South Africa Electricity Overview

Holocene Ventures
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1. Executive summary & market opportunity

South Africa is the 22nd largest energy consumer in the world, just smaller than Spain and Australia. It's also the 3rd largest grid in a democracy that does not have a competitive market with private energy generators and traders after South Korea and Indonesia. However, this is all about to change.

Load shedding has been the biggest impediment to economic growth and positive investor sentiment over the past decade. During the February 2023 State of the Nation Address, President Ramaphosa laid out his energy action plan with 5 key interventions, the final intervention being to *"Fundamentally transform the electricity sector to achieve long-term energy security."*

Fast forward to 2025 and the Electricity Regulation Amendment Bill (ERA) has come into effect with the exception of a few small amendments.

The ERA will transition South Africa to a competitive energy market by effectively unbundling Eskom into generation, transmission and distribution. In the future, Eskom's generation plants will effectively sell their electricity into the market in the same way that any third party would *(note that it will be slightly more complex than this, however this elaboration falls outside of the scope of this memo).* Practically this will be done by creating a Transmission System Operator (TSO) and an open-market platform that allows for competitive electricity trading.

Given these structural changes, South African electricity will never look the same. Renewable energy generation players will proliferate, and electricity transactions will be executed through bilateral and open market transactions (day-ahead and intraday markets). The government will run the natural monopoly of transmission & distribution while continuously running complex algorithms to ensure the grid remains balanced and resilient.

This new, liberalised market provides an incredible opportunity for private sector involvement. This can occur through generation (project finance), transmission (public-private partnerships) and distribution (project finance & VC).

Although there will be many school fees and mistakes made in the transition, other countries have shown that the right electricity sector policies can lead to significant private generation.

Liberalisation of electricity markets in countries like Brazil, Chile, Mexico, India and others has led to private electricity generation of 20% - 40% within 10 years.

The same type of transition can ring true for the South African market, especially when considering that the government has started plans to phase out large coal plants (>50%) by 2035. Although the transition is still early, our research shows that more than 43GW - 66GW of renewable generation is expected to come online in the next 6 - 8 years. A recent Eskom Survey (supported by external sources) shows the following pipeline breakdown:

- 18 GW in advanced development
- 21 GW under development
- 27 GW under 'early' development

It's very difficult to predict at this stage how supply and demand will be matched in the transitioned industry, as it will consist of various mechanisms and models:

- Bilateral agreements/wheeling agreements: Flexible 1 - 20 year Power Purchase Agreements (PPAs) signed between Independent Power Producers (IPPs)/energy traders and consumers. These agreements will be bilateral, but one generator/trader can still provide electricity to various users.
- Open trading markets: Energy traders will play a prominent role in trading electricity in day-ahead and intraday markets. These markets work similarly to a stock exchange or bank with a clearing house. Buyers and sellers submit bids and offers, after which the central clearing house matches and clears the trades.

The percentages of private trading that will fall under each of the above categories remain unknown.

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2. Current state of the South African electricity market

Electricity mix in South Africa - CSIR Energy Report (ESKOM Generation and REIPP)

The document indicates that South Africa's electricity supply in 2022 remained heavily reliant on coal-fired power generation, which constituted over 80% of the country's total electricity generation capacity. Renewable energy sources, including wind and solar PV through the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP), have started making significant contributions, but the overall percentage remains small compared to coal. Hydro power, including hydro and pumped storage, along with diesel (open cycle gas turbines) and imports, make up the rest of the electricity generation mix

Total Capacity			Per Day	Per Year
	GW	Cont %	TWh	TWh
Coal	39,8	73%	1,0	348,6
Nuclear	1,9	3%	0,0	16,6
Diesel	3,4	6%	0,1	29,8
Hydro	0,6	1%	0,0	5,3
Hydro and Pumped Storage	2,7	5%	0,1	23,7
Wind	3,4	6%	0,1	29,8
Solar PV	2,3	4%	0,1	20,1
Concentrated Solar	0,5	1%	0,0	4,4
Total	**54,6**	**100%**	**1,3**	**478,3**
Electricity generated				
	TWh	Cont %		UF
Coal	176,6	80%		0,51
Nuclear	10,1	5%		0,61
Renewables (hydro)	14	6%		0,48
Renewables (non-hydro)	16,2	7%		0,30
Diesel	3,6	2%		0,12
Total	**220,5**	**100%**		**0,46**
New roll-outs	**MW**	**Cont %**		
Coal	720	59%		
Wind	419	35%		
Solar	75	6%		
Total	**1214**	**100%**		

Rooftop solar in South Africa

There has been rapid growth of rooftop solar in South Africa particularly in the commercial and industrial (C&I) sectors due to strong commercial business cases and established technologies.

The overall rooftop solar PV market in South Africa grew from 1.5 GW in 2021 to 6GW by the end of 2025, with an estimated 80% - 90% relating to commercial, industrial and agricultural solar (not residential).

GreenCape predicts that the total annual available market is expected to continue growing at a rate of 600-900 MWp installed per year and exceed 10 GW of installed capacity by 2035. This represents a substantial available market valued conservatively at R7.5 billion a year, cumulating to a total available market of R100 billion by 2035.

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3. Regulatory developments leading to change

REIPPPP:

This programme has been instrumental in introducing renewable energy into South Africa's electricity mix by facilitating the procurement of electricity from renewable sources through competitive bidding.

Licensing threshold for embedded generation:

Initially, Schedule 2 of the Electricity Regulation Act of 2006 set a cap on the size of electricity generation facilities that could operate without needing to obtain a generation licence from the National Energy Regulator of South Africa (NERSA). The cap was set at 1 MW for embedded generation projects, meaning any project above this capacity required a licence, a process that could be lengthy and cumbersome.

In an effort to boost private sector participation in electricity generation, the South African government made significant regulatory changes:

- *Initial increase to 100 MW (2021):* In June 2021, President Cyril Ramaphosa announced an amendment to Schedule 2, increasing the licensing exemption threshold from 1 MW to 100 MW. This move was widely applauded by industry stakeholders, as it allowed larger renewable energy projects to be developed and operated without the need for a generation licence, significantly simplifying the regulatory process for developing renewable energy projects.

- *Further relaxation (2022/2023):* Following a presidential announcement in 2022, the 100 MW cap was lifted for certain activities, most notably for generators entering into wheeling agreements. The amendment was gazetted into law in 2023.

Electricity Regulation Amendment Bill (ERA):

By far the biggest development in South Africa's history, the ERA will transition South Africa to a competitive energy market by effectively unbundling Eskom into generation, transmission and distribution.

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4. Grid challenges

Transmission lines: The need for substantial expansion in transmission infrastructure is critical, with an estimated requirement for over 14,000 kilometres of new transmission lines to accommodate future energy projects and ensure grid reliability.

Interconnections: The backlog of renewable energy projects awaiting grid interconnection has been a significant bottleneck, with estimates suggesting that several gigawatts of renewable capacity have faced delays. This backlog not only impacts the timely integration of renewables into the energy mix but also poses financial challenges for project developers.

Inadequate transmission infrastructure has already cost the country dearly, with the government failing to award wind contracts during an REIPPP bid window as projects couldn't be connected.

Transformer shortage: 105,865 MVA of transformer capacity will be needed in the next 10 years globally, and in South Africa transformer capacity will need to increase by 6x.

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5. Opportunities for climate tech companies

Smart grid technologies: The deployment of smart grid technologies represents a significant opportunity for innovation in grid management. These technologies enable enhanced monitoring, automation, and efficient distribution of electricity, crucial for integrating renewable energy sources.

Virtual Power Plants (VPPs): VPPs utilize software and advanced analytics to aggregate distributed energy resources, offering a novel approach to balancing the grid and optimizing the use of renewable energy.

Energy storage solutions: Addressing the intermittency of renewable energy sources, energy storage technologies like battery systems and pumped hydro storage are essential. These solutions can provide grid stability and support peak demand management.

Advanced metering infrastructure (AMI): The implementation of AMI facilitates improved demand-side management, allowing for more effective consumer participation in energy conservation and grid stability efforts through demand response programs**.**

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6. Short history and evolution of electricity generation in South Africa

South Africa's journey through the evolution of its electricity sector tells a story of resource dependency, challenges in energy sustainability, and the progressive embrace of renewable energy. It is a narrative punctuated by significant figures that highlight the country's past reliance on coal, operational challenges faced by its primary electricity utility, Eskom, and the emerging shift towards a greener energy landscape.

Electricity first lit up South Africa in Kimberley in 1882, setting the stage for the country's electrification; this was mostly to electrify and help power the mining industry (diamonds at that stage). By the early 20th century, the *establishment of Eskom in 1923 under the Electricity Act of 1922* marked a pivotal moment, creating a centralized body to manage the nation's electricity supply. Eskom grew to become one of the *top 11 largest electricity utilities* globally by capacity, signifying its critical role in the national economy and the broader challenges of managing such a vast utility network. Eskom also got voted the Best Power Company in the world during a prestigious event in New York in 2001.

Leveraging the world's *fifth-largest coal reserves, estimated at about 30 billion tonnes,* South Africa became heavily reliant on coal for its energy production. This reliance positioned the country as a major emitter of greenhouse gases, with coal-fired power stations contributing significantly to its electricity generation. Coal still accounts for approximately 80% of South Africa's total electricity production.

The operational efficiency of Eskom, as measured by the Energy Availability Factor (EAF), has seen a marked decline over the years. From an EAF of around 85% in the early 2000s, Eskom

experienced a significant drop to below 60% by 2022, illustrating the utility's struggles with ageing infrastructure, maintenance challenges, and financial constraints. This falls way below the prescribed minimum of 65% set out by NERSA. Massive improvements have been seen in the EAF in the last 12 months from 55% to 62% which has in part helped to stop load shedding.

Together we can build inspiring climate solutions for our incredible epoch.