

The South African Power Sector

Energy Insight

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Introduction to the complex dynamics of South Africa's power sector

South Africa has the most developed electricity sector in (sub-Saharan) Africa, with 54 gigawatts (GW) installed generation capacity, mostly from coal-fired plants. This is almost half the total installed power in sub-Saharan Africa.¹ South Africa's Department of Energy has been celebrated internationally for its competitive renewable energy auction programme, the Renewable Energy Independent Power Producer Procurement Programme (REI4P), which over three rounds produced a 70% price reduction for renewable generation. Still, the power sector has ample room for growth in renewable generation, which makes up just 5% of total generation. This offers important opportunities to decarbonise the energy mix, increase regional energy security, and create green jobs.

As the second largest African economy, South Africa's annual GDP growth has averaged 1.5% in the past decade.² Growth has been especially stagnant in the years since 2014, as chronic power generation shortages have provoked successive waves of scheduled load shedding. Targeted power cuts have affected all sectors in this period, contributing to acute unemployment rates. Globally-publicised scandals of state capture and corruption, notably in the power sector, have exacerbated the economic and financial uncertainties. Eskom, the embattled vertically-integrated power utility, faces unsustainable debts and insecure supply levels as it recovers from a governance crisis that transformed its operations into opportunities for rent-seeking.

The power sector in South Africa, one of the world's most unequal countries, must grapple with major socioeconomic questions, as well as the traditional financial and operational problems of infrastructure. The economy remains divided along racial lines, as

well as by class. Post-apartheid governments have rolled out various initiatives to extend services and improve economic outcomes for poor (overwhelmingly black) populations, with mixed success. National electricity access rates grew rapidly from the mid-1990s to reach 86.1% in 2018 (jumping 47% in 20 years), thanks to ambitious programmes to provide grid connections in disadvantaged communities.³ Parallel policies in health and educational access have tried to close the racial-economic divide. But a quarter-century after the fall of apartheid, 10% of the population still own between 70% to 95% of the country's wealth.⁴ It is no coincidence that 9% of the population is recorded as 'white' in the latest population census.⁵ Meanwhile, the poorest 60% control only 7% of the country's assets. Income per capita for black South Africans has hovered constantly at around 15% of the average income of white citizens since 1996.⁶ Only a small black elite have succeeded in overcoming these odds.

Wealth distribution, race, access, labour, and environmental health data add complex layers to the challenge of power sector policymaking. Persistent economic barriers to low-income groups create unequal patterns of electricity use, benefits, and impacts among South African citizens and residents, with knock-on effects in other areas, including economic, health, and environmental outcomes. Most wealthy households use electricity—the cleanest source of energy at the point of use—for lighting and cooking, while the poorest households are forced to substitute dirtier sources to meet basic lighting needs. Poor households also suffer disproportionately from air pollution from local coal plants, at levels that violate national air safety standards. With its coal-

¹¹ Includes 48 GW Eskom-owned capacity; 4.8 GW municipal and privately-owned plants; 1 GW small distributed generation set below 1 megawatts (MW). Eskom (2019) 'Integrated Resource Plan 2019'.

www.energy.gov.za/files/docs/IRP%202019.pdf. Eberhard, A. (2018) 'IPP Investment Trends and Lessons in SSA'.

² Average annual percentage growth of 1.5% from 2008 to 2017, projected to remain around at 1.7% in 2020.

<https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?end=2018&locations=ZA>; World Bank (2019) 'The World Bank in South Africa', available [online] at: www.worldbank.org/en/country/southafrica/overview

³ Department: Energy, Republic of South Africa, www.energy.gov.za/

⁴ Orthofer, A. (2016) 'Wealth Inequality in South Africa: Insights from Survey and Tax Data', www.redi3x3.org/sites/default/files/Orthofer%202016%20REDI3x3%20Working%20Paper%2015%20-%20Wealth%20inequality.pdf

⁵ Statistics South Africa (2012) 'Census 2011. Census In Brief',

www.statssa.gov.za/census/census_2011/census_products/Census_2011_Census_in_brief.pdf

⁶ Financial Times 'Black South Africans lose out as economic divide bites', www.ft.com/content/42ef27d2-6c13-11e9-a9a5-351eeaf6d84

centred generation mix, South Africa is the 14th greatest greenhouse gas emitter worldwide.⁷ But black workers also represent the majority of workers in coal mining and coal power plant operations, meaning a transition away from coal could hurt black communities hardest, unless it is accompanied by measures to educate, reskill, and provide alternative employment opportunities to coal workers. The solutions needed to fix the sector's ongoing power supply and governance challenges must also take these dimensions into account, in order to develop nuanced mechanisms for a 'just transition' to build an equitable, climate-resilient, low-carbon economic future.

Recent policy and strategy documents outline pathways for South Africa's long-term development, including through reforming the power sector in line with a 'just transition.' The 2012 National Development Plan (NDP), and the 2019 Roadmap for Eskom in a Reformed Electricity Supply Industry (RERESI) and Integrated Resource Plan (IRP) 2019, prioritise investment in energy infrastructure to secure decent jobs and deliver reliable, efficient, and affordable electricity. They also underline the need for greater social equity through expanding access to affordable energy, and call for reducing pollution to protect environmental sustainability. The RERESI in particular outlines reforms to unbundle the state-owned monopoly utility by establishing an independent transmission company to operate transmission and carry out power planning, procurement, and contracting functions, separate from generation and distribution entities. The document envisions a transformation of the power sector through scaling up utility-scale generation from renewables, managed through smart grids with flexible baseload and storage facilities, as well as well-tuned distribution business models and electricity pricing mechanisms to allow sustainable growth of distributed generation.⁸

This article is a product of the Energy and Economic Growth (EEG) applied research programme, which addresses policy questions in low-income countries to help shift energy systems towards a more sustainable, efficient, reliable, and equitable paradigm. EEG carried

out a scoping study on behalf of the UK Department for International Development in South Africa, as well as in several other countries. The scoping study for South Africa provides key socioeconomic information and context, followed by an overview of the power sector, including its structure, key actors and policies, and the main challenges it is facing. This paper presents the key characteristics and challenges in the South African power sector, as well as the opportunities for transitioning the sector towards a just future.

The sections that follow offer an overview of the institutional structure and legal and policy environment of the South African power sector, as well as some key data on supply and demand, before discussing the different dimensions of Eskom's crisis and the solutions needed for a just transition to a low-carbon electricity future.

Institutional structure

The vertically-integrated, state-owned national power utility, Eskom, dominates the South African power sector (see the structure of key sector actors in Figure 1). As a public company, Eskom is subject to national legislation and regulations. Eskom owns and operates 90% of total generation capacity, as well as all 387,633 km of transmission lines in the country, supplying power to large industrial consumers and to other South African distribution utilities, and exporting to the Southern African Power Pool (SAPP). As a distributor, Eskom also sells power to retail residential and commercial customers.

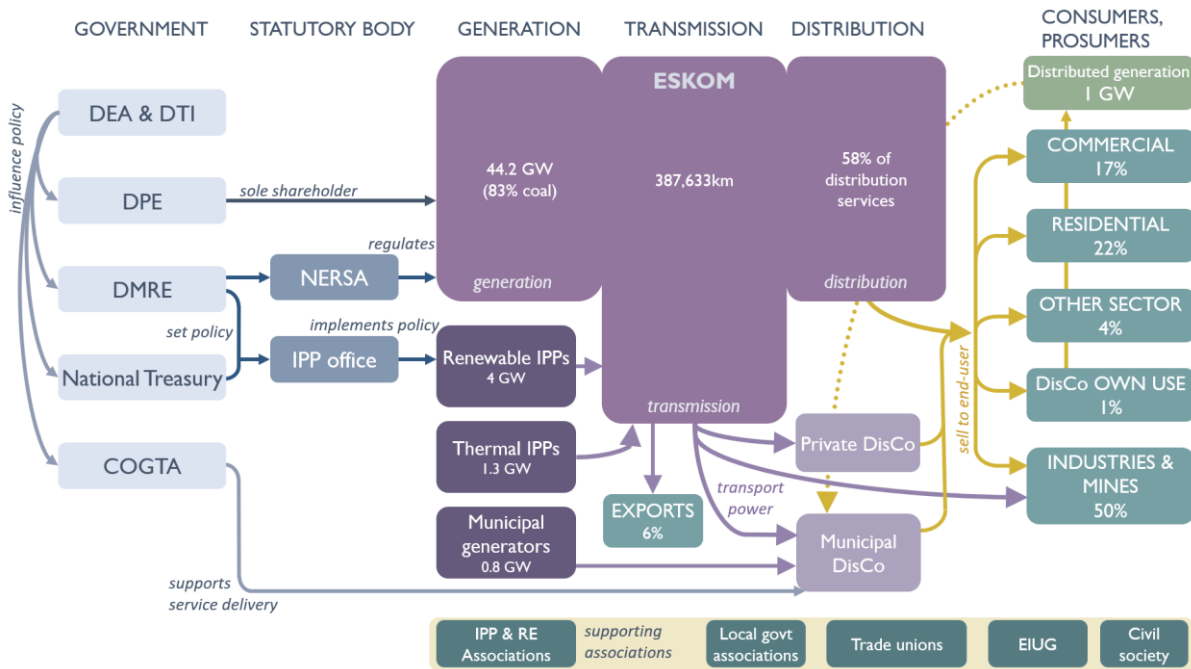
The sector operates as a hybrid between a natural monopoly and single-buyer model, where privately-owned independent power producers (IPPs) are allowed to generate and sell electricity to the Eskom-owned grid in parallel to Eskom's incumbent generation capacity. Alongside Eskom, 186 companies are licensed to distribute and sell power to consumers, including 173 municipal or local

⁷ Carbon Brief (2018) '2015 figures. The Carbon Brief Profile: South Africa', www.carbonbrief.org/the-carbon-brief-profile-south-africa [Accessed 15 October 2019].

⁸ South African Department of Public Enterprises (2019) 'Roadmap for Eskom in a reformed electricity supply industry', https://m2u7e2f8.stackpathcdn.com/wp-content/uploads/2019/10/ROADMAP-FOR-ESKOM_0015_29102019_FINAL1.pdf

government service providers and 13 private distributors.⁹

Figure 1. The structure of the South African electricity sector and key sector entities



Source: OneWorld, 2019

IPPs have increasingly participated in the sector since the Government launched a large-scale renewable energy auction programme in 2011, but they still produce less than 5% of electricity. End-users and distribution companies also increasingly invest in distributed generation of electricity (or small-scale

embedded generation (SSEG)). SSEG installations under 1 MW can interconnect to the distribution grid, feeding power back in under certain circumstances. Such customers (known as ‘prosumers’) both consume grid power and produce their own.

Table 1. Actors involved in shaping or implementing policy in the South African power sector

Institution	Role/mandate in the electricity sector
Policy-setting and planning bodies	
National Treasury	Manages public spending and approves departmental budgets.
Department of Mineral Resources and Energy	Drafts power sector legislation, policies, and plans, including pricing policy for National Energy Regulator of South Africa (NERSA) to regulate tariffs, to secure sustainable energy and mineral resources.
<i>Oversees: IPP Office</i>	Conducts competitive procurement for new generation from IPPs.
Department of Public Enterprises (DPE)	Sole shareholder of Eskom; oversees efficiency and financial sustainability of all state-owned enterprises.
Dept. of Cooperative Governance and Traditional Affairs	Supports municipalities to deliver core services of electricity supply.
Department of Environmental Affairs	Drafts legislation on air quality standards, and promotes clean, efficient energy in line with international obligations.
Department of Trade and Industry	Drafts commercial and industrial policy to promote inclusive and equitable economic development.

⁹ StatsSA (2016) ‘The state of basic service delivery in South Africa: In-depth analysis of the Community Survey 2016 data’.

National Planning Commission	<ul style="list-style-type: none"> • Expert advisory body to draft, promote, and monitor implementation of the NDP. • Consults public on pathways for a just transition in line with the NDP.
State-owned enterprise	
Eskom	Vertically-integrated state-owned electricity generation, transmission, distribution, and retail company.
Statutory regulatory agencies	
NERSA	<ul style="list-style-type: none"> • Regulates and determines electricity tariffs following Electricity Pricing Policy. • Grants licences for generation, transmission and distribution operators according to the IRP. • Sets and monitors technical supply and service standards.
Private sector, civil society, unions	
Renewable energy industry and IPP associations	Various IPP associations advocate for IPPs’ interests in the country, e.g. to improve the policy environment for private participation, run transparent auctions, and increase renewable energy share in the IRP.
Energy-Intensive Users Group	<ul style="list-style-type: none"> • Represents large industrial and mining customers of Eskom, which collectively make up 40% of Eskom sales. • Lobbies for favourable prices for large industrial customers, and now backs regulatory reforms for competition from IPPs.
Trade unions	<ul style="list-style-type: none"> • Advocate for electricity sector workers’ interests and on the affordability of power. • Oppose Eskom restructuring and decommissioning of coal generation due to expected job losses.
Community, social, and environmental groups	Various community groups and non-governmental organisations voice civil society concerns, including for social and environmental justice in realising a just transition, e.g. the Centre for Environmental Rights, Earthlife Africa, Greenpeace, Project 90 by 2030.

Policy and planning environment

Policy, legislation, planning, and strategy documents shape the regulatory environment of the sector. Table 2 describes key documents that outline future planning and regulatory frameworks for sectoral regulation.

Table 2. Key documents defining the policy, planning, and regulatory environment

Document	Year	Provisions/function
NDP 2030	2012	<ul style="list-style-type: none"> • Sets goals for energy investing to ensure reliable, efficient, and affordable electricity delivery for economic growth and social equity. • Notes the need to reduce energy-related pollution and greenhouse gas emissions to mitigate climate change impacts, in line with Nationally Determined Contributions (NDC) to the United Nations Framework Convention on Climate Change.¹⁰ • Creates an independent transmission system operator, endowed with power planning, procurement, and contracting functions.

¹⁰ The NDC outlines emissions reductions targets over a 15-year timeframe, through diversifying and transforming the electricity mix to ensure energy security and environmental health. It identifies mechanisms to reduce emissions through investment in energy efficiency, renewable generation, nuclear energy, and advanced biofuels.

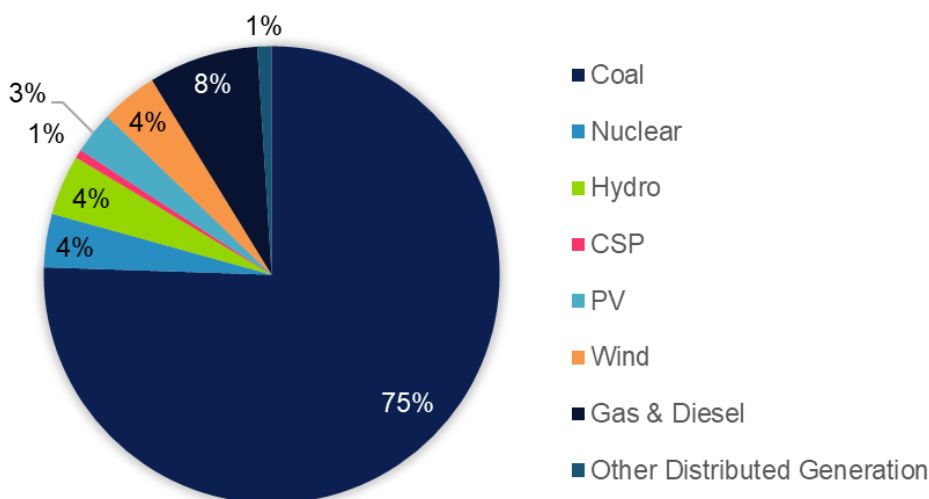
<p>IRP 2010–2030</p> <p><i>Updated:</i></p>	2011	<ul style="list-style-type: none"> • Detailed vision of electricity sector, drafted through expert and public consultation, laying out a 20-year plan to allocate future power generation needs and priority sources. • Offers a legal basis for generation procurement for Eskom and the IPP Office, guiding investments across the power sector and defining the overall generation mix. • Updates to the IRP often face uphill battles due to the politically-charged nature of the sector.
<p>IRP 2019</p>	2019	<ul style="list-style-type: none"> • Generation capacity additions of 39.7 GW from 2019 to 2030. • Ease the impact of decommissioning coal plants to protect the security and stability of the future power grid (recognising promise of new generation). • Prioritise private generation investments (except in nuclear power). • Add 7.2 GW new coal sources, 1.9 GW of nuclear (extending life of Koeberg Power Station), and 3 GW of gas/diesel turbines. • Add 25.4 GW from renewable generation, including 2.5 GW from hydropower (through interconnection with the Democratic Republic of Congo), 22.9 GW from wind, solar PV, and concentrated solar power. • Add 2 GW of storage capacity and 500 MW/year other capacity additions, e.g. distributed generation (from retail, commercial, and industrial customers), co-generation, biomass, and landfill (waste-to-energy).
<p>RERESI, DPE</p>	2019	<ul style="list-style-type: none"> • Sets out steps for long-term sector sustainability, including restructuring Eskom. • Sets out incremental process to separate Eskom’s core functions of generation, transmission, and distribution into distinct subsidiary entities. • Created a separate transmission operator in March 2020 to fulfil role of purchasing, system operation, and grid management. • Legally separates generation, transmission, and distribution entities by 2021. • Offers a much-needed package of fiscal injections amounting to 105 billion South African Rand (ZAR) (US\$ conversion) to service debt obligations, determined by National Treasury and DPE and according to Eskom’s performance, restructuring, and cost reduction.
<p>Electricity Regulation Act</p>	2006	<ul style="list-style-type: none"> • Defines NERSA’s powers and functions of tariff-setting, licensing, and setting technical standards. • Empowers ministers responsible for energy to determine how much energy may be procured in a certain timeframe, and the authorised parties to the transaction. • Electricity Pricing Policy (2008) outlines tariff-setting and pricing methodologies. • Only awards generation licences to new plants according to the capacity allocation defined by the IRP’s planned generation mix. • SSEGs of up to 1 MW are exempt from licensing requirements, reducing obstacles for third parties to connect small renewable generation facilities to the grid.

Power supply, sales, and demand

Abundant and historically cheap coal continues to fuel just under three-quarters of South Africa’s total installed generation capacity of 54.2 GW (see Figure 2 for a breakdown by source). Its coal-heavy generation mix serves to rank South Africa as 14th greatest global greenhouse gas emitter.¹¹ Renewable technologies make up around 8% of installed capacity but still only contribute 5% of total electricity supply (due to their

natural intermittency). The REI4P renewables auction programme—conducted in three rounds since 2011—has allowed Eskom to procure privately-financed renewable generation at increasingly competitive prices.¹² This has made a small dent in the dominance of coal, which generated 83% of electricity output in 2019, compared to over 88% in 2013.¹³

Figure 2. Breakdown of South Africa’s total generation capacity



Department of Mineral Resources and Energy (2019b) IRP 2019. <https://t.co/PCXvWbKPv>

Eskom owns and operates 29 power plants—89% of total generation capacity—most of which are coal-powered, as well as Koeberg, the continent’s only nuclear power plant. IPPs and private industrial generators (such as co-generation plants at pulp and sugar refineries, as well as solar PV installations) own about a tenth of installed capacity, while municipalities own just 1%. Distributed generation or SSEG, such as solar PV systems and diesel generators, is growing and now totals 1 GW.¹⁴

Eskom’s total electricity sales were 208,319 GW per hour (GWh) in 2019 and have declined progressively since 2007. Electricity sales per capita have declined by 7% in the past two years alone. Municipalities

(distribution service providers) buy 42% of Eskom’s electricity, and heavy load industry and mining customers buy about 40%. Eskom also distributes electricity directly to some residential and commercial customers.

Exports make up 6% of Eskom’s sales. In 2019, it exported 12,461 GWh of electricity to SAPP, the longest-serving multilateral trading platform on the continent.¹⁵ In the same period, Eskom imported 7,355 GWh from neighbouring Lesotho, Mozambique, Zambia, and Zimbabwe. With Eskom’s installed capacity representing 80% of the total in SAPP, South Africa plays an important role to address supply shortages among its neighbours. Conversely, South

¹¹ Carbon Brief (2018) ‘The Carbon Brief Profile: South Africa’, www.carbonbrief.org/the-carbon-brief-profile-south-africa.

¹² Eberhard, A., Gratwick, K., Morella, E., and Antmann, P. (2017) ‘Independent Power Projects in Sub-Saharan Africa: Investment Trends and Policy Lessons’, *Energy Policy* 108, pp. 390–424, <https://doi.org/10.1016/j.enpol.2017.05.023>.

¹³ StatsSA (2018) ‘Electricity: Coal use inches lower as solar, wind and diesel rise’, www.statssa.gov.za/?p=11292; Eskom (2019) ‘Integrated Report’, www.eskom.co.za/IR2019/Documents/Eskom_2019_integrated_report.pdf

¹⁴ GreenCape (2019) ‘Energy Services 2019 Market Intelligence Report’, www.greencape.co.za/assets/Uploads/ENERGY-SERVICES-MARKET-INTELLIGENCE-REPORT-WEB.pdf

¹⁵ Eskom (2019) ‘Integrated Report’, www.eskom.co.za/IR2019/Documents/Eskom_2019_integrated_report.pdf

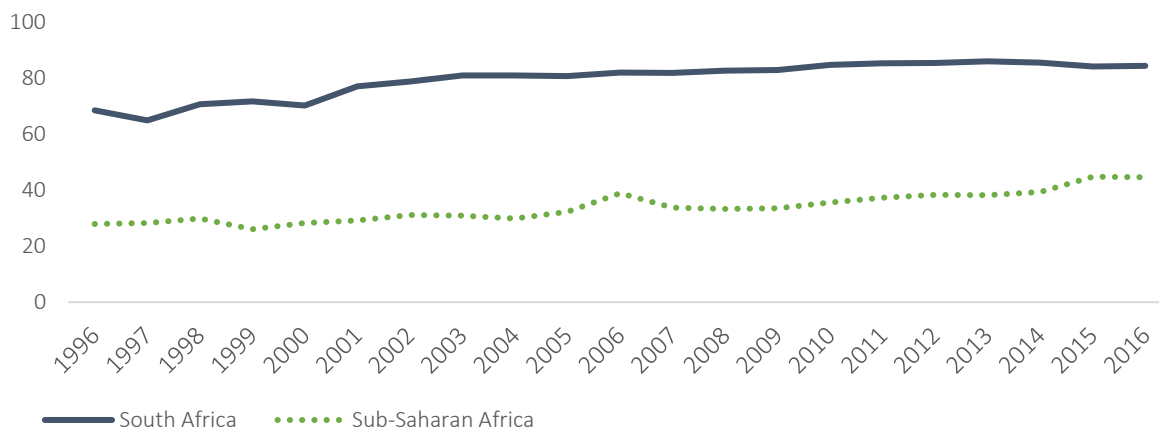
Africa’s recent supply challenges represent a threat to the whole region’s energy security.

Access, demand, and consumption

With 86% of the population connected to the grid, South Africa has the highest rate of electricity access

in sub-Saharan Africa (aside from Cabo Verde, a small island state). Rural access rates (77%) still hover at around 20% below those of urban areas, having increased almost three-fold since the massive electrification programme was rolled out in the 1990s following the end of apartheid.

Figure 3. South Africa electricity access compared to sub-Saharan continental average

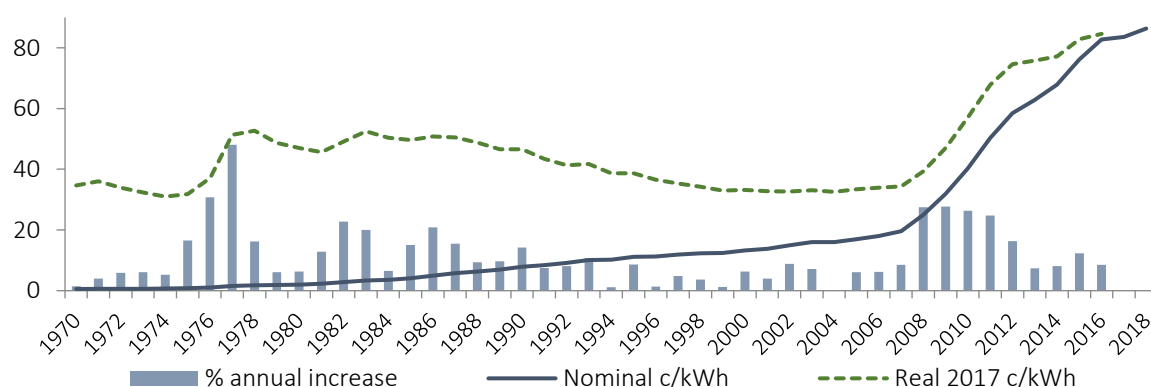


Source: World Bank, Sustainable Energy for All (SE4ALL) database from the SE4ALL Global Tracking Framework led jointly by the World Bank, International Energy Agency, and the Energy Sector Management Assistance Program

Demand, and consumption in turn, have shrunk since 2007, in part due to stagnating economic growth. Rising tariffs—trying to catch up with Eskom’s ballooning operating costs, including coal and salaries—have contributed to declining demand. Tariffs have risen sharply, nearly three-fold since 2007, in real terms (see Figure 4). Large commercial and industrial customers have made energy efficiency investments to reduce their growing electricity costs. Households have also adapted their energy

consumption to compensate. For example, some have practised fuel switching to liquefied petroleum gas (LPG) for cooking, water and general heating purposes. Those with capital have invested in SSEG, including solar PV and diesel generators. While retail consumers and businesses are dismayed at Eskom’s financial mismanagement, which has caused their power bills to spike, Eskom recently won a court battle against the regulator, NERSA, which will mean electricity tariffs increase even more in future years.¹⁶

Figure 4. Average tariff increases from 1970 to 2018



Eskom (2019) ‘Tariff History: Historical Average Price Increase’, www.eskom.co.za/CustomerCare/TariffsAndCharges/Pages/Tariff_History.aspx

¹⁶ Reuters 92020) ‘South African court sides with Eskom in 2018/19 tariff dispute’, <https://af.reuters.com/article/southAfricaNews/idAFL8N2B34UE>

Eskom's debt and governance crises

Eskom's supply shortages have escalated since 2014, resulting in major load shedding programmes that have disrupted electricity supply and, by extension, the wider economy. This not only knocks business productivity, but also harms ordinary residential customers, who lose access to essential services for hours at a time. Inadequate maintenance, and failure to build new capacity, combined with widespread mismanagement, have left the utility unable to meet demand, despite steadily slowing consumption. The successive waves of load shedding since 2014 are estimated to have cost the economy from ZAR 140 to 281 billion (around US\$ 9.4 to 18.9 billion).

The supply crisis results in part from the utility's financial and governance crises. Widening debt squeezes its ability to invest in new capacity and in the maintenance of existing plants. Meanwhile, electricity sales are slowly shrinking, just as its debts and operating costs have continued to grow.¹⁷ Eskom's labour costs, per employee, increased by 145% from 2007 to 2019; and coal costs grew by 485%, even though coal purchases remained stagnant. These dynamics have contributed to Eskom's debt ballooning by 988%, while revenues have increased by only 357%. Eskom generates less than half of the cash it needs to cover its debt obligations.

The debt crisis has shone a light on rent-seeking and patronage scandals that have engulfed the power utility and damaged its reputation. Eskom's governance structures, designed to create barriers to transparency in the pre-democratic era, helped to entrench and intertwine political and industrial interests.¹⁸ Conditions were ripe for managers to take advantage of the utility's monopoly on power production, leading to major fraud allegations surrounding both Eskom directors and national leaders.¹⁹ Eskom's credit rating fell into junk territory, further complicating efforts to secure external funding

to shore up its balance sheet. Eskom, as a monopoly that is considered too big to fail, continues to impose an unsustainable burden on the state, which bails out the utility at every turn.

Electricity tariffs present a problem, rather than a clear pathway to increase Eskom's revenues. NERSA has approved above-tariff hikes to catch up with ever-growing power sector debt and operating costs, but tariffs still fail to cover the utility's costs. At the same time, electricity is increasingly unaffordable for average South African households. Those customers who can afford to avoid increasing power costs (usually larger, more lucrative accounts) reduce their grid consumption by investing in SSEG or energy efficiency upgrades—in turn, reducing Eskom's revenue through sales.

The power sector's contribution to inequality and environmental justice

Electricity poverty in South Africa remains endemic: 16% of the population still lack electricity access, with electricity use divided by class and race. The large minority without power connections are poor black communities in remote areas or overcrowded shanty towns (often bordering wealthy urban suburbs). The richest 20% of South Africans overwhelmingly use electricity for lighting and cooking (over 90% of rich households), compared to only 73% (for lighting) and 55% (for cooking) among the poorest 20% of households.²⁰ Electricity-poor households must resort to dirtier or costlier alternatives like biomass and paraffin. The same households that lack a connection to the grid also experience disproportionate unemployment and lower access to healthcare and education. Delivering electricity to those populations represents an essential means to power complementary services and offer opportunities for

¹⁷ Eskom (2019).

¹⁸ Lawrence A. (2020) 'Eskom and the Dual Character of the South African State'. In: *South Africa's Energy Transition. Progressive Energy Policy*, Palgrave Pivot, Cham.

¹⁹ The Economist (2019) 'A decade of "state capture" has damaged South Africa's institutions', www.economist.com/special-report/2019/04/25/a-decade-of-state-capture-has-damaged-south-africas-institutions; BBC News (2019) 'Eskom crisis: Arrests over \$50m South Africa power station "fraud"', www.bbc.com/news/world-africa-50854186

²⁰ Department of Energy (2012) *A survey of energy-related behaviours and perceptions in South Africa: The Residential Sector*, www.energy.gov.za/files/media/Pub/Survey%20of%20Energy%20related%20behaviour%20and%20perception%20in%20OSA%20-%20Residential%20Sector%20-%202012.pdf

development, through improved healthcare, education, and entrepreneurial conditions.

Pollution and environmental inequalities pose further problems for the power sector. South Africa is likely to experience more intense climate change effects than the global average, and will suffer those effects more intensely than wealthier, advanced economies in the global North.²¹ Yet Eskom's coal power plants routinely violate legal minimum emissions standards for air quality.²² This disproportionately harms poor communities that live and work near coal plants, and exacerbates South Africa's struggle to meet its NDC targets for reducing greenhouse gas emissions under global climate change conventions. At the same time, South African labour unions fiercely protect the coal industry, which holds a central place in the country's political economy and accounts for over 130,000 jobs.²³

A just, green transition in South Africa

The structural failures, political patronage networks, and entrenched socioeconomic inequalities that have grown around the power sector call for urgent, well-planned reform to allow a just transition to a low-carbon power sector. The President's Eskom Sustainability Task Team has outlined strategies to achieve such a transition. Notably, it proposes a restructuring plan to separate the transmission system operation, planning, and power procurement from generation ownership and operation, and from distribution concerns. The proposed structure is designed to free up the system operator to buy least-cost electricity, through fair, transparent, and competitive procurement (by removing pre-existing interests in Eskom's own generation plants). However, the Government has not yet taken further concrete measures to unbundle Eskom and to create more competition.

The plan also prepares the sector to adapt to, and take full advantage of, new disruptive innovations. These promise pathways to decarbonise the economy through a 'just' and 'green' transition, notably thanks to renewable generation at utility scale and SSEG, storage, and smart grids.

Disruptive technologies are changing energy sectors worldwide beyond recognition, notably with the changing economics of wind and solar technologies. At a global level, these innovations light the way for a transition away from fossil fuel-based generation. They also offer power consumers new opportunities to take a role in selecting the source (with competition from 'green' providers at retail level), or even to invest in their own power generation through SSEG, storage, or community-based solutions. SSEG such as solar PV (including for residential, commercial, and industrial customers) also challenge the traditional distribution model by disrupting daily demand curves, reducing revenues from electricity sales, and requiring investment in low-carbon backup technologies to support the intermittency of renewable generation. At a larger scale, renewable technologies offer industrial customers a new way to interact with the power system, as well as providing opportunities for IPPs to invest and sell power to the grid or specific customers.

Small renewable-powered systems with storage for off-grid applications (including mini-grids and standalone solar-powered systems) offer ways to supply electricity in under-electrified rural or urban communities. Such off-grid models can be scaled up through licensed and regulated private or third-party providers, in the right regulatory conditions. Publicly-funded models can also expand off-grid services through targeted funding or subsidy mechanisms, to be rolled out by existing distribution companies or specially-mandated rural electrification bodies. These service models will offer South Africa new tools for serving the most marginalised and vulnerable

²¹ Maure, G., Pinto, I., Ndebele-Murisa, M., Muthige, M., Lennard, C., Nikulin, G., Dosio, A., and Meque, A. (2018) 'The southern African climate under 1.5 °C and 2 °C of global warming as simulated by CORDEX regional climate models', *Environmental Research Letters*.

²² The National Environmental Management Act: Air Quality Act (Act No. 39 of 2004) requires coal power plants to meet emissions standards, or be declared non-compliant and lose legal right to operate. Sahu, R. (2018) 'Eskom Power Station Exceedances of Applicable Atmospheric Emission License (AEL) Limit Values for PM, SO₂ & NO_x During April 2016 to December 2017', <https://cer.org.za/wp-content/uploads/2018/12/Eskom-plant-exceedances-of-AEL-Limits-Ron-Sahu-15-November-2018.pdf>

²³ Strambo, C., Burton, J., Atteridge, A. (2019) 'The end of coal? Planning a "just transition" in South Africa', SEI report, www.sei.org/wp-content/uploads/2019/02/planning-a-just-transition-in-south-africa.pdf

populations, which too often miss out on the economic benefits of electricity services.

The changing landscape of tomorrow's power sector in South Africa calls for urgent policy and regulatory certainty. Incumbent distribution service providers need forward-looking regulatory guidance through tariffs and updated service standards to evolve their business models. This will allow them to continue to serve existing customers with affordable electricity services, and to expand their service offering, such as to provide 'backup' grid services to SSEG owners, or even to offer energy efficiency services. Other actors

wishing to invest in disruptive power infrastructure technologies at any scale—from utility-scale renewable generation to off-grid generation and distribution systems, as well as storage, SSEG, and energy efficiency service providers—need clear regulatory and policy signals about market entry options, licensing, grid connection, and service standards. Future policies for implementing this just, green transition must take into account the need to reskill, educate, and offer new job opportunities to communities that risk losing livelihoods associated with the coal industry.

About the author

Gabrielle Dyson is a specialist in electricity economics and policy, and is Energy Transition Consultant at the University of Cape Town's Power Futures Lab. As founder of Paris-based social science research group *kōtare.network*, her work explores the agriculture-energy-water nexus, global and local inequalities, and pathways towards an inclusive, sustainable global economy. Gabrielle leads research and consulting projects to advise government agencies and international organisations on the themes of renewable energy, electrification, and inclusive development. She has analysed energy and environmental policy in dozens of developing and small island countries across sub-Saharan Africa, South Asia, Latin America and the Caribbean, and the Middle East. Her latest paper [on the development impacts of electricity](#) was recently published by CDC Group (UK). Other recent clients include the Africa-Europe Energy Partnership, the African Development Bank, and the World Bank. Gabrielle holds a M.Sc. in environmental policy from the University of Oxford.

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