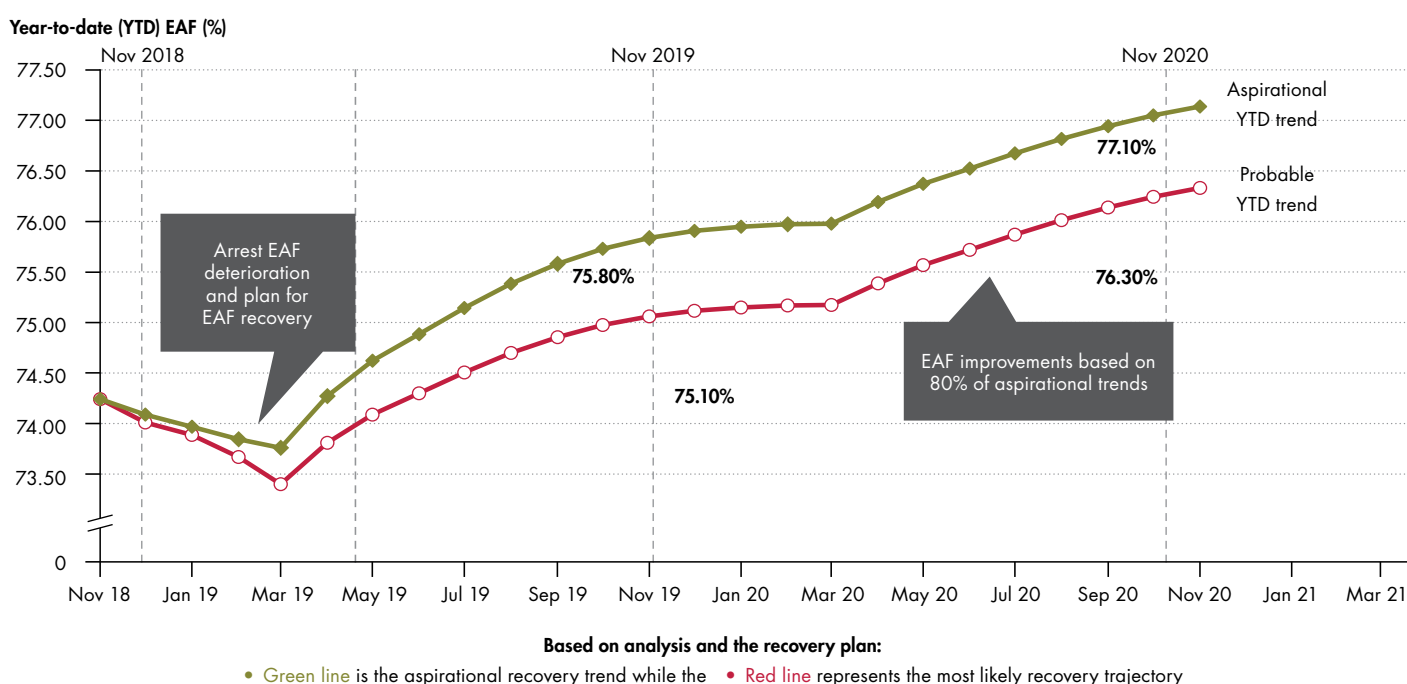
The key elements of the nine-point plan include:

- investing a further R1.50-billion in the new Medupi and Kusile coal-fired power stations, in Limpopo and Mpumalanga, respectively, to address design weaknesses.
- fixing full load losses and trips by improving maintenance planning, accelerating procurement processes and refining spares management.
- fixing units on long-term forced outages, such as Lethabo Unit 5, Duvha Unit 4, Grootvlei Unit 2 and Kriel Unit 2.
- addressing partial load losses by investing R11.50-billion during the implementation of 59 outages across the fleet between September 2018 and December 2019.
- reducing the slippage of outage schedules by improving planning and execution.
- improving human resource accountability by appointing permanent power station managers and increasing their authority to make procurement and operational decisions.
- preparing for increased OCGT use.
- preparing for heavy rainfall during the summer months and the impact of extended periods of wet weather on coal handling.
- fixing coal stockpiles.

It is crucial that Eskom return the EAF to 75% and above, as the group's 'Medium-Term System Adequacy Outlook for 2018 to 2023' indicates that at an EAF of 71%, the system is inadequate, regardless of a medium- or low-growth forecast.

The group's generation unit is also suffering from a loss of critical skills. Large numbers of experienced staff have left the

Comparison of Eskom's aspirational versus achievable EAF for November 2018 to November 2020



Source: Eskom



organisation in recent years, with a report indicating that up to 40% of technical breakdowns are owing to the “human factor”. Eskom is considering bringing back experienced people on a contract basis in the short to medium term to stabilise the situation at its power stations. Many people, some with 40 years of technical and managerial experience, have left Eskom to work at coal-fired power stations, which are being built in countries like the Philippines and Cambodia.

Following the February 2019 load-shedding, Eskom agreed to bring in external engineers and auditors to investigate of the crisis.

The Eskom board has also expanded the executive team to include a COO. In July 2018, Jan Oberholzer – a former senior employee – returned to Eskom to serve in the newly created position. Oberholzer has 38 years of working experience, of which 24 were at Eskom where he held various positions, including that of COO of the distribution division. Prior to his return to Eskom, he led the improvement of a number of hydropower plants in Zambia.

Capacity expansion

The 4 764 MW Medupi and the 4 800 MW Kusile coal-fired power stations, located in Limpopo and Mpumalanga, respectively, are the centrepieces of Eskom’s expansion programme, but a decade after construction started, these power stations are still unfinished and the units that are operational are fraught with design flaws and are not performing according to design specifications.

Three of the six units at Medupi are in commercial operation. The first unit, Unit 6, achieved commercial operation in August 2015 and was followed by Unit 5 in April 2017. Unit 4 was synchronised in May 2017, and achieved commercial operation status in November that year. These three units have a total installed capacity of 2 387 MW.

Medupi’s Units 3 and 2 were synchronised to the grid in April and October 2018, respectively, and will reach commercial operation within six to nine months from the date of synchronisation.

The first unit of Kusile was brought into full commercial operation in August 2017. Unit 2 of Kusile was synchronised to the grid in March the following year.

One additional unit from each of Medupi and Kusile will be placed in commercial operation each year, resulting in the last Medupi unit becoming operational in 2020/21 and the last Kusile unit in 2022/23.

The new build programmes will add an additional 5 721 MW between 2019 and 2023.

The Medupi and Kusile units that have been brought into commercial operations, however, are underperforming and will require R2-billion to fix. The three Medupi units and the one Kusile unit currently in commercial operation have, for the financial year to date, experienced a total of 84 units trips, Eskom technology GM Titus Mathe reported in February 2019. Medupi unit trips rose from 20 during the 2018 financial year to 66 in the 2019 financial year, which runs to the end of March.

While Eskom previously described the poor performance of the four units as “teething problems”, it has since emerged that the problems could be more fundamental, particularly with regard to the performance of the boilers, the grinding mills and the fabric filters.

Mathe says the major design and technical problems that have been discovered mostly pertain to the boilers, which Japanese conglomerate Hitachi Power Systems Africa is building.

It is not the first time that Hitachi’s work at Medupi has been found to be defective. In 2013, 10 000 welding faults were discovered when Hitachi failed to heat-treat the welds. It also failed a crucial steam test in 2015. Hitachi’s award to build the boilers has been controversial from the start, owing to its partnership with the ruling African National Congress’ investment company, Chancellor House.

Some of the technical issues identified include:

- the boiler spray systems being unable to cope, owing to a design that has resulted in higher-than-expected temperatures at the reheater.
- excessive wearing of fabric filter plant bags, which is resulting in ash blockages, trips, load losses and emissions-related losses.
- the milling plants at Medupi are failing to meet technical requirements, which has halved the time between servicing intervals, negatively affected coal quality and resulted in partial load losses.
- the gas air heater performance and fouling is not meeting technical requirements.
- problems with the dust handling plant, which are leading to high ash accumulation, leaks and more frequent maintenance, which is resulting in a lack of spare parts.
- hardware failures on the distributed control system at two Medupi units is leading to trips.
- high vibrations on the generator auxiliary cooling loop.

Eskom has established a specialist task team to develop solutions to rectify major defects and work streams have been established with contractors to jointly evaluate solutions. Eskom aims to



have technical solutions for all the defects by August 2018. It will then enter into commercial negotiations with contractors regarding liability for the defects and on how the repairs will be implemented. Some of the repairs will require the units to be on outage, which means that the defects will probably be repaired in phases from about 2021 onwards.

A forensic investigation is also under way to understand the problems and the reasons for the doubling in the capital budgets of the two megaprojects. The cost of both projects has increased substantially from their initial budgets. It is estimated that, combined, these two power stations will cost the country about R300-billion. According to the latest estimates, Medupi has a budget of R145-billion, compared with an initial budget of R69.10-billion in 2007, while Kusile has a budget of R161.40-billion. These amounts exclude capitalised borrowing costs.

Consultancy Meridian Economics has proposed that Eskom curtail work at Kusile to save costs, arguing that it could be done without threatening security of supply. Meridian MD Dr Grove Steyn has calculated that putting a halt to Kusile Units 5 and 6, combined with the early decommissioning of the Grootvlei, Hendrina and Komati power stations, could yield net financial savings of between R15-billion and R17-billion. Such a move has been ruled out by the utility, which says that it makes no sense as it will incur contractual penalties.

Oberholzer explained in a December 2018 interview with EE Publishers why the construction of Medupi and Kusile should be finished: "Due to the contracting strategy and the fact that the units at each of Medupi and Kusile are not self-standing, but rely on common services, most of the capital expansion cost is sunk anyway, with little saving if we stop now. Yes, there are design and execution issues, with units handed over to Eskom Generation not delivering their rated output. There is work still to be done, and it will take more time and money. But we have the people to do it, and the problems will be ironed out in due course."

Energy expert Professor Anton Eberhard from the UCT Graduate School of Business, has warned that Medupi and Kusile could be stranded assets, as these were committed to at a time when a global energy transition got under way.

The third big-ticket item in the capital expansion programme was the Ingula pumped-storage scheme, on the border of KwaZulu-Natal and the Free State. The four units of 1 332 MW each were brought into operation between March 2016 and January 2017. The project cost R29.30-billion.

Eskom also built a 100 MW wind farm, in Vredendal, in the Western Cape, which entered into commercial operation in

Eskom's capital division head resigns

Eskom group capital division executive Abram Masango resigned on November 16, 2018, a day after the utility suspended him pending an investigation into various allegations of impropriety against him relating to the Kusile power station project.

In April 2018, a disciplinary hearing found Masango innocent of charges of misconduct levelled against him, following a forensic investigation, which made allegations of serious misconduct against him. Masango was first placed on suspension in November 2017. He was on suspension when the new board assumed office in late January 2018.

Source: Eskom

2015. The wind farm was approved together with a 100 MW concentrated solar power (CSP) project, in the Northern Cape, as part of the \$3.75-billion World Bank loan extended to the group in 2010 to help fund Medupi and Kusile.

Eskom has decided against continuing with the Kiwano CSP project and the World Bank has allowed for a restructuring of the project to enable an investigation of clean-energy alternatives. It has determined that a 360 MW/1 440 MWh battery storage solution would be a suitable replacement. The battery energy storage systems project will involve the deployment of battery solutions ranging in size from 1 MW to 60 MW across 90 sites. The average size of an installation will be 4 MW/16 MWh. In October 2018, *Engineering News* reported that Eskom was conducting a due diligence exercise to identify suitable sites, to define which applications would be targeted. A tender for the 200 MW/800 MWh first phase should be released to the market during the first quarter of 2019, and contracts should be awarded in the second quarter, with construction, testing and commissioning expected before the end of 2019.

Coal supply

Eskom is the main user of coal in South Africa and buys about half of what is produced by local coal miners every year. In the 2017/18 financial year, the company bought 115.25-million tons of coal, compared with 120.25-million tons in 2016/17, and paid an average of 3.80% more for each ton of coal it bought.

The South African Grid Code requires the entity to maintain stock levels at an average of 20 days, but Eskom is experiencing a shortage of coal at several of its power stations.

Eskom's normalised stock days (excluding stock at Medupi, Kusile and excess supply at Lethabo) stood at 28 days in March 2018, which was short of the company's target of 37 days, but still



within the requirements of the grid code. By April, seven power stations fell short of the grid code threshold and by October, ten of its 15 power stations did not have adequate stock, with five stations having less than ten days of stock.

The coal shortages have been attributed to historical underinvestment at coal-plus mines, as well as the fact that beleaguered Gupta-linked Tegeta Resources, which supplies coal to several of Eskom's power stations, entered into business rescue in early 2018. Besides volumes, there is also a concern about the poor quality of coal. Oberholzer has called on mining companies to "play ball" and improve the quality of the coal they supply to Eskom.

Eskom is pursuing two coal-buying initiatives to address low levels of coal stock at its plants. The first was announced in April 2018, when it emerged that stock levels at Arnot, Tutuka, Majuba, Hendrina, Camden, Kriel and Komati stations were below the required target of 20 days. This initiative entails a recovery plan to secure additional coal suppliers for the affected power stations, and to redirect coal from some of its other power stations with higher stocks to the affected power stations in Mpumalanga.

The second initiative followed the October revelation of severe coal shortages and focuses on buying four-million tons of emergency coal to bolster overall stock levels to 37 days by March 2019. At the end of January, coal stocks stood at 29 days.

The coal shortages experienced represent what analysts are saying is the first instalment of South Africa's long-anticipated "coal cliff", as the Eskom-tied mines no longer deliver enough feedstock to cover demand. Cost-plus mines are contracted

to supply Eskom with 55-million tons a year, but are currently supplying only 40-million tons a year, owing to underinvestment in the operations.

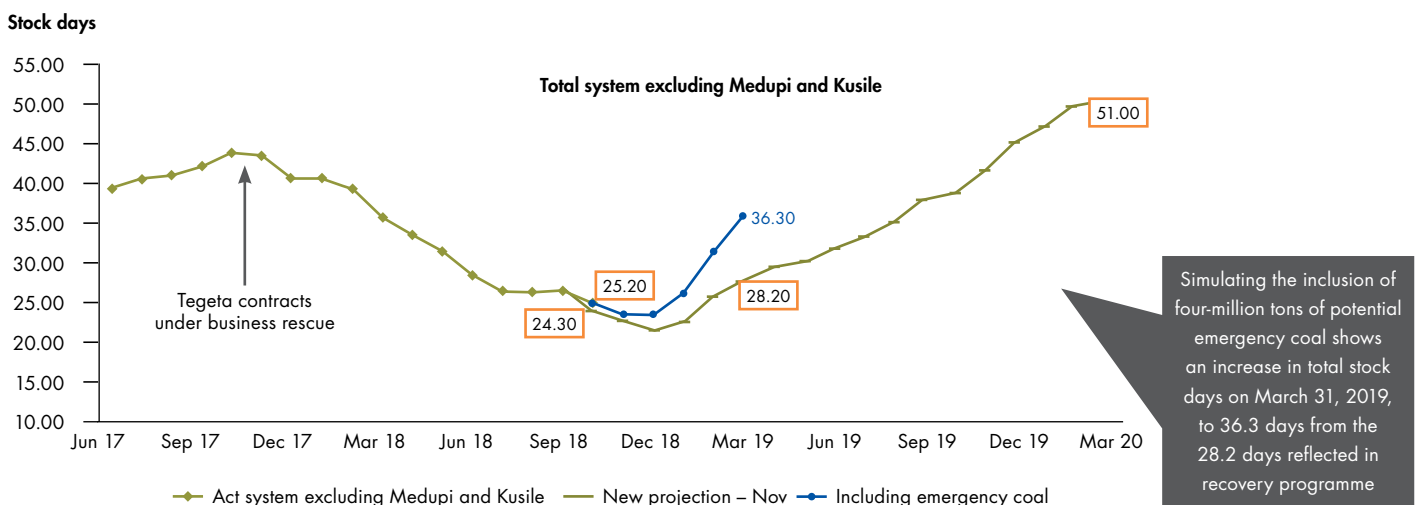
Energy analyst Ted Blom, who in 2007 served on the Coal Taskforce, has reminded the public that Eskom had been warned that it would face a "coal cliff". At the time, Eskom announced an immediate commitment to establish at least 40 new coal mines, but more than a decade after the announcement, no new Eskom-tied mines have come to fruition. Under former Eskom CEO Brian Molefe, the utility in 2016 abandoned the cost-plus mines model.

The utility has now confirmed that it expects a 1.30-billion-ton coal shortfall over the remaining life of its power station fleet. The shortfall takes into account the decommissioning of 12 000 MW of coal-fired capacity in line with the schedule outlined in the draft updated Integrated Resource Plan, which assumes that the Medupi and Kusile power stations will be operational until 2050.

The Eskom board has also approved a strategy to revert coal supply to long-term contracts to avoid a repeat of the recent shortages. Since January 2018, 35 new contracts have been concluded for the supply of 94-million tons of coal, 18.60-million tons of which will be supplied during the 2018/19 financial year.

The long-term strategy also prioritises investments at Eskom's five cost-plus mines, reversing the controversial strategy under Molefe that favoured arms-length supply agreements over investment in mines established with the specific purpose of supplying the nearby power station with coal using conveyor belts. The utility will invest between R10-billion and R12-billion in coal mines. These investments will unlock 223-million tons of

The impact of four-million tonnes of emergency coal on the total stock days



Source: Eskom



Two top executives quit

Eskom's group executive for generation, Thava Govender, tendered his resignation in October 2018, only months after assuming the position.

Govender, who was also acting group executive of risk and sustainability, had worked for Eskom for 27 years. During that time, Govender served in various capacities, including as group executive of transmission and customer services and as the divisional executive of generation division.

Johnny Dladla also resigned in October 2018, as CEO of Eskom Rotek Industries, an Eskom subsidiary, which provides construction, maintenance and transportation services in support of the power utility's operations.

Source: African News Agency

coal between 2020 and 2035 and reduce the overall shortfall to about one-billion tons.

Where cost-plus investments and contract extensions are not feasible, the utility aims to extend existing contracts that are aligned with the remaining operating life spans of the stations.

Eskom is also at an advanced stage in finalising a rail solution to direct coal from Medupi, in Limpopo, to Kendal, in Mpumalanga, using rail infrastructure at mining firm Exxaro's Grootegeeluk mine. Medupi has a coal surplus of 15-million tons, as a result of construction delays. Eskom will rail 1.40-million tons a year to Kendal. It is understood that the cost of using Medupi coal at Kendal is competitive, relative to Kendal's next best alternatives.

Coal from Medupi, however, is not considered a primary or a long-term source for Kendal.

The railing of Medupi coal forms part of Eskom's road-to-rail strategy. In the next three to five years, Eskom is aiming to divert about 20-million tons of the 40-million tons a year of the coal that is currently transported by road to rail.

Air-quality retrofitting

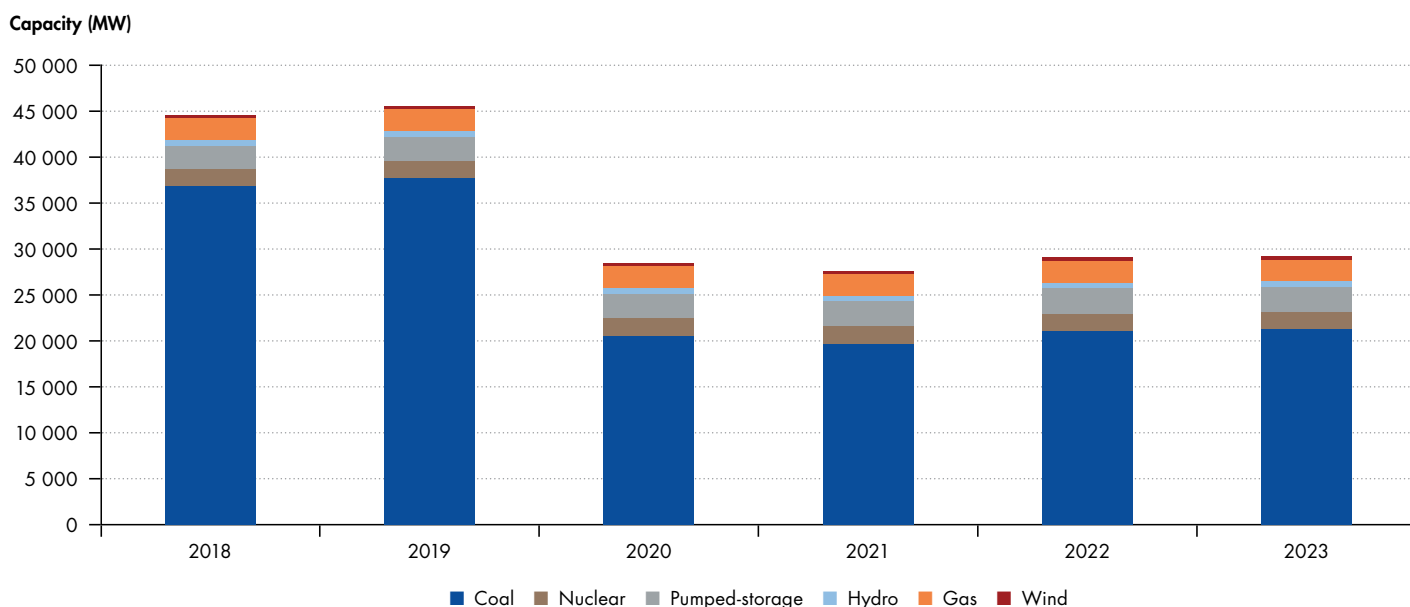
Eskom is legally bound to comply with minimum emission standards (MES) at all its power stations. The MES were promulgated in 2010 and required Eskom to comply with existing standards by 2015, and for existing plants to comply with new standards by 2020.

A number of Eskom power stations, including Majuba, Tutuka, Duvha, Matla, Kriel and Grootvlei, require extensive emission abatement retrofits to ensure compliance with the law. Funding constraints or logistical impediments, such as compatibility of new technologies with ageing Eskom stations, are constraining the retrofitting process.

A postponement application to delay compliance by five years was granted to Eskom in 2015. The group is applying for further postponements to fully implement the MES.

Should all emission projects not be concluded and the Department of Environmental Affairs (DEA) not allow additional postponements, a number of units will be impacted on and may be derated or

Eskom installed capacity without air-quality compliance



Source: Eskom



shut down. That scenario will lead to a reduction in the total Eskom system capacity to below 30 000 MW by 2020.

The DEA has announced that an expert panel will be assembled to provide strategic and technical guidance on the effective management of sulphur dioxide emissions from existing power generation plants. The Centre for Environmental Rights (CER), however, has questioned the need for another panel assessment, stating that the necessary work had already been done when the MES was set up. The CER has called on Sasol and Eskom to either retrofit their plants with sulphur dioxide abatement technology or start an expedited plan to decommission their plants that cannot meet MES.

According to the CER, the South African MES for existing plants is 17.5 times weaker than those in China, Germany and the European Union (EU); nearly six times weaker than India's; and almost five times weaker than Indonesia's. The MES for new plants are still 14 times weaker than those in China, five times weaker than those in India, and three times weaker than those in Germany and the EU.

The Kusile power station is the first coal-fired power plant in Africa to implement clean fuel technology, such as flue-gas desulphurisation. US group GE Power has successfully completed performance tests of the wet flue gas desulphurisation plant at Unit 1 of Kusile. During its performance tests, the plant exceeded original performance commitments as it achieved 93% removal efficiency rate.

ELECTRICITY DEMAND

In the 2017/18 financial year, Eskom sold 212 190 GWh of electricity, of which 196 922 GWh were local sales and 15 268 GWh sales to countries in Southern Africa. However,

the electricity producer has been haemorrhaging customers, particularly energy-intensive clients, which have been forced to adjust to load-shedding and surging tariffs.

Eskom states that South Africa's power consumption has declined by about 0.50% a year on average, since 2006. The biggest decline has been among the large power users, which have reduced their usage by about 17% over the past ten years.

Demand is forecast to be flat over the next few years. Eskom's 'Medium-Term System Adequacy Outlook for 2018 to 2023', published in October 2018, has derived two energy demand trajectories for the country, based on a moderate- and low-growth scenario. The moderate energy forecast has an annual average growth rate (AAGR) of 1.90%, while the low energy forecast is based on an AAGR of 0.64%.

The utility is pursuing strategies to increase sales by about 1% a year over the medium term. Some of these include the 'Demand Response Morning Peak Sales' programme, which since its launch in July 2017 achieved 10 400 GWh in incremental sales. Additional sales were derived by incentivising increased usage in the last hour of the morning peak period (between 08:00 and 09:00), by billing additional volumes at a lower rate.

Eskom has also launched a two-year sales incentive pilot programme, focusing on electricity-intensive users. The pilot programme aims to stimulate additional sales of up to 5 000 GWh and generate revenue of R3-billion over two years. The companies participating in the programme include businesses in the gold and platinum mining, aluminium, steel, ferrochrome and manganese sectors.

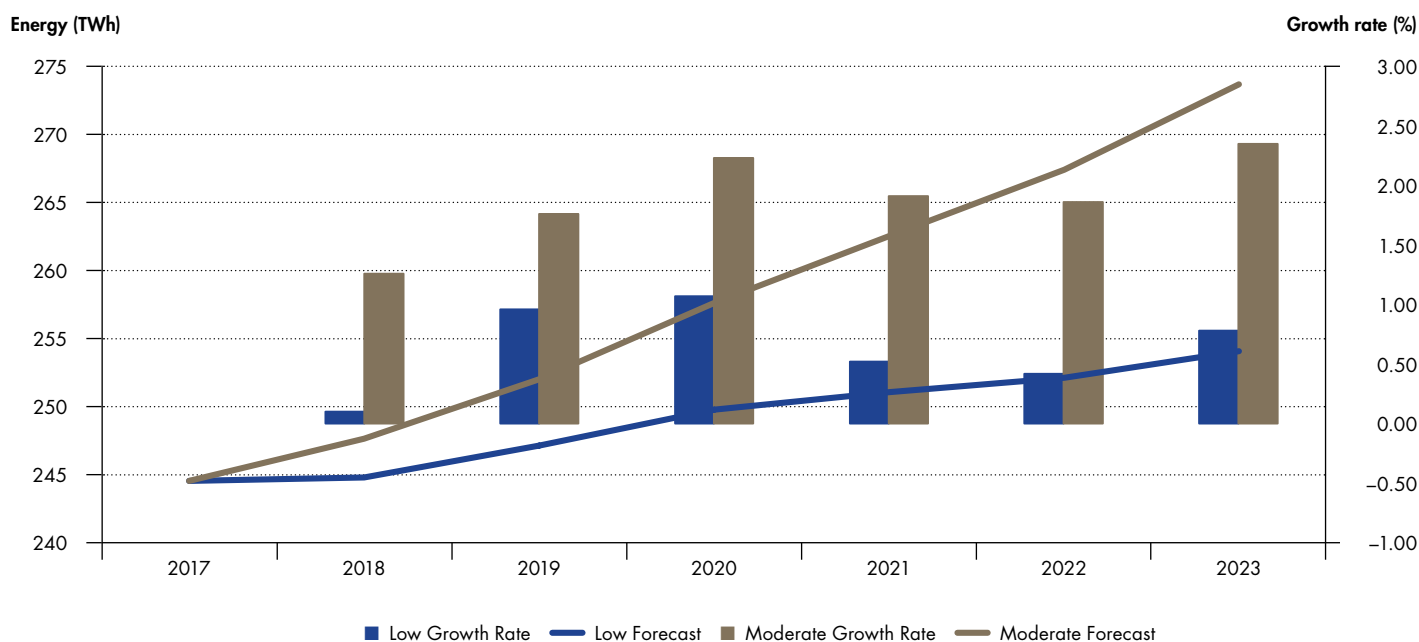
Electricity sales for each customer category – GWh

	2017/18	2016/17	2015/16	2014/15	2013/14
Local	196 922	199 028	201 022	204 274	205 525
Distributors	87 133	89 718	89 591	91 090	91 262
Residential	12 302	11 863	11 917	11 586	11 017
Commercial	10 539	10 339	10 150	9 644	9 605
Industrial	47 854	48 295	50 150	53 467	54 658
Mining	30 235	30 559	30 629	29 988	30 667
Agricultural	5 711	5 405	5 733	5 401	5 191
Rail	3 148	2 849	2 852	3 098	3 125
International	15 268	15 093	13 465	12 000	12 378
Utilities	6 384	5 750	4 018	2 797	3 401
End users across the border	8 884	9 342	9 447	9 203	8 977
Total	212 190	214 121	214 487	216 274	217 903

Source: Eskom



Energy demand forecast and growth rate



Source: Eskom

In parallel, Eskom is investigating an industry tariff intended to facilitate the stabilisation and growth of sales to electricity-intensive industries. The new tariff, should it proceed, will involve a shift to more cost-reflective tariffs by recognising the high load factor impact on Eskom's unit energy cost and minimising cross-subsidy contributions. The current tariffs charged by Eskom to the large high-voltage customers, such as key industrial customers and metropolitan municipalities, contain a number of explicit and implicit subsidies, cross-subsidies, levies, surcharges and special taxes that, in some cases, represent more than 12% of the total cost paid. The tariff will be subject to other criteria, such as assistance with load control, should the system be constrained.

Separately, Eskom has entered into a two-year special pricing agreement for Silicone Smelters, which resulted in the resumption of production at the company's Polokwane and eMalahleni smelters.

FINANCIAL PERFORMANCE

Eskom is in a state of severe financial difficulty and its financial performance has deteriorated to the point where without fiscal support from government, the company is not expected to last beyond April 2019.

Chairperson Jabu Mabuza has admitted that the group is locked in a permanent loss-making position. Its revenue growth is structurally constrained, operating expenditure has ballooned

owing to internal inefficiencies and its debt-load is impossibly high. Essentially, Eskom is not selling enough electricity and not at prices that recover its costs throughout the value chain, despite a sharp increase in tariffs, which in nominal terms have increased from 20c/kWh in 2008 to above 90c/kWh in 2018.

The utility is projecting a record R15-billion-plus loss for the 2018/19, up from the R11.20-billion budgeted for at the beginning of the financial year. It reported an 89% drop in interim net profit, from R6.30-billion at the end of September 2017, to R671-million at the end of September 2018. Historically, any profitability generated during the first half of the year is eroded during the second half, owing to lower summer tariffs and higher planned maintenance.

Against this, the company is unable to afford to repay its debt from declining profits and is borrowing more, at higher costs, to repay what it previously borrowed. Debt has risen from R40-billion in 2007, to R419-billion and is projected to increase to R600-billion by 2023, unless actions are taken to contain the debt.

In the six months ended September 2018, Eskom generated R26.67-billion from operating activities, which is R18.55-billion short of the R45.22-billion it needed to service its debt. However, the figure was inflated by the repayment of a R20-billion bridging loan secured from South African banks in February 2018, to stave off the utility's governance-induced liquidity crisis.



Nonpayment for electricity by municipalities is exacerbating the group's financial problems. Municipal debt had escalated to R17-billion by September 2018, a 25% increase from R13.60-billion in March that year. Invoiced Soweto arrear debts increased to R12.60-billion.

Eskom has reported that its initiatives to encourage municipal payments are having little effect and has called for government intervention to resolve the impasse. The Department of Cooperative Governance and Traditional Affairs has indicated that Cabinet will consider a detailed implementation plan to deal with the debt municipalities owe to Eskom.

Eskom's employee costs have also risen sharply in recent years. The Department of Public Enterprises reports that employees grew from 32 000 in 2007, to 48 000 by 2018. The associated costs grew from R9.50-billion to R29.50-billion.

Although the group has been freezing posts and stopped bonuses and increases at managerial levels, its hand was forced during the 2018 wage negotiations with labour unions. Following a wage strike, which was marred by incidences of sabotage, the National Union of Metalworkers of South Africa (Numsa) and the National Union of Mineworkers (NUM) acceded to a settlement proposal of a 7.50% increase for 2018 and a 7% increase for 2019 and 2020, plus a housing allowance and a R10 000 one-off bonus.

Retrenching workers will be a politically charged issue and unions have indicated that they will shut down the national grid if the power firm lays off staff. The World Bank has benchmarked Eskom with other comparable utilities around the world and has found that it is 50% overstaffed, although an internal estimate is that the State-owned firm is 33% overstaffed.

Excluding Eskom's salary bill, Eskom has committed to accelerate cost compression to more than R20-billion a year by 2022.

On a positive note, Eskom's liquidity has improved and by the end of August 2018, it had already secured 73% of the R72.08-billion funding for the 2018/19 financial year, with 17% funded for 2019/20.

However, CFO Carim Cassim has said that Eskom cannot solve the financial sustainability challenges that it faces alone. Although a yet-to-be-announced turnaround plan will aim to yield about R30-billion in savings over the next five years, ultimately, a solution for its financial problems will impact on either the electricity consumer or the taxpayer. Eskom has requested more tariff hikes, but executives have pointed out that it is not a silver bullet to restoring the firm's financial sustainability.

Eskom has already received substantial shareholder support in the form of equity and loan guarantees. A R60-billion shareholder loan was converted into equity in 2015 and the utility also received a further R23-billion equity injection in March 2016. In addition, government approved R350-billion in guarantees on Eskom's debt. By the end of September 2018, Eskom had drawn on all but R14-billion worth of those guarantees.

Eskom has requested government to take on R100-billion of its debt, but in the February 2019 Budget, Finance Minister Tito Mboweni turned down the proposal and instead announced R23-billion a year in financial assistance. Over a three-year period, the assistance will amount to R69-billion.

The R23-billion will allow Eskom to service its debts and meet redemption requirements, while making resources available for urgent operational improvements.

The injection is conditional on the restructuring of Eskom and the appointment of a chief reorganisation officer, who will be responsible for ensuring that the recommendations of the Presidential task team on Eskom are implemented.

Beyond the medium term, the National Treasury indicates the size of support will depend on several factors, including economic growth, tariffs and the implementation of Eskom's strategy. Treasury's cash injections will come to R230-billion over a decade.

Tariffs

The National Energy Regulator of South Africa (Nersa) determines Eskom's revenue requirement, based on tariff applications.

The country transitioned to a multiyear tariff dispensation in 2006 to provide price visibility about the price path. The third five-year multiyear price determination (MYPD3) ended on March 31, 2018. Eskom submitted a one-year revenue application for 2018/19, owing to legal uncertainty, at the time, over the regulatory clearing account (RCA) mechanism of the MYPD methodology, which allows for adjustments to be made in instances of under- or over-recovery by the utility.

Following public hearings, Eskom was granted a 5.23% tariff increase for 2018/19, which allows for revenue of R190.35-billion for the financial year, instead of the 19.90% for which it applied. Eskom has expressed its disappointment at the increase and has approached the courts to have Nersa's 5.23% tariff determination for 2018/19 set aside for failing to adhere to the MYPD methodology, as well as government's policy of transitioning electricity tariffs towards cost reflectivity.



Eskom has said that, together with the 2.20% increase for 2017/18, the group managed to secure an average increase of 3.72% for the two years, which it argues is inadequate to ensure the recovery of costs, while earning a fair return on assets. This follows increases of 12.96% and 9.40% for 2015/16 and 2016/17 respectively, based on the 8% awarded under MYPD3, together with the recovery of the RCA balances awarded in those years.

In 2018, Eskom applied to recover R66.60-billion through three RCA applications dealing with the 2014/15, 2015/16 and 2016/17 financial years, with Nersa only allowing a recovery of R32.70-billion, phased over a four-year period beginning in 2019/20. This means that Eskom's 2019/20 tariff will increase by 4.41% before any other adjustments that could arise as a result of the MYPD4.

Under the MYPD4, Eskom initially applied for allowable revenue of R219-billion for 2019/20, R252-billion for 2020/21 and R291-billion for 2021/22. If granted, this would have equated to tariff hikes of 15% a year over the three years, before any RCA allowances, increasing the standard tariff from 94c/kWh to 143c/kWh by March 31, 2022.

Eskom subsequently made adjustments to its revenue application, which meant that the requested increases amount to 17.10%, 15.40% and 15.50% in the three years of the MYPD4. The revised application is based on a lower sales forecast for the coming three years, as well as adjustments to its production plan as a result of a decision to shut down 24 coal units, primarily at the Hendrina, Grootvlei and Komati power stations.

Eskom has submitted an RCA application for the 2017/18 financial year, through which it aims to recover R20-billion in cost and revenue variances.

Nersa dealt with the MYPD4 application and the 2017/18 RCA application simultaneously and held public hearings on both matters in January and February 2019. At the hearings, Eskom CEO Phakamani Hadebe highlighted the poor state in which Eskom's finances were and argued that a steep increase was needed to alleviate its financial pressure.

The application was met with resistance from various corners, with the Organisation Undoing Tax Abuse arguing that Eskom should be granted an increase of only 5%, which is in line with the consumer price index (CPI). It called on Eskom to find savings by reducing its headcount and staff cost, along with returning to lower primary costs by undoing the inflated and often corrupt contracts entered into during the previous dispensation.

The Energy Intensive Users Group, which represents the mining and industrial companies that collectively constitute 40% of

Eskom's yearly sales, has called for an electricity price compact that sustains tariff increases as close to CPI as possible. The organisation argues that electricity tariffs, together with price-path uncertainty, represent the biggest threat to large power users in South Africa, and says the tipping point has been reached for many sectors.

Minerals Council South Africa has warned that the hikes sought will render almost all gold operations (95%), representing 96% of gold production, loss-making or marginal in a short period of three years.

Ted Blom from Mining and Energy Advisers called on Nersa to scrap an increase determination until it had received a forensic report into corruption and maladministration in Eskom, arguing that Eskom is "grossly inefficient" and "still captured". He also slammed the utility for taking too long to produce a turnaround plan to stem its escalating debt, while it is losing more than R2-billion a month.

On March 7, Nersa announced its decision on the Eskom application and granted the utility allowable revenue of R206.38-billion for 2019/20, which will translate into a tariff increase of 9.41% from April 1, exclusive of the 4.41% hike sanctioned following an adjudication, in 2018, of three Eskom RCA applications. Tariffs to direct customers will increase by 13.82% on April 1 and increases for municipal customers will follow on July 1.

The regulator also granted further increases of 8.10% and 5.22% for 2020/21 and 2021/22 respectively. This equates to allowable revenue of R221.84-billion in 2020/21 and R233.08-billion. The regulator further allowed Eskom the right to claw-back R3.869-billion in line with its review of a 2017/18 RCA application, which was adjudicated together with the MYPD4 submission.

MINING AND ELECTRICITY

The mining industry is one of the major electricity consumers in South Africa and was severely impacted by the power crisis of 2008, when Eskom sent letters to mining companies saying that it could no longer guarantee uninterrupted power supply. At the time, the utility ordered mining companies to evacuate their underground staff and cease operations for five days to keep electricity usage at a minimum.

A decade later, mining companies are better prepared to cope with scheduled power supply interruptions. Miners have been taking steps to reduce consumption and shield themselves from Eskom outages. In terms of a 2010 agreement between Eskom and miners, the utility gives the industry notice to reduce their



consumption by between 15% and 20% when the national grid is at its tightest.

Harmony Gold CEO Peter Steenkamp reports that the gold miner has “drastically reduced” its consumption of electricity. What the company is doing in the near-term is scheduling its hoisting and milling in operations where it has redundancy. It clips its consumption load where catch-up is possible later and has also put technologies in place to enable the company to deliver ventilation, refrigeration and water services on demand and not around the clock, as old mine designs allowed.

Mining companies are also studying own generation alternatives to reduce their reliance on Eskom, which has increased its electricity costs sixfold in the past decade.

Anglo American Platinum is considering a 100 MW plant to supply the Mogalakwena mine, in Limpopo. Its strategy involves engaging a third-party solar power company to build, own and operate the plant.

Harmony is also considering options of self-generation and is investigating a 30 MW solar plant in Welkom, in the Free State. The company reports that solar will come in at below Eskom prices.

Sibanye-Stillwater has been studying a 150 MW solar plant on the West Rand of Gauteng since 2014, but it has

been delayed by red tape. The first phase of 50 MW has been postponed to 2019.

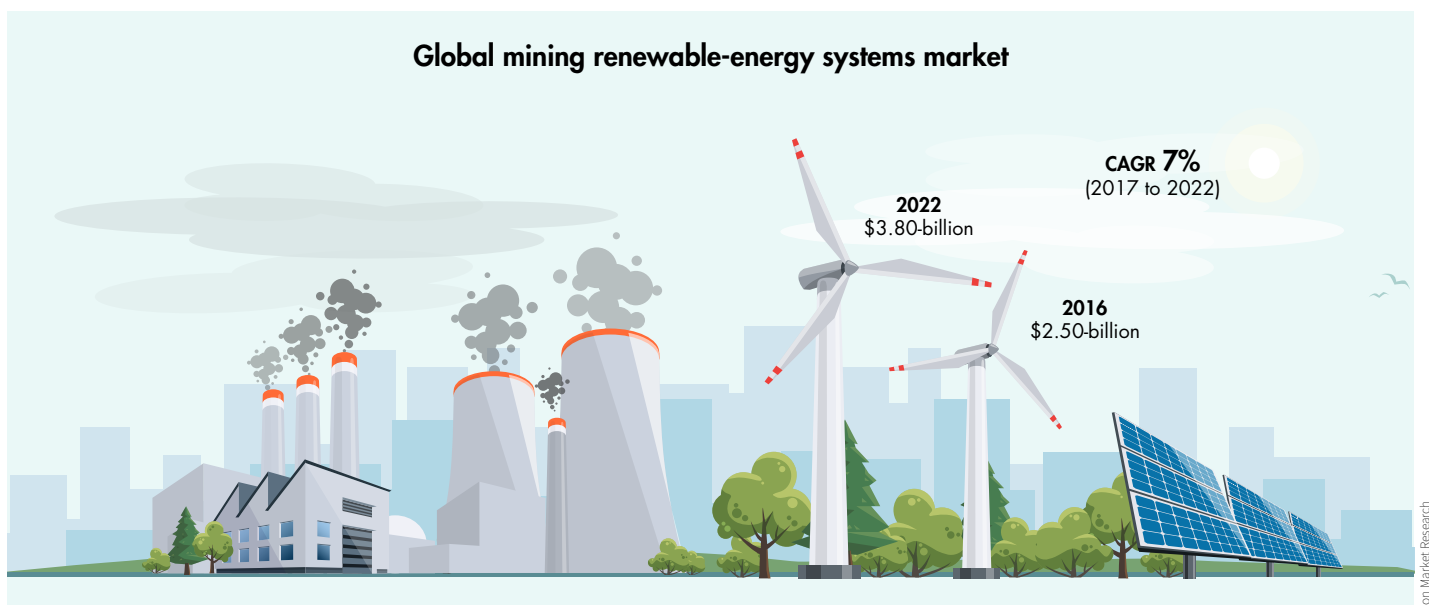
Royal Bafokeng Platinum is doing a study on potential solar energy for its Bafokeng Rasimone Platinum Mine, in North West, and for its housing development in Rustenburg. Results of the study are expected towards the end of 2019.

However, mining companies will not be completely off the grid any time soon, as the size and cost of solar power required to power mines and processing plants will be an investment that will require several decades to come to fruition. There is also a realisation that, should mining companies take their business off the grid, it will severely hurt Eskom’s revenue and accelerate the utility death spiral.

The sharp increase in electricity tariffs since 2006 has had a severe impact on the industry. The Minerals Council South Africa estimates that the tariff increases between 2006 and 2017 have cost the mining industry 53 500 jobs and more than R100-billion in fixed investment that was foregone.

Electricity is the single-largest cost component of the gold mining industry in South Africa, comprising about 16% of the total input costs.

It is also difficult to beneficiate minerals, such as manganese and chromium, if the price of electricity is too high. Minerals Resources Minister Gwede Mantashe wants a power price arrangement for certain categories of customers.



Mining companies are taking an interest in renewable-energy systems to integrate into their mining operations

*CAGR – compound annual growth rate



ESKOM UNBUNDLING

A high-level 'Eskom Sustainability Task Team' of industry experts and academics was appointed in December 2018 to advise government on actions to resolve the organisation's challenges.

The task team initially comprised eight members, but following the resignation of former Eskom CEO Brian Dames and Actom Power head Sy Gourrah over potential conflict of interest, the team comprised energy policy expert Anton Eberhard, chairperson of the Energy Intensive Users Group Tsakani Mthombeni, economist Grové Steyn, former NUM general secretary Frans Baleni, mining magnet Mick Davis and CSIR senior researcher Busisiwe Vilakazi.

The team was charged with assessing the operational, structural and financial viability of Eskom, including key assumptions around life of plant, impact and cost of environment commitment, as well as demand assumptions. It also reviewed the turnaround strategy submitted by the Eskom board of directors.

The task team handed its report to the President at the end of January, and helped inform the announcement in the State of the Nation address in February that Eskom will be separated into three independent companies of generation, transmission and distribution.

The unbundling process, in government's view, will bolster accountability and transparency and enable the managers of the different entities to pay focused attention to turning around the different parts of the business. The reorganisation should also crowd-in private finance and allow lenders to more accurately assess and reflect the risks of the underlying businesses when funding them.

The first step in the separation process will be to transfer a portion of Eskom's assets to a new transmission company, which will invite the participation of strategic equity partners that will provide capital for the business and strengthen oversight. Government insists that the inclusion of a strategic equity partner in the national grid company to be formed in mid-2019 does not amount to privatisation.

Trade unions have voiced their strong opposition to proposals to split up Eskom. Numsa and the NUM, two of the biggest unions at the power utility, have threatened to strike if the split goes ahead, arguing that it is the precursor to privatisation. The President has stressed that there will be "meaningful consultation and dialogue with all key stakeholders".

Mboweni has said that splitting Eskom will "logically" result in greater competition in generation and multiple participants in distribution, but has indicated that the national grid will remain

Eskom clean-up under way

Since the appointment of the Jabu Mabuza-led board in January 2018, Eskom has made notable strides in its clean-up campaign to rid the organisation of corrupt employees and restore its credibility.

Several executives and staff members have been implicated in serious allegations of misconduct and Mabuza reported in November 2018, that 14 executives had left the institution since the inception of the clean-up campaign.

Irregular supplier contracts worth R2.30-billion had been uncovered and reported to relevant authorities.

Lifestyle audits for executives and senior managers are under way and will be completed by the end of March 2019. Mabuza says that the audit process includes validating declaration of interests against Eskom's vendor data base to ensure that none of its employees are doing business with the company.

Meanwhile, lawmakers referred the names of three former chairpersons of Eskom to law enforcement agencies in November 2018 for further investigation, after they found the individuals conducted themselves unethically and possibly criminally during their time at Eskom.

Zola Tsotsi, Ben Ngubane and Zethembe Khoza, together with former CEOs Brian Molefe and Matshela Koko, are among the names that Parliament's Portfolio Committee on Public Enterprises has asked the Directorate of Priority Crime Investigation to focus in its probe.

Fundudzi Forensic Services, which the National Treasury contracted to investigate the appointment of McKinsey & Co to advise Eskom and Transnet, recommended in November 2018 criminal investigations against Molefe and Koko, among others.

Source: Eskom, Bloomberg News

a "monopoly". He has also called on South Africans to support the introduction of multiple participants in generation, as it will ensure alternative sources of supply in the event that Eskom is unable to generate.

The National Treasury has indicated that the decision to prioritise the creation of the transmission company is informed by an analysis showing that South Africa is lagging developments in the global electricity system.

The grid company will incorporate Eskom's existing transmission network assets, including power lines and substations, as well as all transmission-related servitudes and property rights currently held by Eskom. It will also house the national control centre, the system-operator assets, as well as Eskom's peaker stations, which currently include the pumped-storage hydroplants and the utility's OCGTs.

The transmission licence will be amended to allow for the buying and selling of electricity and transferred to the transmission company.



The transfer of employees to the new subsidiary, as well as the generation and distribution entities that will be created, will be finalised in line with the Labour Relations Act and will follow consultation and a new agreement with labour unions.

An independent board will be appointed by mid-2019 and the company will remain a subsidiary of Eskom Holdings.

A yet-to-be-appointed chief reorganisation officer will work with the board and management to implement the Eskom Sustainability Task Team recommendations.

Ratings agency Moody's says the splitting of Eskom into three entities will help with transparency, but that it does little to address the utility's financial challenges. Following the release of the February Budget, the agency – the only major one to have South Africa's sovereign above investment grade – pushed government for a detailed plan on Eskom's restructuring.

A downgrade from Moody's could assign South Africa to debt junk status, with the result that index-tracking portfolio funds, such as those tracked by the Citi World Global Bond index, will immediately flow out of South Africa. It is estimated that this could lead to outflows of \$10-billion, with catastrophic consequences for investment and growth.



Picture by AdobeStock





INDEPENDENT POWER PRODUCERS

Globally, constrained government budgets have necessitated increased infrastructural investments through private-sector financing options and South Africa's situation is no different from that of other countries. South Africa has said that it will increasingly use the private sector for infrastructure development, especially in the development, implementation and operation of energy infrastructure.

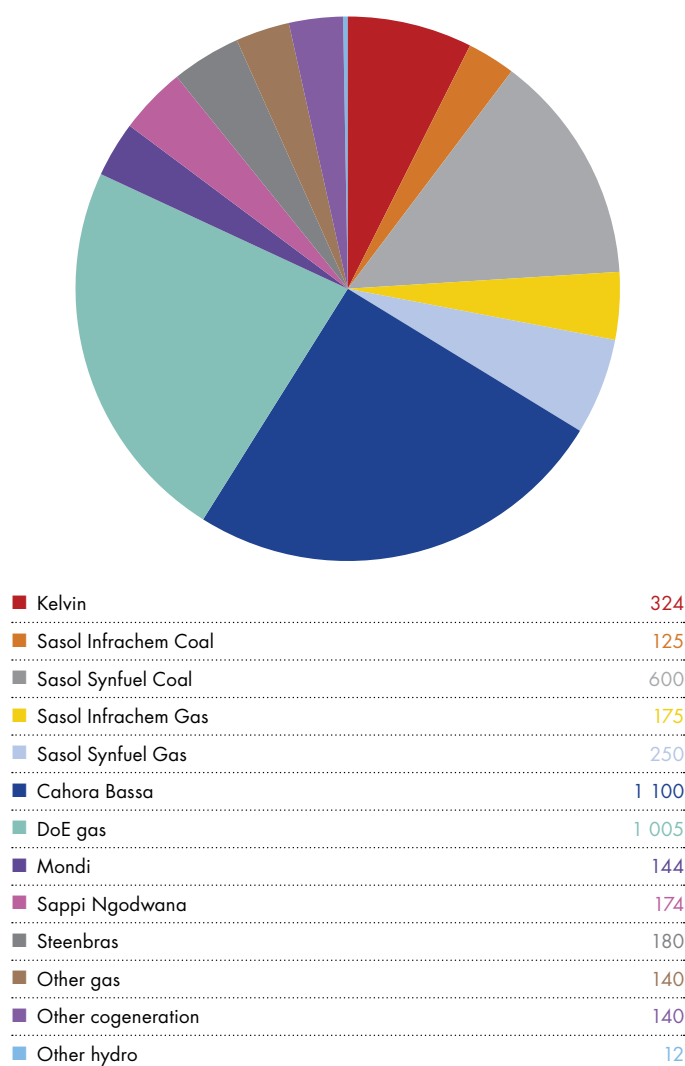
In this regard, the Independent Power Producer Procurement Programme (IPPPP) was established in 2010, to enhance the country's electricity generation capacity and introduce private investors to the sector. Initially, it was focused on renewable energy, but has subsequently branched out to nonrenewable sources.

Under the custodianship of the Department of Energy (DoE) and the National Treasury, the Independent Power Producer (IPP) Office implements the programme and procures electricity generated from private companies.

The programme faced serious challenges under the administration of former President Jacob Zuma, when Eskom, at the time run by Brian Molefe, refused to sign new power purchase agreements (PPAs) for renewable energy. The IPPPP has regained momentum under the Presidency of Cyril Ramaphosa, who in early 2018 overhauled the Eskom leadership and appointed Jeff Radebe Energy Minister.

Ministerial determinations have opened the door for 30 115 MW of capacity to be procured from the private sector, 14 275 MW of which will be from renewable-energy sources and 15 390 MW from nonrenewable sources. The draft updated Integrated Resources Plan (IRP2018) states that the Ministerial determinations for capacity beyond the bid window four of the REIPPPP have

Non-Eskom installed capacity



Source: Eskom



to reviewed and revised in line with the new projected system requirements.

By the end of June 2018, 6 422 MW of electricity had been procured from 112 renewable-energy IPPs, attracting a total investment of R201.80-billion, 24% of which was foreign investment.

Besides the Renewable Energy IPP Procurement Programme (REIPPPP), a Coal Baseload IPP Procurement Programme (CBIPPPP) is under way. The draft IRP2018 does not make provision for new coal capacity, other than the two private coal-fired power plants – Thabametsi and Khanyisa – under the initial phase of the CBIPPPP, as the focus has shifted to wind, solar and gas for new electricity generation capacity.

The gas-to-power programme is still in its infancy, but details of the gas strategy should start emerging once the IRP has been approved and formally gazetted. The IRP2018 places much emphasis on gas for electricity generation.

Besides the IPP programmes currently running, other existing non-Eskom installed capacity is already operating. This includes the privately-owned Kelvin power station, in Gauteng, four power stations at Sasol operations in Mpumalanga and the Free State, the DoE's gas IPPs, power stations commissioned by paper giants Mondi and Sappi, as well as the City of Cape Town's Steenbras hydroelectric scheme.

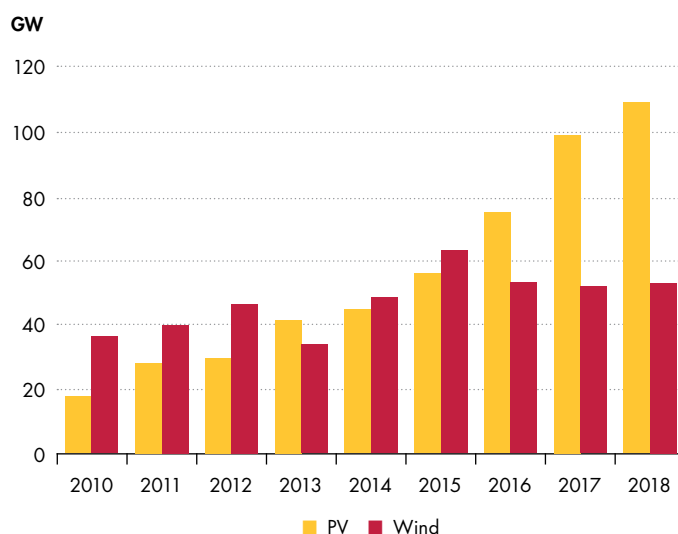
RENEWABLE ENERGY

Renewable energy has emerged at the forefront of the global energy landscape. In 2018, global clean energy investment exceeded \$300-billion for the fifth year in a row. Research company BloombergNEF (BNEF) states that global clean investments totalled \$332.10-billion in 2018, with wind investments comprising \$128.60-billion and solar investments \$130.80-billion of the total. Solar investments dropped by 24% in 2018, which is mainly attributed to sharply declining capital costs. BNEF's global benchmark for the cost of installing a megawatt of photovoltaic (PV) capacity fell by 12% in 2018.

In South Africa, renewable-energy technology is also expected to play an increasingly important role in the energy mix. The National Development Plan prioritises renewable energy and has proposed the introduction of 17 800 MW of renewable-energy capacity by 2030, a target exceeded by the draft IRP2018, which is expected to be approved in 2019.

The IRP2018 envisages that the energy mix will include 11 442 MW of onshore wind, 7 958 MW of solar PV and

Wind and solar photovoltaic capacity added worldwide



Source: BloombergNEF

Note that the capacity added figures in this chart are preliminary estimates

600 MW of concentrated solar power (CSP) by 2030. Wind, solar PV and flexible generators, such as gas, are considered the least-cost option, and allocations have been made for 8 100 MW of additional onshore wind capacity and 5 670 MW of additional solar PV.

Existing Ministerial determinations allow for 14 725 MW of renewable-energy capacity to be procured, including 1 500 MW for a solar park. The determinations were issued in August 2011 (3 725 MW), December 2012 (3 200 MW), August 2015 (6 300 MW) and May 2016 (1 500 MW).

To date, about 44% of the total targeted capacity has been procured. More than half of the wind power has been procured, with 3 357 MW, or 53%, of the 6 360 MW determined for wind having been signed off on. For CSP, 50%, or 600 MW has been procured. Power procured from solar PV has reached 37%, or 2 292 MW of the 6 225 MW determined, while only 14% of the 540 MW allocated to small hydro, landfill gas and biomass have been procured to date.

For small-scale renewable-energy projects, 400 MW have been determined and 49 MW has been procured under the first small-scale bid window and a further 50 MW under a second small-scale bid window. The combined 99 MW represents 25% of the allocated capacity for small projects and includes 80 MW from solar PV, 9 MW from wind power and 10 MW from biomass.

At June 30, 2018, 3 776 MW of capacity from the REIPPPP was in commercial production, including 1 980 MW of onshore wind, 1 474 MW of solar PV, 300 MW of CSP, 14 MW of hydro and 8 MW of landfill technology.



REIPPPP cumulative installed capacity, including commercially connected plants in MW

Technology	2018	2019	2020	2021	2022	2023
Wind	1 980	2 012	2 616	3 343	3 343	3 343
PV	1 474	1 964	2 287	2 287	2 287	2 287
CSP	500	500	600	600	600	600
Hydro	14	14	19	19	19	19
Landfill	8	8	8	8	8	8
Other	–	–	25	25	25	25
Total	3 976	4 498	5 555	6 282	6 282	6 282

Source: Eskom

The projects were built in a short lead time. The IPP Office reports that the projects procured in bid windows 1 to 3.5 have an average lead time of 686 days. In other words, the 3 776 MW was delivered in only 1.9 years.

The generation capacity was procured in several bid windows, including five rounds for larger renewable-energy projects and two rounds for smaller projects of 5 MW and less. The 112 IPPs selected are located across all nine provinces, although the Northern, Eastern and Western Cape are sharing the majority of the projects.

The REIPPPP has been singled out by some, including trade unions, the Economic Freedom Fighters and former Eskom officials, as posing a financial risk to the financially-wrecked Eskom. Radebe has dismissed the assertion, arguing that the renewable-energy IPPs are cost neutral to Eskom as the cost was passed on to the consumer.

Public Enterprises Minister Pravin Gordhan has mooted a potential renegotiation of contracts with projects in the first two rounds of the REIPPPP to “alleviate pressure on Eskom and the electricity tariff”. The tariffs during the first two rounds are higher than the subsequent rounds. A total of 47 projects were procured during the two bid windows at 20-year tariffs that are higher than those achieved in subsequent competitive auctions in 2013, 2014 and 2015.

However, Radebe has said that government will not renegotiate contracts, but that it is open to refinancing proposals from IPPs that could result in a lowering of costs.

The average solar PV tariffs, in 2018 prices, came in at R4.02/kWh in bid window one and R2.40/kWh in the second bidding round, while wind tariffs of R1.67/kWh and R1.31/kWh were achieved during the two bid windows. Tariffs bid for both technologies subsequently declined to R0.68/kWh in the so-called ‘expedited’ bid window of 2015, also referred to as Bid Window 4.5, which was cancelled by the DoE.

Renegotiating PPAs concluded with IPPs in 2011 and 2012 will be a breach of contract and will be damaging investor confidence in the REIPPPP, which is still recovering from a protracted period of uncertainty created by Eskom’s refusal in 2016 to sign PPAs for capacity procured in the previous year’s bid windows 3.5 and 4. At the time, Eskom argued that it could not afford the electricity, considering its return to a generation surplus.

These project agreements, including PPAs with Eskom, were signed in April 2018. The two rounds encompassed 27 projects, including 12 solar PV projects, 12 onshore wind developments, as well as a CSP project in the Northern Cape, a mini hydroproject, in the Free State, and a biomass project, in Mpumalanga.

Following the signing, Radebe indicated that a new bid window would be launched in November 2018, involving similar technologies as the so-called ‘expedited’ projects, for which bids were submitted in 2015. The ‘expedited’ bid window sought 1 800 MW of capacity and was open to unsuccessful bids in previous rounds, but its completion was delayed by the impasse with Eskom over the signing of IPPs. Nineteen projects participated, but were never officially procured.

The next bid window, however, is only expected after the formal publication and gazetting of the IRP2018. The new bidding round will provide government with an opportunity to accelerate its transformation agenda. Government has expressed its desire to enhance local manufacturing to ensure investment and economic growth, as well as pursuing opportunities for black industrialists and the development of black IPPs. There will also be a specific requirement that participation by women- and youth-owned businesses as part of IPP socioeconomic and enterprise development expenditure be more coordinated and integrated with the needs of the surrounding communities.

The bid window is expected to secure renewable-energy IPP investments to the value of R40-billion to R50-billion, contributing further to South Africa’s stated goal of ensuring the energy sector contributes \$25-billion of the \$100-billion investment target as set by Ramaphosa for the coming five years. The electricity sector



New renewables cheaper than existing coal – US study

A 2018 US study comparing the costs of energy from various generation technologies indicates that an “inflection point” has been reached where, in some cases, it is more cost effective to build and operate new renewable-energy projects than to maintain existing conventional generation plants.

Lazard’s ‘Levelised Cost of Energy (LCOE) Analysis’, shows that the cost of generating electricity from utility-scale solar photovoltaic (PV) and onshore wind continued to decline in 2017, with solar PV decreasing by 13% and onshore wind by almost 7%. Decreases since 2009 are more dramatic, with the mean unsubsidised LCOE for solar PV falling 88% and onshore wind decreasing by 69% over the nine years surveyed by Lazard in the report.

The analysis shows the “low-end” levelised cost of onshore wind-generated energy to be \$29/MWh, below the average illustrative marginal cost of \$36/MWh for coal in the US. The levelised cost of utility-scale solar, meanwhile, is stated to be nearly identical to the illustrative marginal cost of coal.

However, Lazard notes that the comparison is accentuated when renewables subsidies are considered. These result in levelised costs of energy of \$14/MWh and \$32/MWh for onshore wind and solar PV respectively.

“Although diversified energy resources are still required for a modern grid, we have reached an inflection point where, in some cases, it is more cost effective to build and operate new alternative energy projects than to maintain existing conventional generation plants,” Lazard power, energy and infrastructure group head George Bilicic says in a statement.

“As alternative energy costs continue to decline, storage remains the key to solving the problem of intermittency and we are beginning to see a clearer path forward for economic viability in storage technologies,” Bilicic adds.

Source: Eskom, Bloomberg News

already banked R56-billion towards that goal through the 27 renewable-energy projects signed in April.

Concern has been raised about the impact that a shift to renewable-energy generation will have on the local coal industry and its implication for jobs in the sector. Unions have indicated that they are not opposed to a renewable-energy shift, but feel that the transition has to be done in a way that protects the livelihoods of mining and energy workers. The South African Federation of Trade Unions claim that the roll-out of more bid windows for the REIPPPP will result in 40 000 job losses at mines, mostly in Mpumalanga.

The Council for Scientific and Industrial Research (CSIR) calculates 100 000 jobs will be lost in the coal sector by 2030, owing to the decommissioning of Eskom power stations, but that the net increase in employment will be 30 000 over

the same period. The CSIR, which used a customised International and Economic Development Impacts model to test the employment potential of generation technologies, has calculated that, in the period to 2030, 60 000 new jobs will be created in the gas sector, while the deployment of solar PV and wind will contribute up to 110 000 jobs. Overall, employment is expected to increase from about 365 000 jobs in 2020 to 395 000 in 2030.

Industry experts argue that a transition from coal to renewable energy in South Africa is possible, if the process is carefully managed.

COAL BASELOAD

The CBIPPPP was launched in 2015, acting on a Ministerial determination to procure 2 500 MW of coal-fired power from IPPs. The Ministerial determination was based on the dated IRP2010, which made provision for 6 250 MW of new coal-fired capacity from IPPs between 2014 and 2030.

The CBIPPPP is expected to be scaled back significantly, as the draft IRP2018 favours least-cost solutions and does not make provision for any new coal capacity, other than the two projects already procured. The IRP2018 includes 1 000 MW of new coal-fired capacity to cater for the Thabametsi and Khanyisa projects, which were named preferred bidders in October 2016.

Thabametsi is a 557.3 MW project, in Limpopo, and Khanyisa is a 306 MW project, in Mpumalanga. Japan’s Marubeni is leading the Thabametsi project consortium and Saudi Arabia’s ACWA Power is heading the Khanyisa project consortium.

Both projects are facing material resistance, which has intensified after the inclusion of the projects in the country’s electricity plan to 2030. Accommodating the two coal-fired power stations will cost the country a cumulative R23-billion more than the least-cost scenario of the IRP2018. Electricity consumers will pay 1.9c/kWh more by 2030 on a projected electricity tariff of 119c/kWh to include the power stations. The DoE has said that South Africa cannot renege on agreements for the two power stations, as it will cost the country in terms of penalties.

The Life After Coal campaign – a collaboration between Earthlife Africa, the Centre for Environmental Rights and groundwork – argues that the projects will lock South Africa into further dependence on expensive coal, while delaying the need to transition to a low-carbon future.

Radebe has expressed confidence that the two coal power stations will proceed, although media reports suggest that the projects could face funding pressures, with some South African



Kelvin power station may convert from coal to gas

A \$1.30-million feasibility study has been initiated into the prospect of converting the coal-fired Kelvin power station, east of Johannesburg, into a 450 MW to 600 MW gas-fired power station. The study will also assess the potential for developing the Kelvin site into a gas distribution hub for Gauteng, South Africa's industrial heartland.

The 12-month study is being funded through a US Trade and Development Agency (USTDA) grant, which has been awarded to NOVO Energy, a South African integrated natural gas company, owned by Harith General Partners.

The Kelvin power station was initially developed and owned by the City of Johannesburg in the 1950s and 1960s. The two-station facility has a nameplate capacity of 600 MW, but only one of Kelvin's two stations is currently operational. In 2001, the plant was sold to private investors, transforming Kelvin into the country's only coal-fired independent power producer, backed by a 20-year power purchase agreement with Johannesburg's electricity utility, City Power. Kelvin has since changed hands on several occasions

and is currently owned by Aldwych, which, like NOVO Energy, is also a Harith General Partners investment.

NOVO Energy CEO Andri Hugo tells *Engineering News* that gas sourcing will form a major portion of the study and that various options will be examined, including tapping into the Rompco pipeline, which transports gas from Mozambique to South Africa. Rompco is a joint venture between Sasol, Companhia Mocambiçana de Gasoduto and the State-owned South African Gas Development Company, or iGas.

However, the study will also assess prospects for using liquefied natural gas, which could, in future, be imported through Richards Bay, in KwaZulu-Natal. Pipeline and rail logistics solutions will be assessed for transporting the gas from Richards Bay to Kelvin, situated in Kempton Park.

In the next few years, USTDA believes there will be a strong incentive for City Power to enter into a new contract, particularly if Kelvin were in the position to produce lower-emission electricity from gas rather than coal. Likewise, there is an incentive for Aldwych to extend Kelvin's operational life, particularly as the plant is already integrated into the Gauteng network and also has all the necessary regulatory licences and permits.



Kelvin coal-fired power station

Source: *Engineering News*



banks reportedly no longer interested in funding coal-fired electricity projects.

The Thabametsi plant's owner, Marubeni, took a policy decision in September 2018 that it would not enter into any new coal-fired power generation business and that it would halve its global coal-fired net generation capacity of 3 GW by 2030. This, however, does not impact on the South African project, company officials have confirmed to *Engineering News*.

The new private coal power stations will be required to have the latest technology to reduce emissions.

GAS-TO-POWER

Gas is forecast to be a significant part of the country's future energy mix. Currently, there is 3 830 MW of installed capacity generated from gas and a further 8 100 MW of new capacity is projected to be procured by 2030. The IRP2018 is forecasting that gas will contribute a total of 11 930 MW of the energy mix by 2030 and additional gas generation plants will enter the system from 2026.

Existing Ministerial determinations call for 3 726 MW of IPP gas-fired generation capacity.

Definitive plans for the gas-to-power plan will emerge only once the IRP2018 is finalised and gazetted, but in 2016 government said that it planned to procure 3 000 MW through the Liquefied Natural Gas-to-Power Independent Power Producer Procurement Programme (LNG IPPPP) and 726 MW through separate programmes, including a 600 MW public-private gas-fired plant and a 126 MW domestic gas programme.

The DoE's plan for the LNG IPPPP is to build a 2 000 MW facility at Richards Bay, in KwaZulu-Natal, and a 1 000 MW power station at Coega, in the Eastern Cape. These plants will operate on imported LNG.

The 600 MW gas-fired power generation project will be located in one of the major ports under consideration for the LNG IPPPP and will source its gas through import infrastructure established through that programme.

The gas-to-power programme will be premised on imported LNG in the short term; the development of pipeline infrastructure from Mozambique in the medium term; and sourcing of shale gas from the Karoo in the long term.

Radebe and his counterpart at the Mineral Resources Department, Gwede Mantashe, have said that they have no doubt that the country's shale gas resources will be exploited, despite concerns raised by farmers and environmental groups about its impact on the water-stressed Karoo region.

The US Energy Information Administration (EIA) estimates South Africa's shale gas reserves at about 390-trillion cubic feet (tcf), make it the eighth-largest holder of technically recoverable shale gas in the world. Geologists at the University of Johannesburg and three other institutions, however, estimate that the gas resource is probably 13 tcf, which ranks its thirty-fourth out of 46 nations in the EIA estimates. However, even at a lower estimate, the resource still holds significant development potential for South Africa. Exploitation of the shale gas resources could help the country become energy sufficient.

A substantial gas discovery by French group Total off the coast of South Africa in early 2019, has excited many. Although it is still too early to jump to conclusions on the final use of the gas, it is likely that it will be used to feed PetroSA's gas-to-liquids plant in Mossel Bay, in Western Cape. It could also be converted into electricity.

Some estimate that the one-billion-barrel condensate find is three to five times bigger than all the gas finds so far in South Africa put together.

COGENERATION

The DoE has prepared a cogeneration IPP procurement programme that will focus on procuring 1 800 MW of electricity from cogeneration plants using waste-to-energy, combined heat and power and industrial biomass technologies. Preferred bidders for the first bid submission phase were named in 2015, and an announcement in respect of the preferred bidders of the second bid submission phase has been delayed.





Picture by Creamer Media

EMBEDDED GENERATION

The changing electricity landscape and advancements in technology have resulted in an increase in the number of own-generation facilities in the form of rooftop solar photovoltaic (PV) installations in residential, commercial and industrial facilities, as well as a shift to energy efficiency.

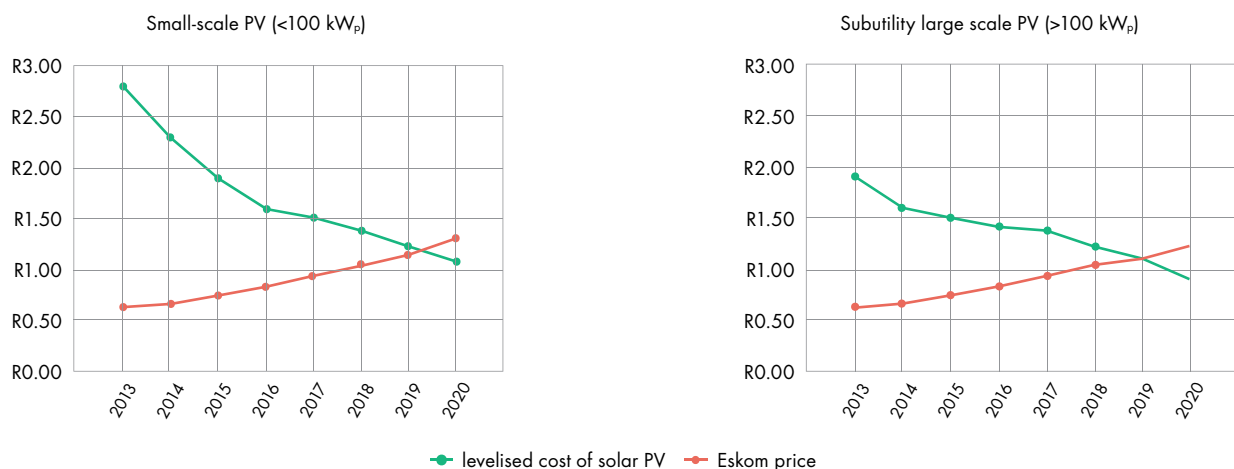
There are a number of growth factors driving small-scale embedded generation (SSEG) and energy efficiency, including electricity price spikes and concern about security of supply. In addition, the price of solar PV technology has fallen sharply in recent years.

Industry commentators liken the growth of SSEG to the explosion of mobile phones and the impact that it has had on the landline telephone industry.

GreenCape, a provincial agency that promotes the development of the green economy in the Western Cape, publishes a yearly report that details developments in the energy services sector. In its latest edition, published in May 2018, the agency estimates that South Africa's installed rooftop solar PV capacity increased by as much as 110 MWp between November 2016 and November 2017. Citing information from local solar PV data assurance entity PQRS, it states that the market could grow at 500 MWp/y, to a total of 7.5 GW of installed capacity by 2035. At a cost of R10/Wp, the market is estimated to expand at R5-billion a year to R75-billion by 2035.

The GreenCape market intelligence report notes that the commercial and industrial sector has been driving the uptake of rooftop solar PV, driven by the falling cost of technology.

The levelised cost of solar PV installations against projected Eskom prices



Source: GreenCape



According to PQRS, the commercial and industrial sector accounts for about 70% of the total verified systems, or about 180 MWp. It is estimated that the average payback for a 100 kWp system is five to seven years, which makes embedded generation an affordable investment for businesses.

There are municipalities also challenging the Eskom single-buyer model, which restricts the acquisition and sale of electricity to the State-owned power utility. One such municipality, the City of Cape Town, has set a target of using renewable energy for 20% of its total energy usage by 2020. The city affirmed in July

2018 that it was continuing to pursue that goal, which partly relies on an increased uptake of embedded generation.

The city reports that the uptake for rooftop PV in its SSEG programme is growing at a rate of 6% compounded growth a month. It has an SSEG tariff, which supports consumers who buy solar panels and generate surplus energy that is fed back into the grid.

An expansion of embedded generation has necessitated changes to the regulatory regime.

Eskom struggles and tariff hikes strengthen case for distributed generation – SAWEA study

In March 2019, the South African Wind Energy Association (SAWEA) released a new study highlighting the role that distributed generation renewable energy (DG-RE) could play in the South African electricity market.

The study examined 14 scenarios in five different South African municipalities.

The study found that wind and solar systems embedded in distribution networks could reduce the load on municipalities, lower the price of electricity, prevent electrical interruptions, reduce losses and provide an effective and efficient contribution to resolving South Africa's power crisis.

"Distributed generation can directly serve loads behind-the-meter as we have seen increasingly in South Africa over the past years, but they can also make use of existing public network infrastructure to supply offtakers that are not colocated with the energy plant. This type of scheme presents a number of advantages at various levels, and this is what we wanted to better understand through the study," SAWEA technical working group chairperson Kevin Minkoff explained.

He added that State-owned Eskom's tariff increases and continued struggles only strengthened the business case for DG-RE plants and the role these could play in supporting the sustainable delivery of power.

The report also highlights opportunities for investors interested in projects other than utility-scale, as it reveals opportunities and potential routes for corporate power purchase agreements (PPAs), which support the purchase of electricity at an agreed price for an agreed period, typically between 10 years and 20 years.

Instead of buying power directly from utilities, several businesses are now beginning to consider how to buy electricity from independent generators, as well as investing in generation assets themselves, within the limits of the current regulatory framework.

"PPAs have economic and environmental advantages," says SAWEA CEO Brenda Martin, adding that large multinationals are beginning to apply their sustainability pledges to their global supply chains and data centres, which has led to a significant uptick in corporate PPAs globally.

"However, in South Africa, current regulations are restricting the uptake of corporate PPAs. To support growth of the industry, the SAWEA report calls for regulatory reforms to allow for direct PPAs between municipalities and energy intensive users and details how this could provide security of supply to heavy industry at lower tariffs".

Martin has highlighted that it is important for local municipalities and utilities to revise planning methods, devise new technical specifications and update commercial arrangements.

Investing in DG-RE plants can help corporates to meet environmental targets, giving them an instrument to evidence compliance with increasing climate change reporting and corporate governance requirements.

The report also states that Eskom will benefit from DG-RE projects as the loss of revenue will be offset by a reduction in the cost of distribution.

Further, the practice of "wheeling", whereby renewable-energy plants pay a fee to use the national grid to transport the electricity from the production site to the end-user, could also benefit the State power utility.

Source: Eskom, Bloomberg News



On a local level, more municipalities are adopting SSEG processes. According to information provided by the South African Local Government Association (Salga), the number of municipalities allowing SSEG installations without authorisation on their grids increased from ten in February 2016, to 34 by October 2017. Twenty-one municipalities allow SSEG installations, but require an official application system and 18 municipalities have National Energy Regulator of South Africa- (Nersa-) approved SSEG tariffs to compensate customers for excess electricity fed back into their electricity grids.

On a national level, the Electricity Regulation Act guides the issuance of licences for generators and transmitters, wheelers and distributors of electricity. In November 2017, the Department of Energy made amendments, which exempt independent generators of up to 1 MW of electricity from the legal obligation to be licensed. If an installation meets certain criteria, it has to be registered only with Nersa.

Nersa is required to publish regulatory rules to ensure efficient registration and in April 2018, its consultation paper of the draft rules for the registration of SSEG was published. The draft rules

require all installations of under 1 MW, whether connected to the grid or not, to be formally registered. Above 1 MW, the law requires the same sort of licensing as for a full-blown power station.

There were concerns about the draft rules, particularly as to why installations that are not connected to the grid require registration. For on-grid installations of under 1 MW, the requirement of a Nersa registration could add between six and nine months to the registration process of an SSEG system. A lengthy registration process is likely to hinder the uptake of SSEG.

The draft Nersa rules were withdrawn in May 2018.

The anticipated growth of the embedded generation sector is highlighted by its inclusion in the draft updated Integrated Resource Plan (IRP2018). The IRP2018 allocates 200 MW a year for embedded generation between 2018 and 2030, but deals only with capacities of between 1 MW and 10 MW.

There are calls for a higher allocation for embedded generation, with Salga stating that about 1 500 MW of capacity is awaiting generation licences.



Picture by Creamer Media





Picture by Reuters

DISTRIBUTION AND ELECTRIFICATION

Power utility Eskom and 187 municipal governments share the responsibility of distributing electricity to households and businesses. Eskom services about 43% of electricity end-users and municipalities the balance.

The current municipal utility business model recovers costs and generates surpluses, based on a mark-up on the Eskom bulk supply tariff. This volumetric approach is coming under pressure as consumers are investing in alternative options, such as small-scale embedded generation and energy efficient appliances.

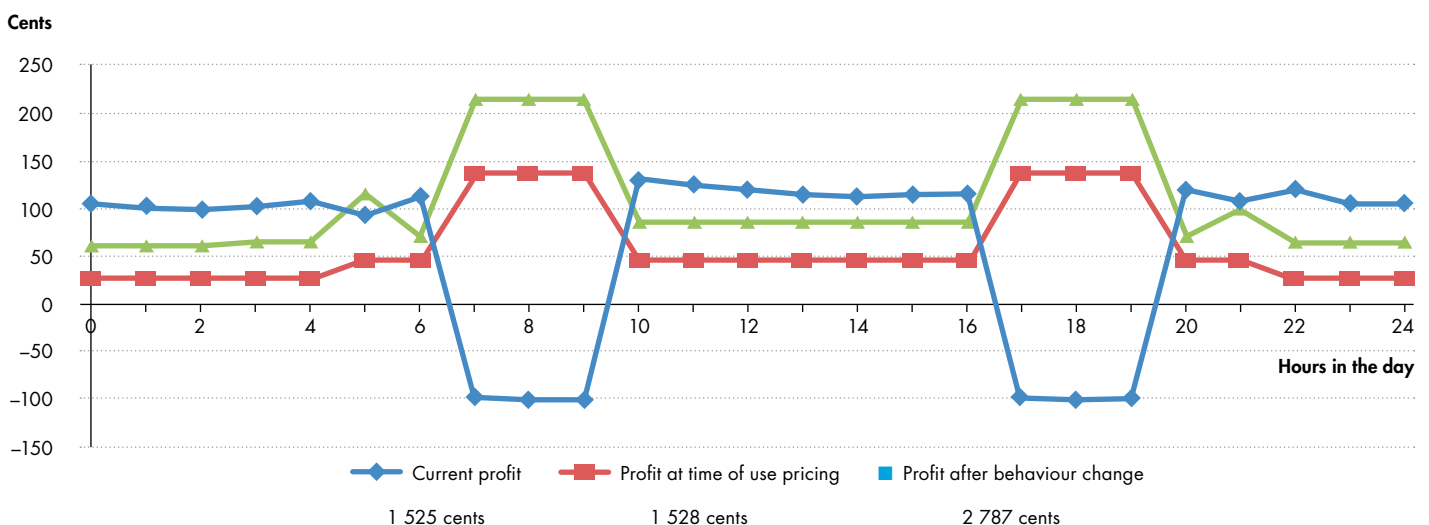
In light of these disruptions, delegates at the South African Local Government Association (Salga) energy summit agreed

in March 2018 that new electricity distribution models are needed.

This dovetails with arguments in a paper tabled at the Association of Municipal Electricity Utilities conference in October 2018. In the paper, titled the 'Dawn of the New Municipal Business Model and the Legal Imperatives to Realise Same', the authors argue that municipalities will have to implement "tariff unbundling". This entails separating the network service costs from the kilowatt-hour costs.

Salga explains that many municipal electricity tariffs are charged at a flat rate and do not consider time of use or level of

The impact of a change in usage on municipal profit



Source: South African Local Government Association



consumption. This approach is resulting in an under recovery and leads to an inability to pay for the bulk acquisitions and operating costs associated with the electricity business. However, the tariff that Eskom charges the municipality does include these tariff elements and, as a result, the municipality carries the financial risk. It uses the example of a cold evening and how the high residential spike in electricity consumption will result in a municipality paying Eskom at a peak tariff, while residential customers are only billed a flat municipal tariff.

One suggestion is that municipalities introduce a time-of-use (ToU) tariff, which will allow local governments to charge customers at a comparatively higher rate during the peak periods, while maintaining their profit share. The profit margin could be extended further if customers are encouraged to reduce consumption during peak periods. The introduction of ToU tariffs, however, will require an expensive smart metering system.

The Council for Scientific and Industrial Research (CSIR) believes that local energy master plans could improve prospects for the creation of sustainable municipal electricity distributors. An energy master plan should assist a municipality to assess the “optimal blend” between wholesale acquisitions from Eskom and embedded distributed resources. Such a plan will also offer greater insight into how a council can meet the twin objectives of lowering the costs of electricity to consumers and reducing emissions. A master plan could help a municipality to design a more sustainable tariff architecture that disentangles the fixed and variable costs.

The CSIR plans to partner with a metropolitan council and a district municipality to compile pilot municipal energy master plans (MEMPs), which will provide the two councils with insight into the best electricity supply blends for their respective grids. The CSIR is partnering with German development finance institution GIZ in piloting the MEMPs initiative, which will be conducted in collaboration with the Department of Energy (DoE), Eskom and Salga. The MEMPs modelling, which will focus on electricity, while assessing the potential to expand into transport and heating, will be completed during the course of 2019.

The declining kilowatt-hour sales, coupled with a lack of skills and institutional capacity, are impacting on funding to maintain infrastructure. Citing information by the Financial and Fiscal Commission, Salga states that the investment in infrastructure by municipalities since 2010 has been about 60% of the benchmark for adequate maintenance investment. This amounts to R10-billion a year underinvestment in the grid infrastructure.

Ageing infrastructure and a lack of maintenance are resulting in localised blackouts. Rapid urbanisation is further putting strain on municipalities’ ability to provide infrastructure and services, including electricity.

According to the ‘2017 General Household Survey’, published in June 2018, 84.40% of South African households were connected to the mains electricity supply in 2017. Mains electricity was most common in the Northern Cape (92%), Limpopo (90.80%), and the Free State (90.50%). It was least common in Gauteng (80%), North-West (80.90%), and KwaZulu-Natal (82.90%). Between 2002 and 2017, the percentages of households with access to mains electricity declined in Gauteng, the Western Cape and North West, which Statistics South Africa attributes to the rapid in-migration experienced by cities in these provinces.

Urbanisation and economic migration are creating new unconnected communities, which makes the objective of the DoE’s integrated national electrification programme a moving target.

More than 7.40-million households have been connected to the grid from 1994 to March 2018. In areas where it is difficult to reach the grid, solar home systems have been installed, with more than 160 000 having been connected through nongrid technology in the past 14 years.

Communities are increasingly receptive to the solar home systems, which was originally intended to serve as a temporary measure to provide basic lighting and power for a radio or television, while households were connected to the grid. These systems could become a permanent solution for rural communities, considering decreasing solar panel and battery costs.



Picture by AdobeStock

84.40% of South African households were connected to the mains electricity supply in 2017





Picture by Bloomberg

TRANSMISSION

Power utility Eskom is the sole licensee of transmission infrastructure in South Africa. The group has about 32 200 km of power lines traversing the country.

Eskom's transmission planning is anchored in the strategic grid plan (SGP), which formulates long-term strategic transmission corridor requirements, and the transmission development plan (TDP), which represents the transmission network infrastructure requirements.

The SGP is based on a range of generation scenarios and associated strategic network analysis. It is updated every two to three years and has a 20-year horizon. The TDP covers a ten-year window and is updated in October every year. The plan sets out the financial commitments required in the short to medium term.

In the next ten years, 6 535 km of high-voltage lines and 45 900 MVA of transformation capacity is planned. The additional transmission capacity will require R91-billion, according to the TDP 2019 to 2028. The total transmission capital expenditure estimate, which includes refurbishment costs, environmental assessment and servitude costs, as well as costs related to production equipment, pertaining totals R109.35-billion for the ten-year period.

The majority of the TDP work for 2019 to 2028 is focused on including independent power producers (IPPs) in Eskom's national grid network. Eskom currently generates 52 GW of power, comprising about 90% conventional power generation (of which 73% is coal-fired), 7% renewables and about 2% imports. By 2028, Eskom expects total generation of

74 GW, comprising about 74% conventional generation (of which 56% is coal-fired), about 23% renewable-energy generation and 2% imports.

The Northern Cape has emerged as the priority province for IPPs. The province has hydropower generation capacity of about 600 MW, wind generation capacity of about 590 MW, solar photovoltaic (PV) generation capacity of 667 MW and concentrated solar power generation capacity of about 300 MW, amounting to a total 1 567 MW. The province has a load peak demand of 1 077 MW, which is predicted to increase by 50% to 1 593 MW by 2028, when the province is expected to produce 5 GW of power, which will mostly be exported. Key development plans for the Northern Cape include transmission line strengthening between the Gromis, Nama and Aggeneys substations, while transformer capacity will be expanded at the Helios substation. Additional transmission lines will be added between the Upington and Aries substations, to expand the corridor that collects IPP generation.

The North West province generates 7 MW of power, from a solar PV plant in Rustenburg. Demand in the province is about 3 263 MW, which is imported from other provinces. A transformer commissioning is planned for Rustenburg, with various substation transmission integrations planned to cater for increased solar PV generation capacity. Load demand is expected to increase to 4 651 MW by 2028. There are four IPP-related substation expansions planned near the border of Gauteng, in the Carletonville area. Substation construction is planned for Mahikeng, which will eventually be linked with a transmission line that is still to be built to the Mookodi substation, near Vryburg.



Limpopo hosts Eskom's Matimba and Medupi power stations, but four solar PV plants will be commissioned soon. The province's power generation totals 6 500 MW, half of which is exported to other countries and provinces, since the load demand is at an estimated 3 600 MW.

Main TDP plans for the province include three units to be commissioned at Medupi in the next three years, 400 kV lines to be built to run down from Medupi into the North West, and a 400 kV line to be built to run across the province from Medupi to Senakangwedi.

Mpumalanga has the most extensive transmission network of all nine provinces, owing to it being the hub of power generation in the country – producing about 4 GW. Load demand for the province is expected to increase by 24% to 2028. Key developments planned for the province include transmission line construction between the Kusile power station and Gauteng, as well as integration into the transmission network of the Khanyisa IPP project.

Gauteng accounts for 30% of all power consumption in the country, with peak grid demand of about 11 GW. There is a 32% load demand growth forecast for the province until 2028. Key developments planned for Gauteng include the upgrade of various substations, as well as the construction of four substations near Mesong, Sebenza, Sisimuka and Lesokwana. In the east of Gauteng, there will be a Jupiter B substation integration project, which entails connection through a 400 kV line from Matla power station, in Mpumalanga. There are also additional grid connection points planned for Pretoria.

KwaZulu-Natal has a peak load demand of about 6 200 MW; however, there is 3 010 MW of power generation capacity, with the gap in demand met by electricity imported from other provinces. Projected load demand for the province is expected to grow by 20% to about 7 500 MW by 2028. Key developments in the province will include the strengthening of a 765 kV line from the Majuba power station, a 400 kV line between Ariadne and Venus substations, a line between Ariadne and Eros, and a line between Eros and St Faiths substations. St Faiths substation is due for construction soon. There is also line strengthening planned between the Normandie and Iphiva substations, and subsequently between Iphiva and Duma. Iphiva and Duma will be built soon, in addition to construction of another substation called Nzalo, which is situated between the Umfolozi and Normandie substations.

Free State currently generates 3 761 MW of electricity. Load demand is expected to reach 2 024 MW by 2028. Key projects in the province include line strengthening between substations in Bloemfontein. Construction is also planned for a new substation

called Igesi, which is in the Sasolburg area. The Merapi substation will be commissioned soon.

The Eastern Cape has a peak load demand of 1 716 MW and produces about 1 900 MW of electricity, of which 1 300 MW comprises renewables. The load demand is expected to grow to 2 387 MW by 2028, the main drivers of which are the industrial development zones in the province. The province will generate 6 692 MW by 2028, comprising gas generation and wind energy generation, resulting in the province becoming a net exporter of power. Line strengthening is planned between the Neptune and Pembroke substations through a 400 kV line, and between the Poseidon and Pembroke substations. Eskom further plans to build a 760 kV line between the Gamma and Cambridge substations.

The Western Cape has a peak load demand of 3 930 MW, while generating 4 608 MW of electricity, comprising nuclear, gas, pumped-storage and wind generation. A transmission line will be built between the Philippi substation and to-be-built Erica substation. Load demand is expected to reach 4 527 MW by 2028, owing mostly to growth in the Saldanha Bay Industrial Development Zone. To meet the load growth, Eskom will build extra transmission lines between the Ankerlig and Sterrekus substations. A new substation is near completion, called Pinotage. The Asteria, Komsberg, Narina and Aghulhas substations will also be commissioned in due course, mostly to cater for IPPs. A new substation called Bokkom will also be built.

Eskom in R1.5-billion loan agreement for transmission grid

Eskom and Agence Française de Développement (AFD) have signed a R1.50-billion loan agreement to support the electricity utility's investments in extending and strengthening its power transmission grid along the west coast of South Africa.

The loan constitutes the first tranche of a R6.50-billion multitranchise loan facility signed between the two institutions in March 2017.

This first tranche will be dedicated to financing the Namaqualand Strengthening Phase 2: Juno Gromis project, which aims to strengthen the power network in the Northern Cape, integrate renewable-energy sources and, ultimately, facilitate crossborder transmission.

The project will include the construction of a 282 km 400 kV line between the Juno substation, in the Western Cape, and the Gromis substation, in the Northern Cape, with associated feeder bays and transformer bays.

Construction is expected to start in early 2019.

Source: Engineering News





Picture by Creamer Media

ELECTRICITY PLANNING

South Africa has a centrally controlled electricity generation planning and procurement system. The Electricity Regulation Act of 2006 and associated electricity regulations, assign responsibility to the Energy Minister to develop an Integrated Resource Plan (IRP).

The Minister is also empowered through Section 34 of the Electricity Regulation Act to make procurement determinations in consultation with the energy regulator on what new generation capacity is needed, from which sources, and who should be the developer – either State-owned Eskom or an independent power producer (IPP).

The National Energy Regulator of South Africa (Nersa) is mandated to issue electricity generation licences for any generator wishing to connect to the transmission or distribution grid.

The first IRP for South Africa was promulgated in March 2011. The plan, commonly referred to as the IRP2010, is being used to roll out electricity infrastructure development in line with Ministerial determinations. The IRP has always been intended to be a “living plan” that is updated frequently, although it has not happened.

A number of assumptions used in the IRP2010 have changed or have not materialised, most notably the disconnect between forecast electricity demand and actual sales. According to the Department of Energy (DoE), the actual total electricity consumed at the end of the 2017/18 financial year was about 30% less than what was projected in the IRP2010. Eskom’s generation plant performance is also below the IRP2010 assumptions of 80% and above.

A draft IRP update was prepared and published in 2013, but was never ratified by Cabinet. A new draft was published in late 2016, the base case of which scaled back peak demand, and increased the role of solar photovoltaic (PV) and wind energy resources while deferring the introduction of new nuclear capacity by 14 years. Several stakeholders have called on the DoE to rerun the IRP to exclude artificial constraints on the amount of onshore wind and PV capacity that could be added each year, so that the base case can reflect a least-cost scenario.

The DoE published an updated IRP in August 2018 for a 60-day public consultation, which reflects the changing electricity generation and distribution landscape. The least-cost plan contains only PV, wind and gas and, thus, includes no new nuclear and no new coal. Nevertheless, five policy adjustments have been made to that least-cost path, including:

- the retention of yearly build limits on renewables for the period until 2030;
- the inclusion of 1 000 MW of coal-to-power in 2023 and 2024, based on two coal IPP projects already procured by government;
- the inclusion of 2 500 MW of hydropower in 2030 to facilitate a treaty signed by South Africa and the Democratic Republic of Congo for the Inga hydropower project;
- the use of the existing solar PV, wind and gas allocations in the plan to enable, through Ministerial determinations, IPP procurement; and
- allocations of 200 MW a year for certain categories of ‘generation-for-own-use’ of between 1 MW and 10 MW, starting in 2018. These allocations will not be discounted off the capacity allocations in the plan, but will be considered during the issuing of Ministerial determinations.



The policy-adjusted plan includes the following new additional capacity by 2030: 1 000 MW of coal, 2 500 MW of hydro, 5 670 MW of solar PV, 8 100 MW of wind and 8 100 MW of gas.

Should the new capacity be introduced as envisaged, by 2030 South Africa's electricity will comprise: 34 000 MW of coal (46%); 1 860 MW of nuclear (2.50%); 4 696 MW of hydro (6%); 2 912 MW of pumped-storage (4%); 7 958 MW of solar PV (10%); 11 442 MW of wind (15%); 11 930 MW of gas (16%); and 600 MW of concentrated solar power (CSP) (1%).

Owing to the variability of supply from wind and solar PV, 65% of actual energy arising from the installed base will arise in the form of coal, while nuclear will contribute 4% of the electrical energy generated in 2030.

Despite the inclusion of 1 000 MW of IPP coal and the completion of Medupi and Kusile coal-fired power stations, the IRP2018 still assumes that South Africa's coal-fired capacity will fall from 39 000 MW currently to 34 000 MW in 2030, owing to the decommissioning of 12 000 MW of Eskom capacity between 2020 and 2030. The plan also assumes that the hydrocapacity from Inga will be introduced in 2030.

Two major changes to the IRP are the inclusion of 2 600 MW of embedded generation between 2018 and 2030, and a

significant increase in gas capacity to nearly 12 000 MW by 2030.

Several technologies have been excluded from the IRP2018, including battery storage, pumped storage, CSP and biomass. The DoE has indicated that, at some point, it may open bidding for other solutions not listed in the IRP, but which share the characteristics of the supply solution sought for the system. DoE chief director for electricity Jacob Mbele has explained that some technologies should be seen as proxies, rather than absolutes. It is thus possible for technologies other than gas, such as batteries or pumped-storage, to be procured to complement the generation arising from variable energy plants.

The draft updated IRP has generally been welcomed, largely for departing from previous attempts at forcing certain technologies, such as nuclear, into the plan. The renewable-energy fraternity has called on energy planners to even out the procurement of wind power between 2021 and 2030, and to do away with the decision to sustain yearly limits on the procurement of renewable technologies. The draft plan has a gap in 2022, 2023 and 2024, when no wind energy will be procured, which the South African Wind Energy Association says will create a stop-start scenario with a negative impact on employment and growth in the local manufacturing sector. A loss of about 1 200

Proposed plan for new generation capacity for the period ended 2030

	Coal	Nuclear	Hydro	Storage (pumped- storage)	PV	Wind	CSP	Gas/diesel	Other (cogeneration, biomass, landfill)	Embedded generation
2018	39 126	1 860	2 196	2 912	1 474	1 980	300	3 830	499	Unknown
2019	2 155					244	300			200
2020	1 433				114	300				200
2021	1 433				300	818				200
2022	711				400					200
2023	500									200
2024	500									200
2025					670	200				200
2026					1 000	1 500		2 250		200
2027					1 000	1 600		1 200		200
2028					1 000	1 600		1 800		200
2029					1 000	1 600		2 850		200
2030			2 500		1 000	1 600				200
TOTAL INSTALLED	33 847	1 860	4 696	2 912	7 958	11 442	600	11 930	499	2 600
Installed capacity mix (%)	44.60	2.50	6.20	3.80	10.50	15.10	0.90	15.70	0.70	–

Installed capacity
 Committed/Already contracted capacity
 New additional capacity (IRP update)
 Embedded generation capacity (generation for own use allocation)

Source: Department of Energy



full-time manufacturing jobs is forecast if procurement is stalled for three years.

The nuclear industry has slammed the technology's exclusion from the draft IRP2018 and has even described the modelling process as flawed.

The exclusion of other technologies, including pumped hydro and CSP, has also been reversed, as has the plan's overreliance on imported gas.

Several organisations have also voiced their concerns about the provision for new coal-fired power stations,

the inclusion of which will cost a cumulative R23-billion more.

The South African Local Government Association has said that the demand forecast should be revised to reflect the decrease in sales that municipalities are experiencing.

The plan is forecasting yearly electricity demand growth of 1.80% by 2030 and 1.40% by 2050, based on average gross domestic product growth of 4.26%.

Energy Minister Jeff Radebe has indicated that the IRP will be finalised in March 2019.



Picture by AdobeStock





OUTLOOK

The Eskom crisis has come at a critical time for the South African economy, which is struggling with high unemployment and low growth. Not only does it threaten South Africa's entire economy if the utility defaults on its debt, but it also hampers economic growth prospects.

The country requires economic growth of 5.40% a year by 2030, to meaningfully address unemployment, inequality and poverty, according to the National Development Plan, yet economic growth is below 2% and is forecast to remain at that level in 2019.

The National Treasury is forecasting economic growth of 1.50% in 2019, increasing to 2.10% in 2021, while the World Bank pegs gross domestic product expansion at 1.30% in 2019, increasing to 1.80% in 2021.

Fixing Eskom is a priority for South Africa, and unbundling the cash-strapped utility is deemed an important step in stabilising its finances and operations. The National Treasury notes in the Budget Review that the nature of an efficient electricity system and grid has changed and that Eskom's model is no longer desirable.

"Systems no longer resemble Eskom's vertically integrated monopoly model, with central power stations distributing power via grids to consumers. Instead, they have become increasingly decentralised, with electricity flowing from the centre to the periphery and vice versa."

The World Bank believes that government is moving in the right direction and that the restructuring should form part of a broader reform agenda.

Reforms are needed to ensure that the South African electricity industry responds to the major trends shaping the global energy transformation. These, according to the World Economic Forum, are:

- electrification of large sectors of the economy, such as transport and heating.
- decentralisation, spurred by the sharp decrease in cost of distributed energy resources, like distributed storage, distributed generation, demand flexibility and energy efficiency.
- digitisation of the grid, with smart metering, smart sensors, automation and other digital network technologies, and beyond the meter, with the advent of the Internet of Things and a surge of power-consuming connected devices.

These innovation trends are assisting variable renewable energy (VRE), like wind and solar energy, integrate into global power systems, displacing conventional fossil fuel-based alternatives.

The 'Energy Outlook 2018' report, published by Bloomberg New Energy Finance, highlights that wind and solar energy will account for about half of global electricity generation by 2050. This is increasingly supported by flexible capacity from battery energy storage, peaking gas-fired facilities, energy efficiency and electric vehicles.

The International Renewable Energy Agency (Irena) estimates that decarbonising the global power sector, in line with the United Nations Framework Convention on Climate Change Paris Agreement, will require an 85% share of renewable energy in global electricity generation by 2050.



The European Union has been leading the VRE integration, with close to 15% of VRE share in yearly electricity generation. This is forecast to increase to about 50% by 2050. Irena states that the three largest power systems in the world – China, India and the US – are expected to double their share of VRE to more than 10% of yearly generation by 2022.

South Africa's grid is also expected to transition to higher renewable-energy penetration levels, owing to a combination of the country's formidable solar and wind resources and ongoing reductions in the cost of wind and solar technologies.

The draft Integrated Resource Plan outlines a vision for the country's electricity mix, which relies heavily on new wind, solar photovoltaic and gas capacity. Although there are concerns from labour and some political parties about South Africa's progression to more renewable energy, Energy Minister Jeff Radebe has said that renewable energy is here

to stay and has called on the country to be prepared for the disruptive times ahead.

"The energy sector is at the cusp of an exciting period, reminiscent of the huge changes brought about by rapid technological advancement in the mobile telephony industry in recent years . . . Big centralised power generation plants will disappear and replaced by distributed generation, mini grids and batteries. We must ensure that our youth will embrace the new technologies and move with the changing times."

Where renewable energy displaces coal-fired generation capacity, South Africa will have to explore practical solutions to preserve and increase employment. Radebe has said that renewable investments could be directed to areas likely to experience job losses from the decommissioning of coal-fired power stations, such as Mpumalanga and Limpopo. Simultaneously, affected workers could be reskilled to align their capabilities in industries surrounding their existing areas of work to avoid relocation.



Matla coal mine and power station



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ELECTRICITY 2019

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