SOUTH AFRICA COUNTRY STUDY **2021**

CLEAN CAPTIVE INSTALLATIONS FOR INDUSTRIAL CLIENTS IN SUB-SAHARA AFRICA

Solar panel rows on solar farm in South-Africa.
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Black River Park, from the South African Astronomical Observatory, Cape Town. *© Shutterstock / Grant Duncan-Smith*

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CLEAN CAPTIVE INSTALLATIONS FOR INDUSTRIAL CLIENTS IN SUB-SAHARA AFRICA

Frankfurt School
FS-UNEP Collaborating Centre
for Climate & Sustainable Energy Finance

UN environment programme

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The electronic copy of this report can be downloaded at *www.captiverenewables-africa.org*.

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SUMMARY OF PUBLICATION

This country report presents the state of the clean captive installations market in South Africa as of year-end 2019, with a focus on the commercial and industrial market and solar photovoltaic (PV) technology.

The project team collected stakeholders' views on their experiences with: a) the current clean captive installations for the commercial and industrial sector; b) the perceived barriers for its development; c) potential synergies between their activities and the project; and d) industry sectors and technologies to be targeted under this project (for modelling support and to initiate a pilot project). For the purposes of confidentiality, the names of persons and/or institutions have not been included in this report.

The information presented in this report was collected during the last quarter of 2019 and is valid as of that date. The South African energy and captive market and its regulatory framework are changing rapidly. Readers are invited to consider any evolution that may have taken place since year-end 2019.

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1/ ABBREVIATIONS AND ACRONYMS

AFD	Agence Française de Développement/The French Development Agency
AMEU	Association of Municipal Electricity Utilities
C&I	Commercial&Industrial
CPI	Consumer Price Index
CSP	Concentrated solar power
CSRI	Credit Suisse Research Institute
CUOSA	Connection and Use of System Agreement
DEFF	Department of Environment, Forestry and Fisheries
DMRE	Department of Mineral Resources and Energy
DNT	Department of National Treasury
DST	Department of Science and Technology
dtic	Department of Trade, Industry and Competition
DWS	Department of Water and Sanitation
EPC	Engineering, procurement and construction
EPP	Electricity Pricing Policy
ERA	Electricity Regulation Act
FIRST	The Facility for Investment in Renewable Small Transactions
FNB/RMB	First National Bank / Rand Merchant Bank
FS-UNEP	Frankfurt School-UNEP Collaborating Centre
GDP	Gross Domestic Product
GEF	Global Environment Facility
GIZ	German International Cooperation Agency
GW	Gigawatt
GWh	Gigawatt-hour
IDC	Industrial Development Corporation
IEP	Integrated Energy Plan
IFC	International Finance Corporation
IKI	International Climate Initiative
INDC	Intended Nationally Determined Contribution
INEP	Integrated National Electrification Programme
IPP	Independent Power Producer
IRP	Integrated Resource Plan
KfW	Kreditanstalt für Wiederaufbau
kV	Kilovolt
kVA	Kilovolts-ampere
kWdc	Kilowatt direct current
kWh	Kilowatt-hour
kWp	Kilowatt-peak
LPG	Liquefied Petroleum Gas
MSW	Municipal Solid Waste
MW	Megawatt
MWh	Megawatt-hour
NDB	New Development Bank
NDP	National Development Plan
NERSA	National Energy Regulator of South Africa
PPA	Power purchase agreement
PV	Photovoltaic
R	South African Rand
R&D	Research & Development
Rc	Rand cents
RECORD	Renewable Energy Centre of Research and Development
REFIT	Renewable Energy Feed-In Tarrif
REIPPPP	Renewable Energy Independent Power Producer Procurement Programme
REPA	Renewable Energy Purchasing Policy
RMB	Rand Merchant Bank
SANEDI	South African National Energy Development Institute
SAPP	Southern African Power Pool
SAPVIA	South Africa Photovoltaic Industry Association
SAWEP	South African Wind Energy Programme
SCADA	Supervisory Control and data Acquisition
SDG	Sustainable Development Goal
SEZ	Special Economic Zone
SSEG	Small Scale Embedded Generation
SUNREF	Sustainable Use of Natural Resources and Energy Financing
UNEP	United Nations Environment Programme
VAT	Value-added Tax
WASA	Wind Atlas for South Africa
ZAR	South African rand

1/ INTRODUCTION

Solar modules on a roof, Johannesburg.
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This report is published under the project titled "Clean Captive Installations for Industrial Clients in Sub-Saharan Africa" developed in four partner African countries: Ghana, Kenya, Nigeria and South Africa.

The project aims to demonstrate the economic and financial viability of clean captive energy installations for industries and to enhance their adoption in the four partner countries and beyond to the entire continent. Captive energy installations are electricity generation facilities that are used and sometimes managed by a commercial or industrial energy user for its own energy consumption. Captive power plants can operate off-grid or can be connected to the grid to feed in excess generation wherever regulations allow for it.

Renewable energy captive installations alleviate the pressure to generate electricity from national grids and reduce industrial clients' needs to rely on private supplementary fossil-fuelled generators, which are expensive to run. These clean captive installations are frequently referred to as the second generation of renewable energy business models, as they do not rely on national governments' incentivizing policies to enhance the deployment of clean energy technologies.

The project will strengthen the ability of partner countries to move towards low carbon-emitting development strategies. It also contributes to several Sustainable Development Goals (SDGs), including Climate Action (SDG 13), Responsible Consumption and Production (SDG 12), Affordable and Clean Energy (SDG 7) and Industry, Innovation and Infrastructure (SDG 9). The project will raise awareness among industry players, financiers and governments, and will support the dissemination of clean modern energy technology through business models tailored to the national contexts and beyond throughout Sub-Saharan Africa.

This project is part of the International Climate Initiative (IKI) of Germany. The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety supports this initiative based on a decision adopted by the German Bundestag.

The implementing team of the project comprises the United Nations Environment Programme (UNEP) in partnership with its collaborating centre at the Frankfurt School of Finance & Management (Frankfurt School), together with locally hired consultants who provide local market and captive power expertise.

THE PROJECT

The project's activities fall under four components:

Component 1	Baseline studies and awareness raising
Component 2	Economic and financial tools and assessments
Component 3	Realization of one pilot project per country
Component 4	Knowledge dissemination and outreach

This country report is part of Component 1. Initial desktop research was conducted followed by extensive consultation by the project team of local public and private sector stakeholders through a week-long scoping mission.

In South Africa, the scoping mission took place from 4 November 2019 to 8 November 2019. The official kick-off meeting hosted by the National Cleaner Production Centre and the Department of Trade and Industry on 4 November gathered 22 stakeholders from 11 institutions. Following this in-depth discussion of the South African market with public stakeholders, the project team met with around 15 private sector stakeholders throughout the week.

The project team collected stakeholders' views on their experiences with: a) the current clean captive installations for the commercial and industrial sector; b) the perceived barriers for this development; c) potential synergies between stakeholder activities and the project; and d) industry sectors and technologies to be targeted under this project (for modelling support and to initiate a pilot project). For the purposes of confidentiality, names of persons and/or institutions have not been included in this report.

The information collected during the desktop research and in-person interviews in the four partner countries will inform the overall design of the project and guide its implementation. This country report presents the state of the clean captive installations market in South Africa as of year-end 2020 with a focus on the commercial and industrial market and solar photovoltaic (PV) technology.

The information collected will also support the development of a robust financial model to be used as a tool to prove the financial viability of clean captive PV technology installations. Relevant and key information about the clean captive energy markets in the four partner countries and the project progress will be shared through the project website, www.captiverenewables-africa.org.

The information presented in this report was collected during the last quarter of 2020 and is valid as of that date. The South African energy and captive market and its regulatory framework are changing rapidly. Readers are invited to consider any evolution that may have taken place since year-end 2020.

2/ KEY FINDINGS

South Africa has a severe undersupply of electricity, and the national utility faces a financial crisis.	More than 85 per cent of South Africa's electricity is generated by coal power plants, many of which are nearing the end of their lifetimes. The national power utility Eskom has over R440 billion of debt (as of June 2019, or around US$31 billion[1]) due to ageing infrastructure and to problems in bill collection from customers in recent years.
Growth in local renewable energy markets has stagnated.	The local renewable energy industry has had some success with over 6 gigawatts (GW) procured from 92 utility-scale projects since 2011, thanks to four rounds of the South African government's Renewable Energy Independent Power Producer Procurement Programme (REIPPPP). The installed capacity of rooftop-scale solar PV projects (smaller than 1 megawatt (MW) was an estimated 280 MW in 2018 and continues to grow due to falling solar PV costs and rising electricity tariffs from Eskom. However, delays to the government's utility-scale procurement from independent power producers and uncertainty around government regulations for distributed generation have limited growth in the renewable energy market to date.
There is a lack of consensus around political support for renewable energy development.	Concerns raised by mining unions about potential job loss in the local coal industry have led to limited political support for renewable energy and highlighted the need for further work on how a just energy transition away from coal can be achieved in South Africa.
Municipalities have provided support for small-scale embedded generation (SSEG) (less than 1 MW).	As of year-end 2018, 165 municipal electricity distributors across the country were reselling electricity to customers in their localities using their own tariff methodology and structure. A number of those municipalities have also taken steps to enable distributed generation installations in the form of small-scale embedded generation (SSEG) by their customers. As a result of municipal support for SSEG and rising electricity tariffs, the commercial and industrial sectors have the highest installed capacity for distributed solar PV in South Africa at around 130 MW as of 2017.
Eskom has single-buyer responsibility to procure from independent power producers (IPPs), but restructuring may change the market.	In late 2020, South Africa's government gave municipalities the authority to buy electricity directly from independent power producers. Likewise, the Eskom Roadmap released by the government in October 2019 plans to unbundle Eskom into independent generation, transmission and distribution entities. These changes should increase opportunities for independent power producers in South Africa and potentially for the commercial and industrial sector if municipalities choose to sign power purchase agreements with these customers for larger projects.
Renewable energy financing is well established for some market segments.	Many of the major commercial banks have funded utility-scale solar PV projects as part of the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP). In addition, banks offer a variety of financing mechanisms for rooftop-scale installations, and some engineering, procurement and construction (EPC) firms offer financing for customers to lower upfront costs. However, more affordable and scalable financing solutions are still needed in the market to accelerate growth, especially for low-income communities that face challenges in accessing traditional financing.

1 Exchange rate from South African Rand to US dollars of 14.42:1, South African Reserve Bank as of 19/05/2019, the same below if not otherwise indicated.

Solar panels on a Cape Town's building terrace.
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3/ SOUTH AFRICA KEY SOCIO-ECONOMIC INDICATORS

SOCIO-ECONOMIC INDICATOR	RESULT	DATE	SOURCE
Population	57.7 million	2018	Statistics South Africa (Stats SA)
Population growth	1.4%	2017-18	World Bank
Female population share	51%	2016	Statistics South Africa (Stats SA)
Youth population share (<15 years)	29.5%	mid-2018	Statistics South Africa (Stats SA)
GDP	US$366.3	2018	World Bank
GDP growth	0.62%	2017-18	World Bank
Contribution to GDP growth	0.787% annually	2018	World Bank
GDP per capita	US$6 339.5	2018	World Bank
Total labour force (share of total population >15 years)	55.2%	2018	World Bank
Female labour force (share of female population >15 years)	48.4%	2018	World Bank
Unemployment rate	29%	2019	Statistics South Africa (Stats SA)
Inflation rate	4.5%	July 2019	Statistics South Africa (Stats SA)
Corruption perception index	43 points 73/180 ranking	2018	Transparency International
Ease of doing business	84/190 ranking	2019	World Bank

4/ ELECTRICITY MARKET

This section provides an overview of the electricity sector in South Africa in terms of supply, demand, generation, transmission and distribution, with the main objective of illustrating the potential for clean captive power generation.

Despite a recent government announcement about plans to restructure the electricity market and the national electricity company (Eskom), South Africa's electricity market still operates within a vertically integrated model that is dependent on the state-owned utility. Private generation from independent power producers that sell to Eskom is allowed, as are smaller distributors of electricity at the municipal level that buy power from Eskom and resell it to customers on their distribution network.

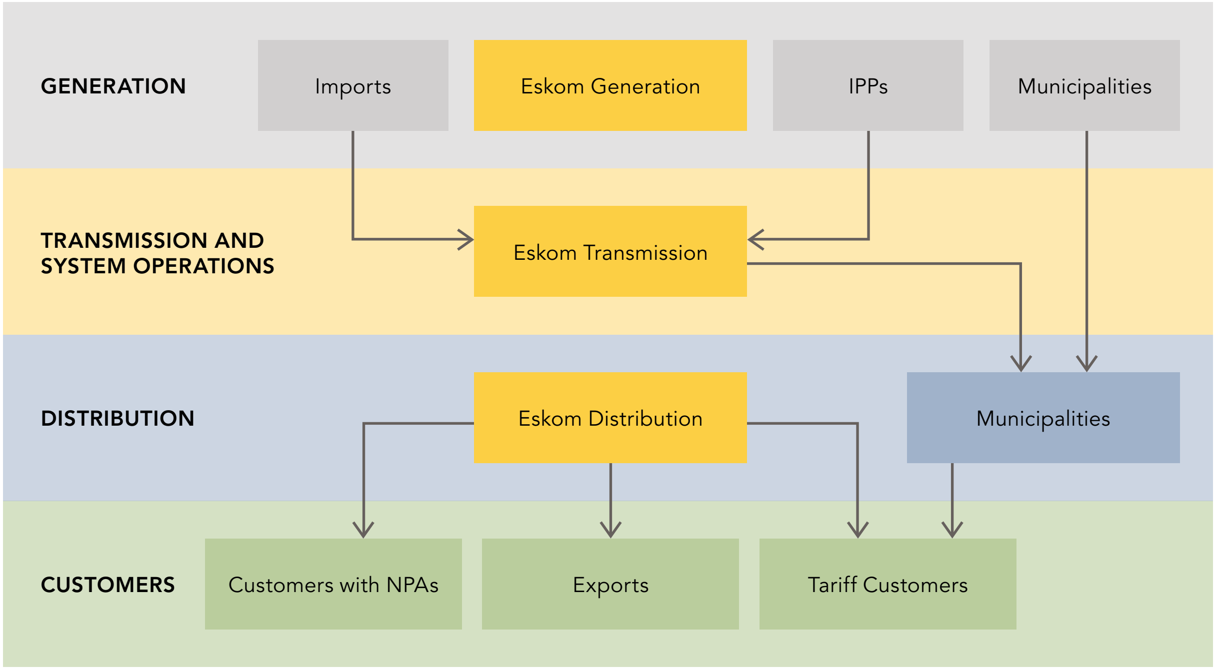
Eskom generates most of the electricity for the country from its coal power fleet and has struggled with reliability and bill collection from its customers in recent years. Eskom is in a financial and supply crisis with over R440 billion (around US$31 billion) of debt as of June 2019 (Gokoluk 2019), which it could not service with revenue collection alone.

As part of the government's recent conditions for Eskom's bailout, South Africa has announced plans to restructure the utility company by June 2021. Eskom, as a result of the proposed restructure, will see separate generation, transmission and distribution operations (Gokoluk 2019).

Figure 1 illustrates the current electricity infrastructure in South Africa. Eskom generates, transmits and distributes electricity to various users, mainly to municipalities and to industrial, mining, commercial, agricultural and residential customers. The municipalities redistribute electricity to businesses and households within their areas (Department of Energy 2019).

Aerial view of the Cape Town Harbour.
© Pexels / Jean van der Meulen

Figure 1: South Africa's electricity supply market structure



Note: IPPs = independent power producers; NPAs = Negotiated Pricing Agreement.

Source: Eskom 2019a

4.1/ ELECTRICITY GENERATION

The National Development Plan (NDP) developed for South Africa's vision of the 2030 Sustainable Development Goals targets the reduction of poverty and inequality (Government of the Republic of South Africa 2012). To achieve those targets, the country aims to adopt a growing and inclusive economy where sufficient energy is produced at competitive prices to support industries and to ensure energy access for deprived households. In parallel, the country's Intended Nationally Determined Contribution (INDC) target from 2016 aims to hit peak emissions by 2025 before plateauing for a decade and then decreasing emissions. However, the electricity sector is still facing significant challenges despite restructuring plans.

This section provides an overview of the electricity sector in South Africa in terms of supply, demand, transmission and distribution.

4.1.1/ CURRENT SITUATION

Table 1: Key energy indicators

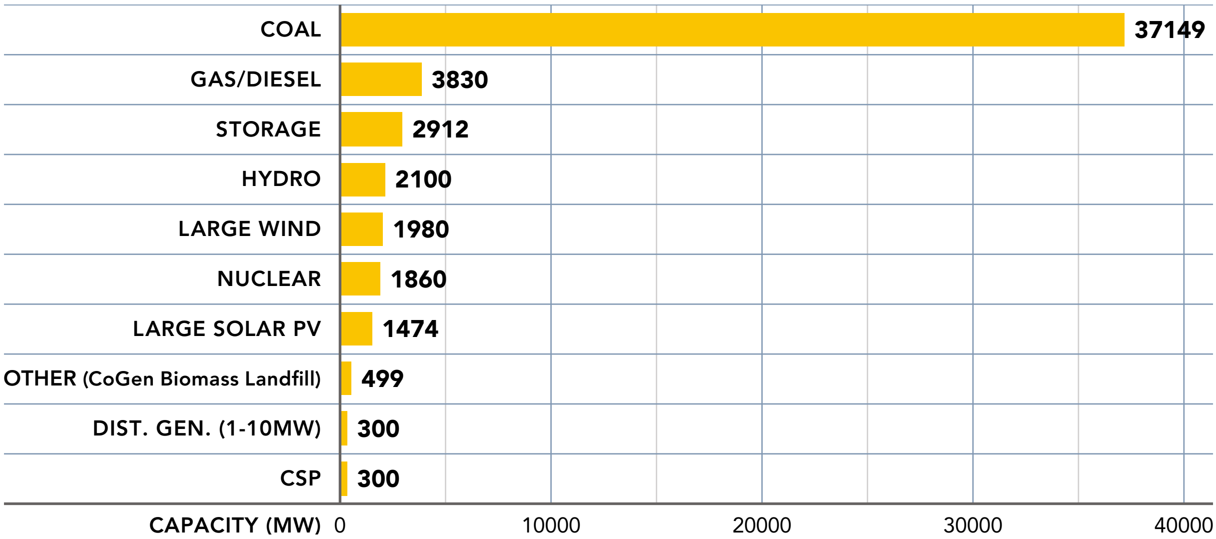
ENERGY INDICATORS	RESULT	DATE	SOURCE
Electrification – total population	84.2%	2017	World Bank
Electrification – urban areas	93.5%	2017	World Bank
Electrification rate – rural areas	66.9%	2017	World Bank
Electricity generation	21 923 gigawatt-hours (GWh)	Jan-Jun 2019	Statistics South Africa (Stats SA)
Electricity consumption	19 585 GWh	Jan-Jun 2019	Statistics South Africa (Stats SA)
Electricity exports	1 264 GWh	Jan-Jun 2019	Statistics South Africa (Stats SA)
Electricity imports	692 GWh	Jan-Jun 2019	Statistics South Africa (Stats SA)
Electricity total installed capacity	51.3 gigawatts (GW)	2017	World Bank

The energy supply sector in South Africa has been dominated by coal since as early as the 1880s (Eskom 2021). On average, coal represents around 85 per cent of the electricity generation mix. This significant reliance on coal is attributed to the country's abundant coal resources: estimated annual coal production in South Africa is around 224 million tons, making it the fifth largest coal-producing country globally (Eskom 2021).

Even though the share of coal generation decreased slightly in 2018, it still contributed significantly to the generation mix. The total installed electricity generating capacity of South Africa was 52 GW as of 2018, with coal contributing the highest share (71 per cent) of all the sources. Natural gas represented just 7 per cent of the total installed generating capacity. Other sources of power generation include renewables (8 per cent excluding hydropower) and nuclear (4 per cent).

Figure 2 details the country's installed electricity generation capacity by source. South Africa has only one nuclear power plant and also an abundance of sunshine, making it a good candidate to harness solar energy for heat and electricity generation. The Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) has, up to 2018, attracted R209.7 billion (around US$ 15 billion) of investment (equity and debt), of which R41.8 billion (around US$ 2.9 billion) (20 per cent) is foreign investment (Department of Mineral Resources and Energy, Department of National Treasury and Development Bank of Southern Africa 2019). The REIPPPP procurement process for Round 5 was expected to begin in 2021, although the exact date was not yet available. Section 6.3 provides more detail on the programme's achievements to date.

Figure 2: South Africa's estimated electricity supply capacity as of 2018



Source: Department of Energy 2019

4.1.2/ FUTURE PROJECTIONS

South Africa's Integrated Resource Plan (IRP), promulgated in October 2019, provides guidance on the build-out of future power plants by 2030. The IRP 2019 accounts for some growth in the distributed generation market for renewable energy, as well as for larger utility-scale projects. While most of the new capacity to be added is projected to come from renewable energy, some new coal is planned for, as indicated in Table 2. According to the IRP 2019, 24,100 MW of conventional thermal power, specifically from coal, is likely to be decommissioned within the next 10-30 years (2019 to 2050). The decommissioning is due mainly to the non-compliance of many existing coal plants with national environmental regulations, as plants are nearing the end of their lifetimes; this is expected to lead to the building of more coal-based generation plants soon, as illustrated in Table 2.

Eskom continues to rely on government bailouts and has limited funds to upgrade existing facilities to comply with national environmental regulations. This was exemplified in 2014, when the retrofitting of five main coal power plants was expected to take place to ensure compliance with environmental regulations. However, Eskom applied for a postponement, which the government granted. By 2019, only one coal plant had been retrofitted and brought into environmental compliance (Department of Energy 2019). By 2019, the failure in compliance had resulted in the non-availability of production from plants of other energy sources, as shown in Table 2.

Nevertheless, coal will still account for around 59 per cent of the country's energy generation by 2030 due to the already contracted capacity and to the new additional capacities planned in the coming years, as shown in the table. The short-term capacity gap identified in the IRP 2019 ranges from 2,000 MW to 3,000 MW between the years 2019 and 2022, which could be addressed with more clean captive power projects in the country. However, it should be noted that back-up diesel generators owned by customers are not included in Table 2. The distributed generation capacity listed is referring to own-generation facilities in the form of rooftop PV installations in the residential, commercial and industrial sectors, indicating the potential for clean captive installations across the various sectors.

Table 2: South Africa's 2019 Integrated Resource Plan (generation mix projections to 2030. Units in MW)

RECOMMENDED PLAN IRP 2019	COAL	COAL DECOMMISSIONING	NUCLEAR	HYDRO	STORAGE	SOLAR PV		WIND	CSP	GAS & DIESEL	OTHER*
Current Base	37149		1860	2100	2912	1474		1980	300	3830	499
2019	2155	-2373						244	300		***
2020	1433	-557					114	300			***
2021	1433	-1403					300	818			***
2022	711	-844			513	400	1000	1600			***
2023	750	-555					1000	1600			500
2024			1860					1600		1000	500
2025							1000	1600			500
2026		-1219						1600			500
2027	750	-847						1600		2000	500
2028		-475					1000	1600			500
2029		-1694			1575		1000	1600			500
2030		-1050		2500			1000	1600			500
Total Installed Capacity by 2030 (MW)	33364		1860	4600	5000	8288		17742	600	6380	
% Total Installed Capacity (% of MW)	43		2.36	5.84	6.35	10.52		22.53	0.76	8.1	
% Annual Energy Contribution (% of MWh)	58.8		4.5	8.4	1.2	6.3		17.8	0.6	1.3	

Installed Capacity
Committed/ Already Contracted Capacity
Capacity Decommissioned
New Additional Capacity
Extension of Koeberg Plant life
Distributed Generation Capacity for own use

Note: "Other" refers to distributed generation and includes all generation facilities operating solely to supply electricity to an end user customer within the same property within the facility.
Source: IRP 2019

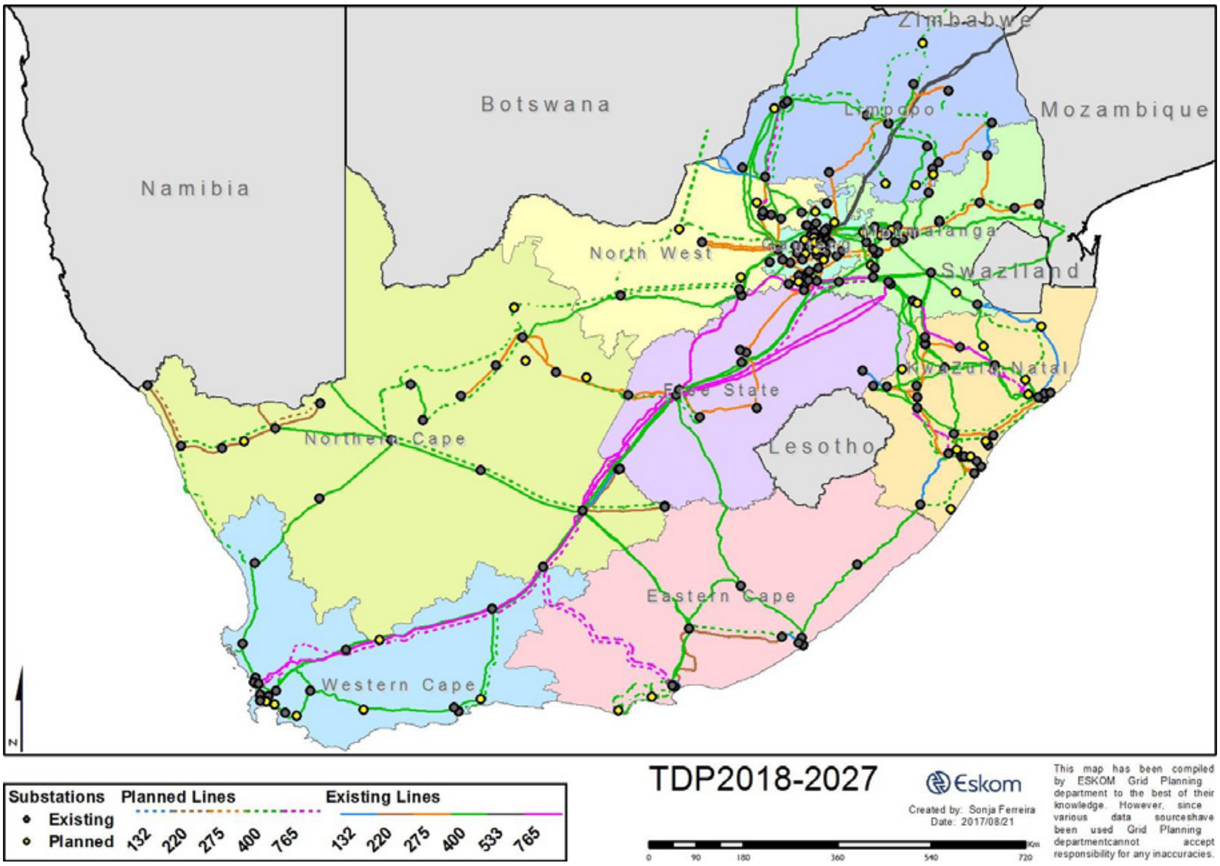
To help address the short-term capacity gap in energy, South Africa's Department of Mineral Resources and Energy (DMRE) issued a Request for Information in December 2019 from the private sector for clean captive power installations in order to meet the 2,000-3,000 MW near-term supply gap identified in the IRP 2019. This power procurement process is taking longer than planned and was still ongoing as of 2019 (DMRE 2019).

4.2/ ELECTRICITY TRANSMISSION AND DISTRIBUTION

South Africa has one of the highest electrification rates in Sub-Saharan Africa at around 91 per cent, which is well balanced between urban (around 92 per cent electrified) and rural (around 90 per cent) populations (World Bank 2018). The transmission network is fully owned and operated by Eskom. Unelectrified customers include a mix of informal settlements in urban and rural areas, and other customers that are located beyond the reach of the distribution network.

The transmission lines extend all over the country with a total length of around 33,000 kilometres (Eskom 2019a). As shown in Map 1, the transmission network mainly covers the needs of the domestic market within South Africa; however, it is also connected to the regional market through the Southern African Power Pool (SAPP) (Eskom 2019c). This facilitates the import and export of electricity within the region.

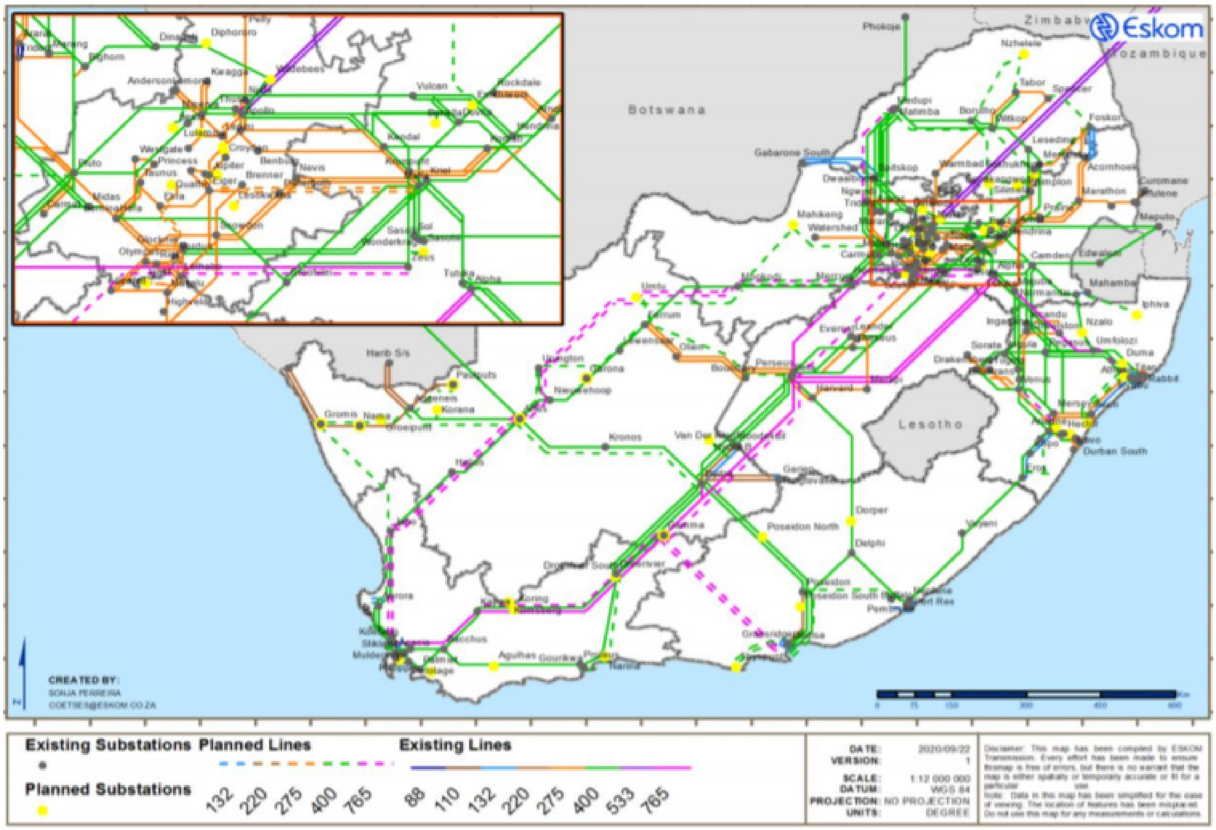
Map 1: Eskom's transmission lines



Source: Eskom 2019a

Even though the transmission network extends throughout the country, its performance has deteriorated since 2014. Interruptions on the transmission network are estimated to have increased from 2.85 minutes to 3.16 minutes (Eskom 2019c). These interruptions may lead to possible outages for end users in the affected areas. The decline in the network's performance is due to ageing transmission lines that require refurbishment. To address this, Eskom has developed the Transmission Development Plan (TDP), a 10-year plan to refurbish the transmission network; however, successful implementation remains to be seen (Eskom 2020). Map 2 illustrates the planned transmission lines to be constructed as part of the TDP.

Map 2: Eskom's existing and planned transmission lines



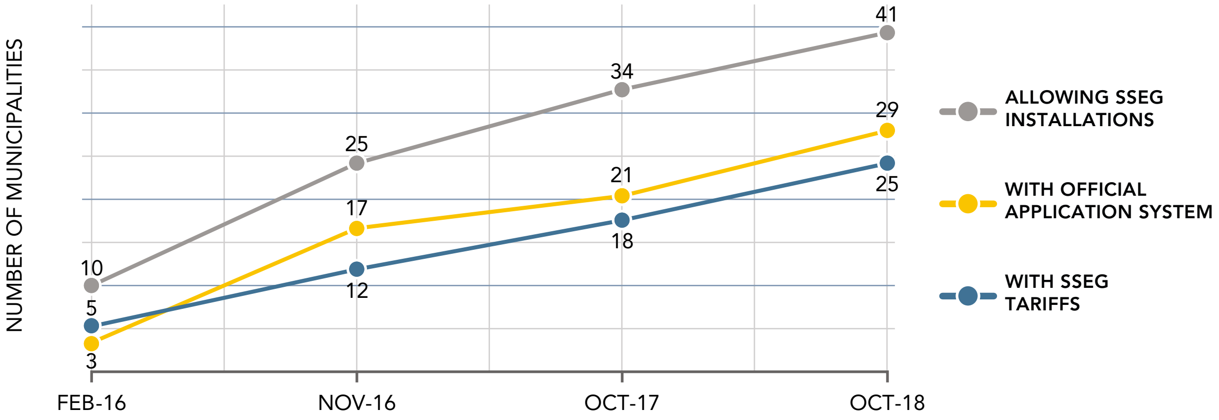
Source: Eskom 2020

The distribution network is owned partly by Eskom (in some locations) and partly by those municipalities that have a distribution licence, which own and operate the network exclusively in other areas in the country. Eskom mainly distributes electricity directly to industrial, mining, commercial, and agricultural users, as well as to municipalities, which in turn redistribute the electricity to businesses and households within their respective areas. South Africa's municipal power companies buy 40 per cent of the electricity generated by Eskom to supply (distribute to) end users. However, in some areas, municipalities do not provide services for electricity reticulation and thus rely on Eskom as a distributor.

Overall, Eskom acts as a direct distributor to 40 per cent of the end users in South Africa, with the remaining distribution being provided by municipalities (Eskom 2019a). Municipalities that have a distribution licence buy their electricity from Eskom and then redistribute it after adding a mark-up on top of what they pay Eskom; this may lead to high electricity tariffs for end users and create the need for alternatives means for electricity supply. As of 2018, there were 165 municipal electricity distributors across the country reselling electricity to customers, using their own tariff methodologies and structure (South African Local Government Association 2018).

Small-scale embedded generation (SSEG) applies to customer generation with an installed capacity of less than 1 MW. Several municipalities offer guidelines and feed-in tariffs for SSEG, as shown in Figure 3. The figure shows that, as of October 2018, 41 municipalities allowed SSEG installations with published regulations, and 25 of those already have SSEG tariffs approved by the regulator. The municipal tariffs for SSEG vary, but most buy electricity back from customers at a rate below the sales tariff in order to cover service and operational costs.

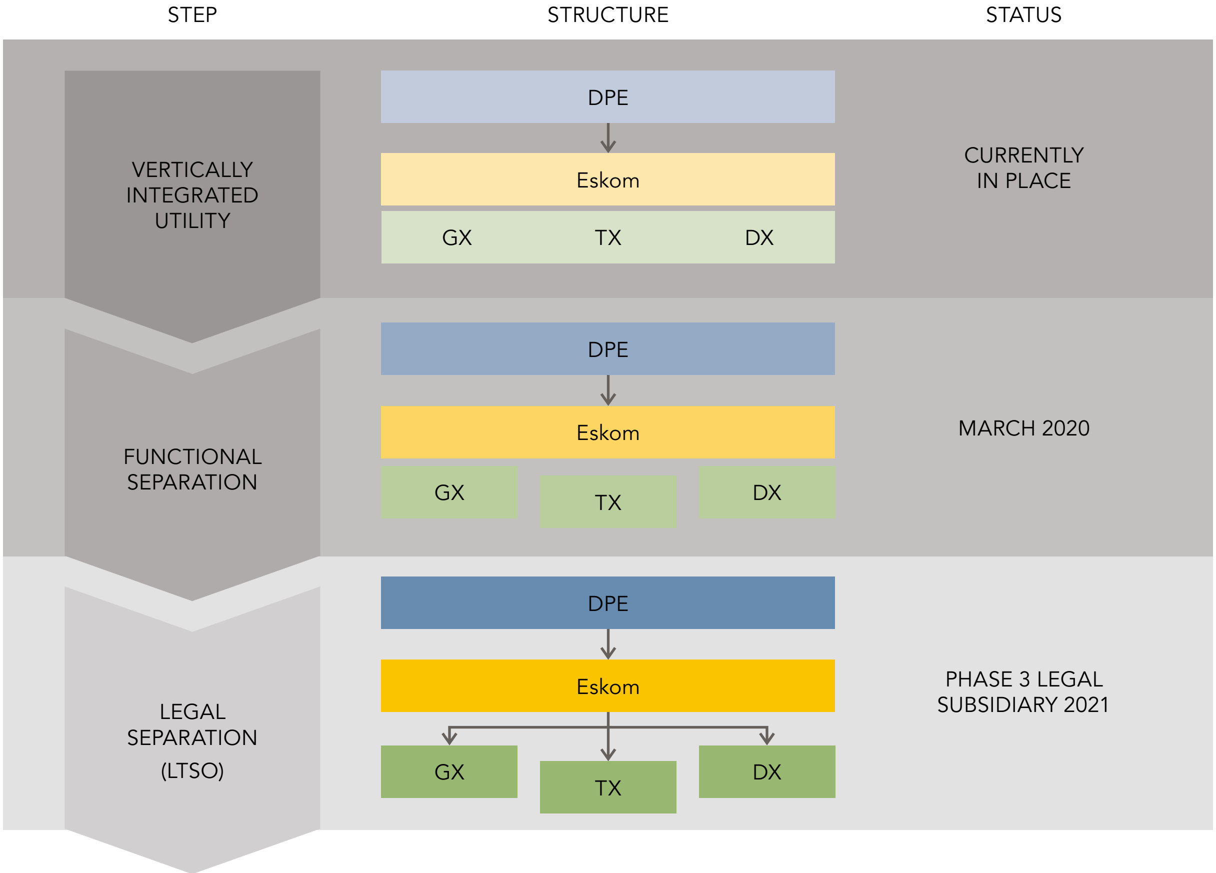
Figure 3: Uptake of SSEG support by municipalities (No.)



Source: South African Local Government Association 2018

The current electricity market structure and power procurement guidelines for municipalities have restricted the municipalities' ability to procure electricity directly from independent power producers for large-scale projects (typically over 1 MW). As per national rules, Eskom has to be a single buyer and has responsibility to procure electricity from these producers. However, in 2020 South Africa's government amended its Electricity Regulations Act to give municipalities in good financial standing the authority to buy electricity directly from independent power producers. These projects still require final approval from the Ministry of Mineral Resources and Energy, which will likely slow market uptake (ESI 2020).In October 2019, the South African government published a *Roadmap for Eskom in a Reformed Electricity Supply Industry*. This plan aims to remove conflicts of interest with Eskom by enabling independent generation, transmission and distribution operations. Figure 4 illustrates the stages of the Eskom unbundling plan.

Figure 4: Eskom unbundling plan from the Department of Public Enterprises



Note: GX = generation; TX = transmission; DX = distribution; LTSO = legally unbundled transmission system operator.

Source: Eskom 2019a

In the Eskom unbundling plan, the integrated utilities perform all operations in the electricity value chain – comprising generation, transmission and distribution (including retail supply) – by themselves (Power Futures 2019). Unbundling refers to structural reform that involves separating principal functions into smaller entities to focus on specific core operations. Vertical unbundling is the separation of generation, transmission, distribution and (sometimes) retail functions. This form of unbundling allows for the separation of potentially competitive segments (generation and retail), where many actors can participate, from uncompetitive segments (transmission and distribution) that generally require a single actor to manage the grid infrastructure in a specific area.

It is proposed to form "three separate entities – Generation, Transmission and Distribution", all still state-owned. These are expected to be established under "Eskom Holdings". Each of these entities is envisaged to have its own board and executive structure. The process of trifurcation may take time to implement (probably at least five years), as it will require legislative and policy reforms. However, due to the urgent need for transformation in the sector, due attention may be provided to the establishment of an independent state-owned transmission grid company. The proposed entity will include Eskom's current transmission system operation as well as power planning and procurement functions.

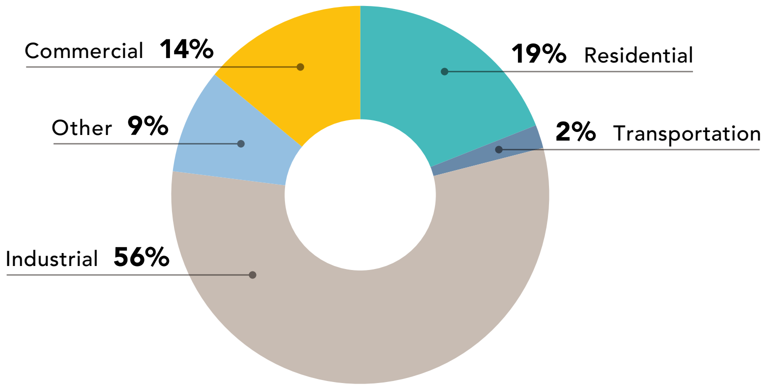
Unbundling of Eskom can result in several benefits, such as improved operational efficiency, better transparency and higher accountability. Least-cost power procurement can be adopted, including the procurement of electricity owned by independent power producers and generated from renewable energy sources (thus diversifying generation). Unbundling can also improve the resilience and sustainability of the power sector. As of the end of 2020, the unbundling plan was progressing slower than originally planned, with Eskom citing challenges to implementing legal separation of the different entities.

4.3/ ELECTRICITY DEMAND OF COMMERCIAL AND INDUSTRIAL CLIENTS

4.3.1/ CURRENT SITUATION

South Africa's total electricity consumption in 2019 was 203.7 terawatt-hours (TWh) across all sectors, down slightly from 225 TWh in 2016. The industrial sector accounted for the highest share of consumption at 56 per cent, followed by the residential sector at 19 per cent, as illustrated in Figure 5.

Figure 5: Electricity consumption shares by sector in 2019 (per cent)



Source: Enerdata n.d.

Electricity consumption in South Africa has decreased steadily in recent years, due to several factors. Low economic growth impacted energy-intensive sectors, resulting in lower output. Eskom has also faced supply constraints over the past decade, which persisted as of early 2021 and were expected to continue for the next few years. Many electricity end users improved their energy efficiency in response to the rising electricity tariff. Meanwhile, embedded generation from rooftop solar PV reduced electricity demand, and some households switched from electricity to liquefied petroleum gas (LPG) for cooking and space heating (Department of Energy 2019).

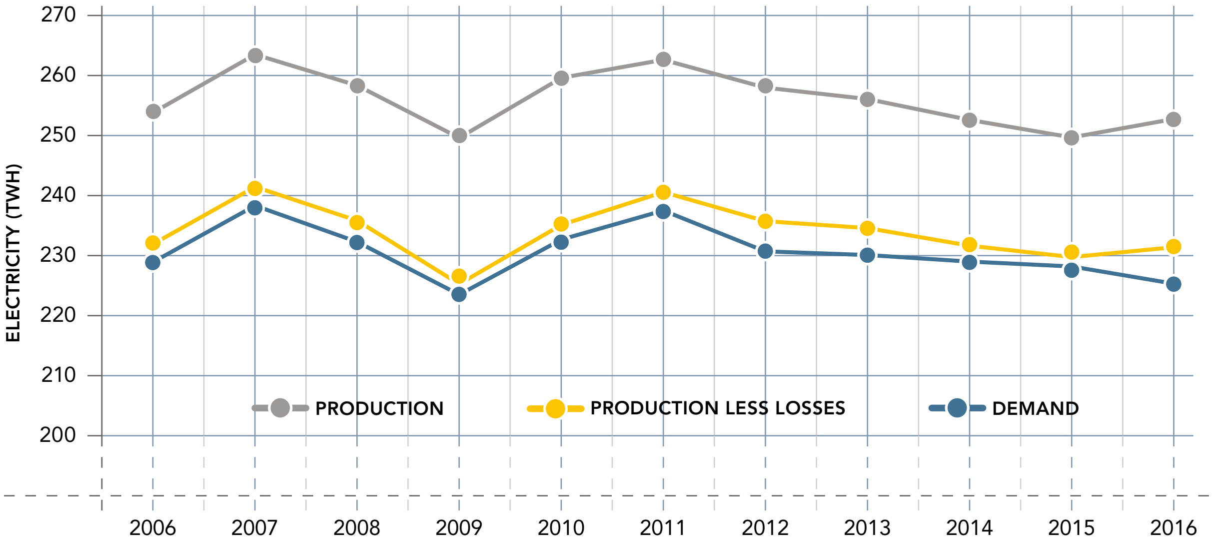
Figure 6 illustrates electricity supply and demand in South Africa (excluding imports or exports) during the period 2006-2016. Losses averaged 9 per cent over the decade, and, when these are included, the figure reveals the low surplus margin between supply and demand, which contributed to load shedding[2]. Losses occur at various stages of electricity generation, transmission, and distribution and include both technical and non-technical (commercial) losses.

Technical losses are unavoidable and arise due to inherent conversion inefficiencies in equipment (turbines, alternators, power transformers, distribution transformers, etc.) However, poor maintenance of the electricity network across the various stages (from electricity generation to distribution) leads to higher losses in equipment efficiency, thus increasing the technical losses. South Africa's transmission and distribution infrastructure is characterized as old and outdated (Eskom 2019a).

Non-technical losses in the country are attributed to the struggle of most municipalities to pay back Eskom for their bulk electricity purchases. As of March 2018, Eskom announced that the debt burden exceeded R13.5 billion (around US$ 0.9 billion) and was expected to increase. In addition to non-payment for electricity, the theft of distribution infrastructure (copper and cables) and poor credit control systems are contributing to overall losses on the network (Eskom 2019c). This has led to end users experiencing sudden power outages, as discussed further in section 4.4.

2 *In South Africa, load reduction countrywide is used as a controlled option to respond to unplanned events to protect the electric power system from a total blackout.*

Figure 6: South Africa's electricity supply and demand (TWh)



Note: Excludes imports and exports.

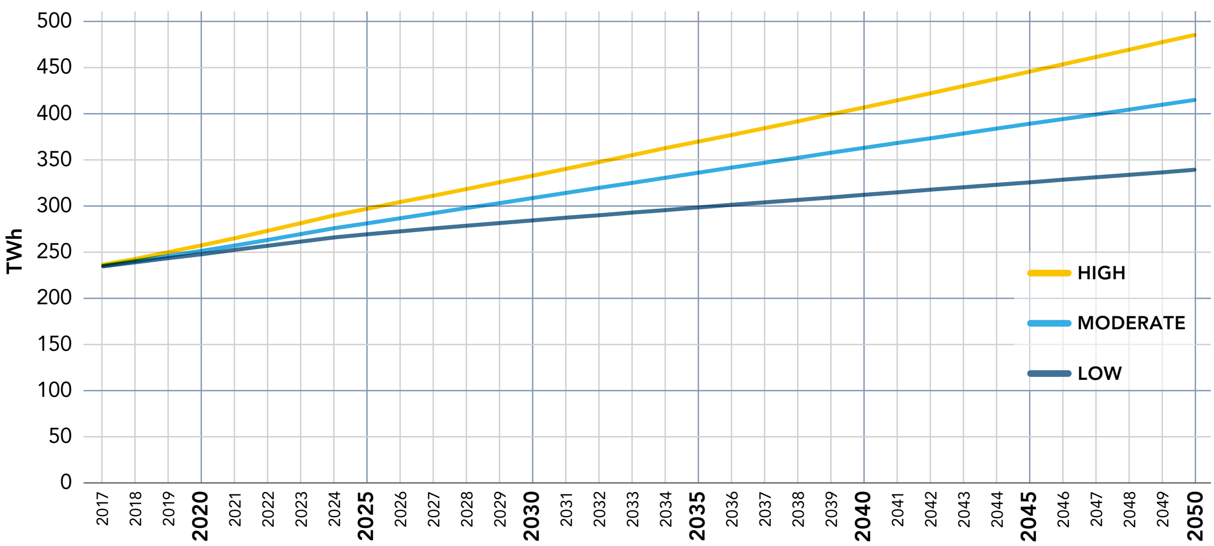
Source: International Energy Agency [IEA] 2019

4.3.2/ FUTURE PROJECTIONS

The Department of Energy in South Africa has developed a forecast for national electricity demand to 2050 (Department of Energy 2017). The Department has developed several sets of forecasts over the years, with the initial one used for the IRP 2015. Following the initial publication of the demand forecast, the Department gathered additional inputs from public entities and experts to update its forecasting models and scenarios (Department of Energy 2017).

Figure 7 illustrates the latest demand forecast published by the Department of Energy. The forecast is based on several parameters such as historical data, population increase, electricity consumption by sector, technical losses and gross domestic product (GDP) (Department of Energy 2017). The figure illustrates the forecast based on three different scenarios, which represent the uncertainties in future forecast values. Electricity demand is estimated to range from 284 TWh to 332 TWh by 2030, and from 338 TWh to 486 TWh by 2050 (Department of Energy 2017).

Figure 7: Demand forecast based on three main scenarios



Source: Department of Energy 2017

4.4/ GRID DOWNTIME

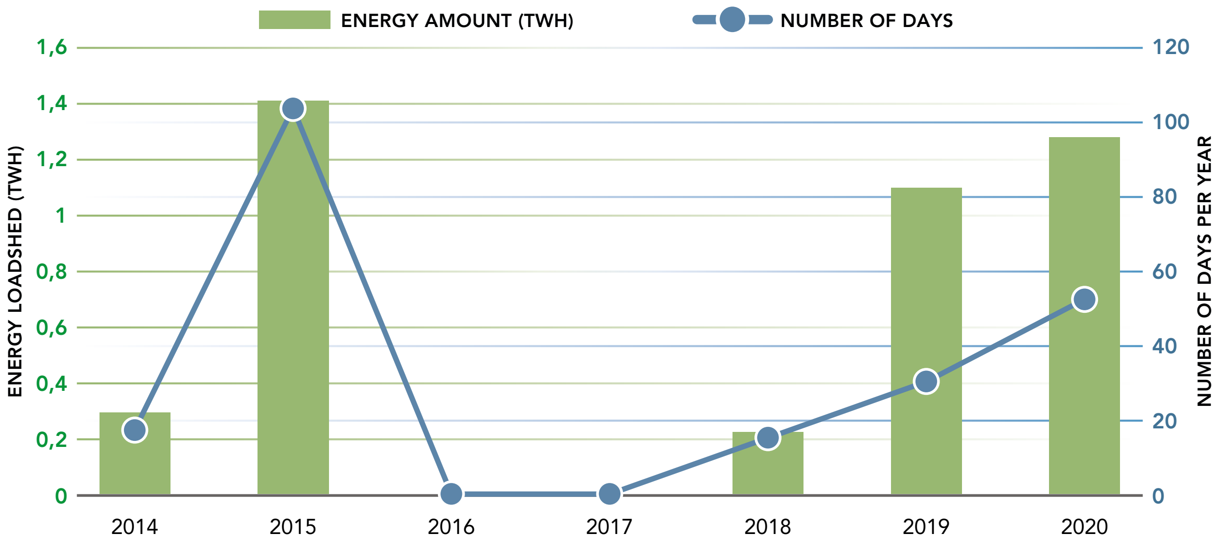
Load shedding has persisted to varying levels of frequency and stages[3] since 2007, when it hit the country for the first time following 12 years of supply stability; this has led to disruptions to business operations and to the closure of some mining operations, as well as impacting households (Niselow 2019). The initial load shedding was attributed to an increase in electricity demand, which the generation capacity was unable to meet (Niselow 2019).

Starting in 2014, load shedding was experienced again following a steady supply period of six years, reaching a peak in 2015 (see Figure 8); this resulted in 100 days of rolling blackouts with various levels of severity (Niselow 2019). This trend was attributed to several problems that occurred in late 2014 (Nest 2015), including a shortage in the dry coal stockpiles needed in some coal-fired power plants (Niselow 2019). Other factors contributing to the extreme event included a reduction in the water levels needed for hydropower plants and the breakdown of several critical components of the system (in addition to planned maintenance), leading to some generating capacity being offline (Nest 2015).

The interruption of the power supply in 2015 had consequences for manufacturing and commercial activities in South Africa. The grid downtime resulted in a decline in manufacturing and mining activity, which in turn led to a reduction in the country's overall economic growth (Niselow 2019). One study estimated that the losses experienced by the retail industry alone due to these load shedding events totalled R13.72 billion (around US$0.95 billion) during the first six months of 2015; meanwhile, the retail industry invested an estimated R716 million (around US$50 million) in back-up generation during this period (Goldberg 2015).

The subsequent two years witnessed almost no load shedding events, as illustrated in Figure 8. However, load shedding events began occurring again in 2018, reaching a second peak in 2019 and 2020.

Figure 8: Eskom's historic load shedding, 2014-2020



Source: Muller 2021

The average load shedding duration (i.e., period with no power) was 2.5 hours at a time (Coetzee and Els 2016). Additional stages were recently added to the load shedding schedule, which now goes from stage 1 to stage 8. (For example, stage 1 allows for up to 1 GW of demand to be switched off across the national grid; stage 2 allows for 2 GW and so on, up to stage 8 which allows for 8 GW to be disconnected.)

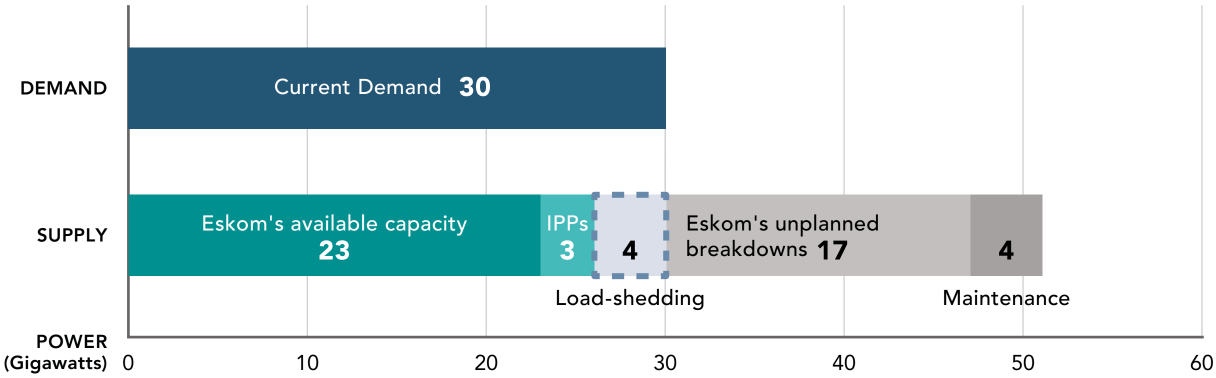
The location and schedule for rolling blackouts typically follows predetermined municipal schedules that break up the outages into two-hour blocks, rotating through various load centres. In March 2019, more than two weeks of load shedding occurred, escalating to stage 4 (4 GW of power cuts), and in December 2019 ongoing load shedding escalated to stage 6.

Eskom's unplanned plant breakdowns are a significant recurring issue for the utility. Figure 9 highlights this challenge with a representative example of the causes of load shedding in March 2019. Eskom outages during this event were largely a result of unplanned plant breakdowns (17 GW), as only 4 GW should have been offline for scheduled maintenance. This unexpected breakdown of unforeseen capacity is attributed to the cumulative lack of proper maintenance during the previous 12 years, resulting in a system-wide breakdown (Retief 2019).

3 *Each stage corresponds to 1 GW of demand to be disconnected.*

As a main reason for the load shedding in December 2019, Eskom cited wet coal from the rains, which affected the coal supply to power plants (Eskom 2019b). Also during this time, a power line failure due to a cyclone in Mozambique reduced supply by 1 GW.

Figure 9: Eskom's stage 4 load shedding status on 20 March 2019 (GW)



Note: In addition, 1 GW of imported hydropower from Mozambique and 2 GW of diesel plants that ran out of fuel were offline on this day.

Source: Eskom 2019e

Research from Efficient Group found that load shedding reduced GDP growth in South Africa by roughly 0.30 per cent in 2019, the equivalent of R8.5 billion (around US$0.6 billion) of real GDP (Instinctif Partners 2020). The impact of load shedding on individual sectors depends on the nature of business or industry. Both batch-process sectors as well as continuous-process industry suffer losses, due mainly to loss of the entire production batch and equipment failures.

Based on the recurrence of extreme load shedding events in 2015 and 2019, it can be expected that similar extreme events could occur in the future. The two main factors leading to such extreme events were the under-maintained electrical infrastructure and the supply of coal to the power plants. Such events have a high impact on the overall economy as they lead to interruptions in business activities across various sectors and impact the attractiveness of South Africa to foreign investors. As such, efficient measures need to be ensured to amend the situation and reduce losses, which burden the economy overall as a result of the unreliability of the power supply.

4.5/ CONCLUSION

The electricity sector in South Africa is characterized by its inability to meet declining demand and by the dominance of the state-owned utility company Eskom. The company is the focal point for procuring electricity from independent power producers and selling it to small distributors. Eskom is currently facing a financial crisis, with estimated debt in 2019 of R440 billion (around US$31 billion). The government has mandated the restructuring of Eskom into three separate entities for generation, transmission and distribution; however, the process is taking longer than originally planned and was still ongoing since 2019.

Additionally, there is a supply crisis caused largely by Eskom's plants that are at or nearing the end of their lifetime. Unplanned power outages at these plants and the shortage of coal supply in some cases are the main causes of load shedding in recent years.

The IRP requested by the Ministry of Energy identified the need to build additional utility-scale power plants as well as distributed generation to address a near-term supply gap of 2,000-3,000 MW and longer-term demand growth projections. Accordingly, there is an opportunity for captive installations to help address the near-term supply gap, assuming that these installations can obtain regulatory approval for projects over 1 MW. The IRP also reflected an increased share of renewables in the generation mix by 2030, with grid-scale projects that will be beneficial for the whole sector. The REIPPPP procurement process for Round 5 is expected to begin in 2021.

Aerial photo of solar panels on a rooftop, Cape Town.
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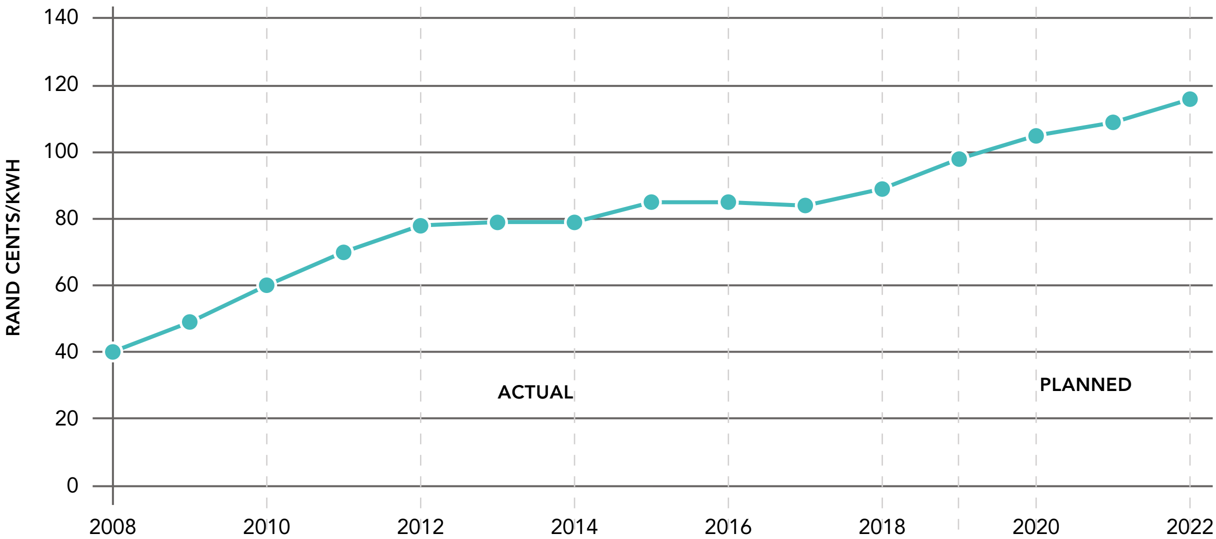
5/ ELECTRICITY TARIFFS

5.1/ BASE TARIFF

South Africa's electricity tariffs vary depending on where a customer is located, its demand profile, its consumption level and capacity, and the mark-up of the electricity price by the municipality. Tracking Eskom's average electricity tariff provides some insight into the rise in tariffs for customers over the past decade. As shown in Figure 10, Eskom's average tariffs have risen rapidly since 2008, well above inflation levels. The tariff is expected to reach US$7.75 cents per kilowatt-hour (kWh) (R116 cents/kWh) in 2022 (Head 2019).

Figure 10: Eskom's average electricity tariffs (R cents/kWh)



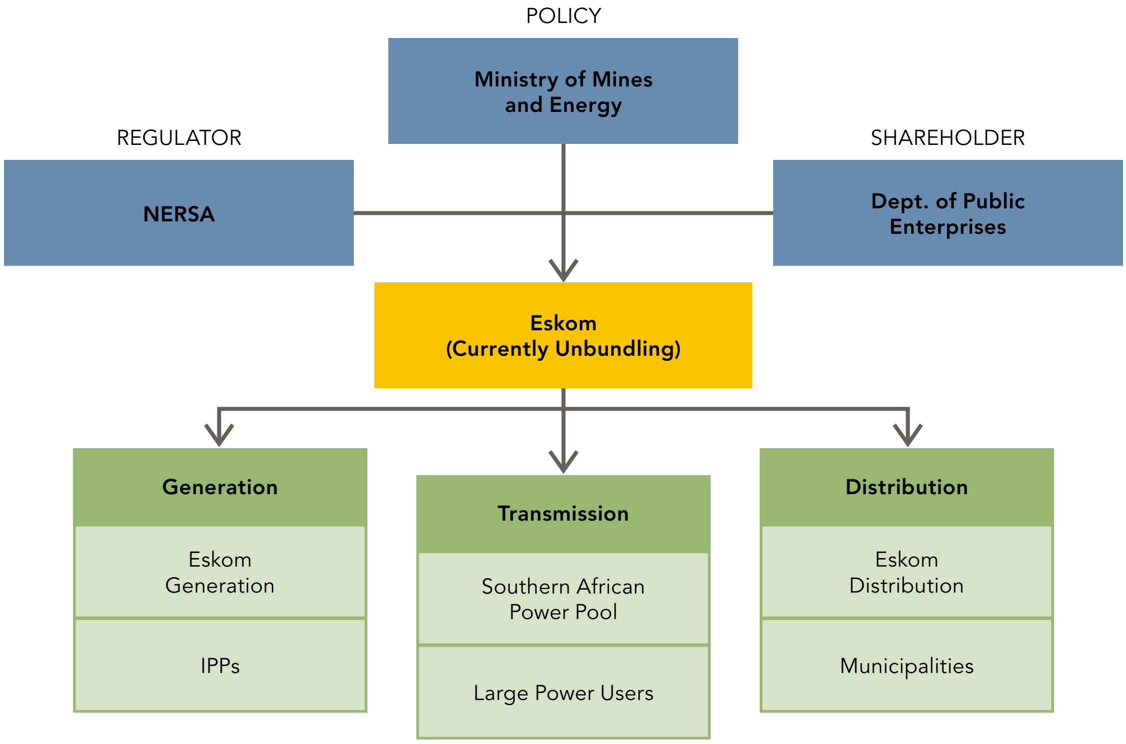
Note: In 2019, R100 cents/kWh = ~US$7 cents/kWh.

Source: Head 2019

While this is the average tariff, Eskom has around 20 different tariff categories for its customers, with varying tariff structures (e.g., time-of-use, incline block) as well as fixed charges. Municipalities have recently been given government authority to procure power directly from independent power producers, but options for most customers are limited to on-site generation for own-use and in some cases wheeling (the sale and transport of energy over the grid from one party to another).

Eskom is in the process of unbundling into separate generation, transmission and distribution entities, which should further open up the market and business models for captive power projects. Figure 11 shows a high-level depiction of South Africa's evolving electricity market, which is currently undergoing reforms as Eskom unbundles into the separate entities.

Figure 11: South Africa's evolving electricity market and key stakeholders



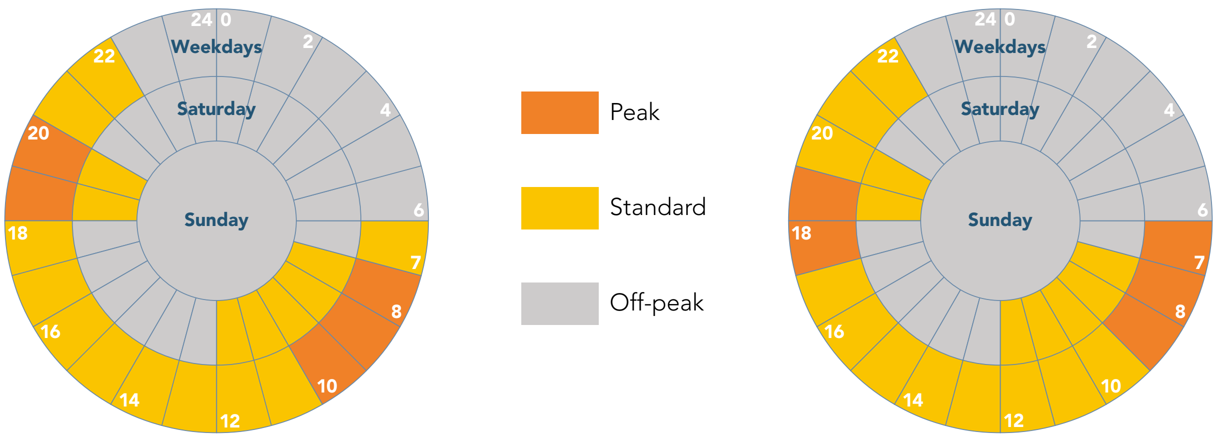
Soure: Eskom 2019a

This is a simplified depiction of the key stakeholders in the local electricity market, which is currently in flux. Embedded generation for own-use by customers is also allowed, as is wheeling for some eligible customers (typically over transmission networks), so captive customers still have some alternatives to buying from the municipality or from Eskom.

5.2/ TIME-OF-USE PERIODS

Figure 12 illustrates South Africa's electricity demand peaks in the morning and evening hours, with the highest demand during the winter months of June to August (Eskom 2019d). Eskom charges time-of-use rates to some of its customers and distributors, as shown in the figure. Winter electricity demand in the country tends to be higher than summer demand, due largely to heating loads in winter. In addition, daily peak demand occurs during the morning and evening periods, which does not correspond well with the afternoon output of most solar PV installations, unless storage is used. Therefore, captive installations that want to reduce peak demand charges would likely need to consider storage technology. Nevertheless, even the use of captive installations during off-peak hours may result in significant savings from grid purchases, given that the average tariff is forecasted to increase, as shown in Figure 10.

Figure 12: Eskom's time-of-use periods



ESKOM ENERGY CHARGE/ TIME-OF-USE PERIOD	LOW SEASON SEP-MAY (RAND/KWH)(AND US$/KWH)	WINTER HIGH SEASON JUN-AUG (RAND/KWH)(AND US$/KWH)
Peak	R0.98-R1.12($0.070-$0.080)	R3.00-R3.43($0.21-$0.24)
Standard	R0.67-R0.77($0.048-$0.055)	R0.91-R1.04($0.065-$0.074)
Off-peak	R0.43-R0.49($0.031-$0.035)	R0.49-R0.56($0.035-$0.040)

Note: Eskom's energy tariffs exclude 15 per cent value-added tax as well as charges for the transmission and distribution network, demand, reliability, subsidies and some other service charges.

Exchange rate from South African Rand to US dollars of 14.42:1 (South African Reserve Bank as of 19/05/2019)Source: Eskom 2019d

The time-of-use pricing signal from Eskom is not always passed through to the customer, as the tariff rate and structure depend on the customer's location and type.

5.3/ MUNICIPAL TARIFFS

Municipalities primarily purchase electricity from Eskom and resell it to local customers after applying a mark-up for the distribution network and other service costs. The large number of municipalities and the different approaches used make it difficult to generalize these tariff amounts. For example, more than 165 municipalities across the country have an electricity distributor licence, each with its own approach to designing tariff structures for both energy and demand charges for various customer types (e.g., low-demand residential, medium-/high-demand residential, agricultural, commercial, large industrial). Examples of tariff structures used by these municipalities include:

- non-seasonal demand charge with time-of-use energy charge that matches Eskom time-of-use period
- incline block[4] energy charge that varies by high (winter) and low season
- high- and low-season energy charges and access charges
- constant energy charge especially for pre-paid metering
- free basic electricity of around 50 kWh per month provided to many low-income households connected to the national electricity grid.

In addition, Eskom and some municipalities add value-added tax (VAT) and surcharges on to customer electricity bills for various national and local programmes (e.g., energy efficiency levy, environmental levy) and to cross-subsidize other municipal services. This further contributes to the complexity of electricity costs for customers in South Africa.

4 *The tariff amount increases in tiers based on the customer's monthly demand. For example, the first 500 kWh is charged at a low rate, while the second 500 kWh used that month is charged at a higher rate.*

Table 3 shows the end-user tariff for commercial and industrial users in the city of Cape Town[5], including 15 per cent VAT. The tariff for commercial users is divided into three categories based on monthly consumption. For commercial and industrial users, the consumer is mainly charged a service charge and an energy charge. However, unlike in Ghana, the service charge in South Africa is charged on a daily basis, leading to a significant increase in the monthly electricity bill.

One commercial business located in Cape Town stated that the electricity tariff based on the structure shown in Table 3 is quite substantial, and during certain months the cost of electricity incurred is equivalent to the property base rent (Questiaux, J, 2020). This cost can be considered significant for the sustainability of commercial and industrial activities in the country and may lead to the relocation of many establishments outside of South Africa (as has been the case in Nigeria), which will have an overall impact on the economy.

Table 3: Electricity tariff and structure for different tariff categories in Cape Town, as of 2021

TARIFF CATEGORY	ENERGY THRESHOLD (KWH/ MONTH)	TARIFFS			
		DAILY SERVICE CHARGE IN US$ (AND RAND)	ENERGY CHARGE PER KWH IN US CENTS (AND RAND CENTS)		DEMAND CHARGE PER KVA IN US$ (AND RAND)
Commercial users	> 1 000	$4.36 (R64.75)	12.43 cents (Rc 184.61)		N/A
	< 1 250	$0.34 (R5.11)	21.82 cents (Rc 324.15)		N/A
	< 250	N/A	26 cents (Rc 386.27)		N/A
			High demand season (June to August)	Low demand season (September to May)	
Large user – Low Voltage		$8.33 (R123.73)	Peak: 32.11 cents (Rc 476.99) Standard: 11.34 cents (Rc 168.43) Off-Peak: 7.21 cents (Rc 107.18)	12.03 cents (Rc 178.73) 9 cents (Rc 133.75) 6.56 cents (Rc 97.39)	$13.70 (R203.54)
Large user – Medium Voltage		$8.17 (R121.30)	Peak: 32.11 cents (Rc 476.99) Standard: 11.34 cents (Rc 168.43) Off-Peak: 7.21 cents (Rc 107.18)	12.03 cents (Rc 178.73) 9 cents (Rc 133.75) 6.56 cents (Rc 97.39)	$8.34 (R123.86)
Large user – High Voltage*		$8.17 (R121.30)	Peak: 30.87 cents (Rc 458.64) Standard: 10.90 cents (Rc 161.95) Off-Peak: 6.94 cents (Rc 103.06)	11.57 cents (Rc 171.86) 8.66 cents (Rc 128.60) 6.30 cents (Rc 93.64)	$2.06 (R30.54)

** For large user – high voltage, in addition to the above-listed charges network access charges of $5.85 cents (Rc 86.94) apply.*

Note: 1 South African Rand = 0.067 United States Dollar as of March 2021, from xe.com; kVA = kilovolt-ampere

Source: (City of Cape Town 2021)

5 *Cape Town is one of the main cities in South Africa with large economical activities, contributing 9.5% to the national GDP (Invest Cape Town n.d.).*

Accordingly, distributed generation for commercial and industrial users may be a possible alternative for many establishments across South Africa for a reliable and more economical source of electricity. This is because the commercial and industrial user will also be able to generate revenue from the excess electricity exported to the grid. Taking the City of Cape Town as an example, the small-scale embedded generation (SSEG) feed-in tariff, including the 15 per cent VAT, is US cents 5.72/kWh (Rc 84.95/kWh), which is the rate at which the City of Cape Town will purchase excess energy generated onto the grid (City of Cape Town 2021). The cost of energy generation from solar captive installations ranged from an estimated 10 US cents/kWh to 15 US cents/kWh across Sub-Saharan Africa in 2019 (BloombergNEF 2019).

In comparison with the rates illustrated in the previous figures, this leads to the energy generation from solar PV being competitive to that procured from the grid in Cape Town. However, the competitiveness of solar PV generation may be based on each municipality. By comparing the cost of generation from solar PV (10 US cents/kWh to 15 US cents/kWh) to the average tariff of 7 US cents/kWh illustrated in Figure 10, the generation from solar may not be commercially viable in all municipalities.

The shift in deployment towards such types of generation may have an impact on municipalities. Various studies have analysed the potential impact of distributed generation on municipal revenue in South Africa. One paper by the Association of Municipal Electricity Utilities (AMEU) concludes that the impact can be significant and can either increase or decrease net revenue for the municipality depending on the tariff design (Shumba *et al.* 2019). For example, distributed generation can lower revenues collected by municipalities due to:

1. reduced sales of electricity generated by Eskom to customers with distributed generation, and
2. payments to customers for energy from distributed generation fed onto the grid.

However, distributed generation also lowers the electricity costs of municipalities through:

1. reduced purchases of electricity from Eskom, as cheaper electricity will be purchased from distributed generation customers, and
2. reduced technical losses.

While the net impact on municipal revenue varies, tariffs can be designed to ultimately improve revenue for some municipalities, as shown in the AMEU report (Shumba *et al.* 2019). For example, municipalities that have implemented cost-reflective fixed charges to recover network costs can limit the impact of distributed generation on municipal revenues. Given the challenges currently facing the electricity sector in South Africa and the reliability issues of the electricity supply in comparison to the high incurred tariff, especially by commercial and industrial users, some actions have been initiated by these users, especially the Energy Intensive Users Group.

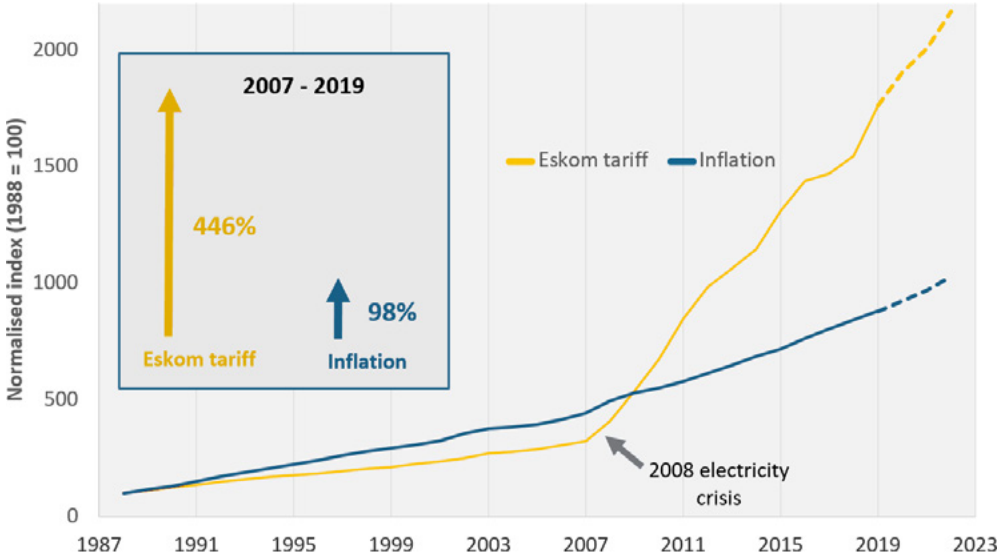
The Group, which accounts for around 40 per cent of the country's electricity demand, reiterated in December 2019 its request for the government to allow industrial customers to procure power directly from independent power producers or to streamline licence approvals for large self-generation projects over 1 MW (Creamer 2019). Likewise, the mining sector renewed calls for regulatory reform for more self-generation in South Africa, as mines have over 600 MW of new generation planned to be built by independent power producers, pending licencing approval from the National Energy Regulator of South Africa (NERSA) (Seccombe 2019). Recent government actions have also given municipalities in good financial standing the ability to procure directly from independent power producers, which will likely further open up the electricity market that is currently in an unbundling phase.

5.4/ HISTORICAL ELECTRICITY TARIFFS

Electricity tariffs in South Africa have gone through two distinct phases of growth, the first during 1988-2007 and the second from 2008 to the present. As shown in Figure 13, electricity tariffs rose during the first period by 223 per cent, but this was still lower than inflation (335 per cent) over the same period. The government policy at the time aimed to keep tariffs low to make electricity affordable for low-income users. In addition, Eskom had an oversupply of electricity (in the 1990s), which enabled lower tariffs. The government also did not invest in new capacity in the first decade of 2000.

During January 2008, near-daily load shedding events occurred over a two-week period, leading the government to declare a national power emergency on 25 January. This had a wide range of impacts in all sectors of the economy. After the electricity crisis in 2008, electricity tariffs rose sharply in South Africa to help fund two coal mega-projects. During the period 2007-19, electricity tariffs rose by over 446 per cent, whereas inflation grew 98 per cent. Thus, electricity tariffs increased more than four times in 12 years. Figure 12 shows the rising trend in electricity tariffs over the years.

Figure 13: Eskom's average tariff vs. inflation (CPI)



Source: Moolman 2019

5.5/ PROJECTED ELECTRICITY TARIFFS

Although detailed projections for multi-year tariffs are not readily available, some details on tariffs in the near term can be provided. The average electricity tariff approved by NERSA for the financial year 2021-2022 will increase to Rc 128.24/kWh (around US cents 8.89/kWh) (as per the decision by the Pretoria High Court in July 2020). NERSA (in March 2019) did provide allowable revenue and tariffs for the years 2019-2020 to 2021-22. However, the Pretoria High Court ruled that R23 billion (around US$2 billion) be added to the allowable revenue already determined by NERSA for the financial year 2021-2022. The main dispute between NERSA and Eskom involved the deduction of a R69 billion (around US$5 billion) cash injection from the government to Eskom to help the utility stem its liquidity crisis.

The increase in the grid tariff may lead to the commercial viability of solar PV generation across the country. This is because the cost of generation from solar captive installations is expected to decrease in the coming years, to 5 US cents/kWh by 2030 (BloombergNEF 2019). Meanwhile, the grid tariff in South Africa is expected to continue to rise to cover the costs of generation and added new capacities, in addition to the nuclear programme (Pay As You Go Solar n.d.).

5.6/ CONCLUSION

Electricity tariff amounts and structures in South Africa vary widely depending on a customer's location, type, size and whether it buys its power from a municipality or from Eskom. The VAT and surcharges added to customer electricity bills by municipalities and Eskom contribute to the complexity of electricity costs. However, recent growth in the rooftop solar PV industry shows that it can be more cost effective for many commercial and industrial customers to install solar PV than to purchase electricity solely from the grid. Since tariffs from both Eskom and municipalities are projected to continue to rise, the growth in clean captive solar installations is expected to also continue in the coming years.

The historical trend illustrates that the electricity tariff has increased over the past decade to exceed the inflation level, which has burdened end users, especially commercial and industrial users. Furthermore, the tariff in South Africa is expected to continue to rise due to added generation capacities and the nuclear programme, leading solar PV generation to be competitive and economical, as it is expected to reach 5 US cents/kWh by 2030.

Due to the high tariff increase and the unreliability of the power supply experienced in past years, the Energy Intensive Users Group has requested the government to allow industrial users to procure power directly or to approve large self-generation over 1 MW. This illustrates the demand for alternative sources of generation, especially from solar PV, which would provide a reliable and affordable source of electricity to commercial and industrial users.

Aerial photo of Discovery Head Office, Sandton.
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6/ ENERGY POLICY AND REGULATORY FRAMEWORK

An overview of the policies, laws and regulations governing the energy and electricity sector in general and clean captive installations in particular are presented in this section. Additionally, key considerations and current areas of uncertainty relevant for captive power are covered.

6.1/ ENERGY POLICIES AND LAWS

The policy and regulatory framework for South Africa's electricity industry is informed by a number of national energy plans, policies, acts and regulations, as indicated below.

6.1.1/ WHITE PAPER ON ENERGY POLICY, 1998

Published in 1998, the *White Paper on the Energy Policy of the Republic of South Africa* outlines a policy of reshaping and liberalization of the electricity supply industry, identifying the needs for competition, customer choice and private sector participation (Department of Minerals and Energy 1998). However, consensus on these issues among the political and administrative leadership of the national and local governments and relevant ministries has not been fully achieved, and the entities responsible for electricity supply, namely Eskom and municipalities, have not shown strong willingness to restructure themselves. Thus the policy objectives detailed in the *White Paper* have not been achieved yet, even though the 1998 policy document is still being actively implemented today (Yelland 2020).

6.1.2/ NATIONAL ENERGY ACT (NO. 34), 2008

The National Energy Act (No. 34) was published in 2008. It aims to: ensure that a wide range of available energy resources are supplied in a sustainable way; support economic growth, poverty reduction and energy infrastructure while considering environmental requirements; and set up a national Integrated Energy Plan and measures to provide data and information on energy demand, supply and production (IEA 2014). Nevertheless, the annual Integrated Energy Plan has not been published as promised since 2008 (Yelland 2020).

6.1.3/ NATIONAL DEVELOPMENT PLAN 2030, 2012

The National Development Plan (NDP) states that South Africa needs to invest in a robust economic infrastructure network to support the country's medium- and long-term economic and social goals (Government of the Republic of South Africa 2012). A stable energy infrastructure is fundamental to economic growth and the transition to a low-carbon and resilient economy. The NDP sets targets including:

- carbon budgeting, carbon reduction targets and an economy-wide price for carbon,
- programmes and standards to increase energy efficiency, and
- a simplified regulatory regime for renewable energy and independent power producers.

6.1.4/ THE INTEGRATED ENERGY PLAN, 2003 AND 2005, AND THE INTEGRATED RESOURCE PLANS, 2011 AND 2019

The Integrated Energy Plan (IEP) is South Africa's overarching energy plan, and the Integrated Resource Plan (IRP) sets out the details required to implement the plan. The objectives of these two plans can be summarized as follows:

- guide the development of energy policy and establish regulations for the sector,
- guide the selection of appropriate technologies to meet demand,
- guide investments in energy infrastructure development,
- promote universal access, affordability and environmental sustainability,
- ensure electricity security by bridging supply gaps in the short term and
- implement energy mix and diversification in the medium to long term.

Both plans operate within a framework that projects energy and electricity demand through 2050 (Eskom 2019a).

6.1.5/ ELECTRICITY POLICIES AND ACTS

The Integrated National Electrification Programme and a series of acts and policies lay the foundation for the operation of South Africa's electricity market – from generation to transmission, distribution and procurement. These are illustrated in Table 4.

Table 4: Policies and acts that lay the foundation for the electricity market

NAME	YEAR OF PUBLICATION	BRIEF DESCRIPTION AND RELEVANCE
INTEGRATED NATIONAL ELECTRIFICATION PROGRAMME (INEP)		
Bulk Infrastructure Policy Guidelines for INEP	2018	The Integrated National Electrification Programme has been running since 2001 and was recently updated in 2018. The programme has a goal of reaching universal access to electricity by 2025. To achieve this goal, the rate of electrification needs to be accelerated to catch up with the rate of housing growth.
Farm Dweller Houses Policy Guidelines for INEP	2018	
Informal Settlements Policy Guidelines for INEP	2018	
Mixed Developments and Developer Projects Policy Guidelines for INEP	2018	
Non-Grid Policy Guidelines for INEP	2018	
Suite of Supply Policy Guidelines for INEP	2018	
ELECTRICITY ACTS		
Renewable Energy IPP Procurement Programme 2015 Determination under Section 34(1) of the Electricity Regulation Act, 2016 (Act No. 4 of 2006)	2016	Regulates that renewable energy generation capacity needs to be procured to continue energy security and to facilitate the achievement of the renewable energy targets.
IPP Procurement Programme 2012 Determination under Section 34(1) of the Electricity Regulation Act 4 of 2006	2012	
Electricity Regulation Act	2006	Governs the country's electricity supply industry and gives authority to regulator NERSA to oversee the licencing regime and approval of tariffs and pricing.
National Energy Regulator Act	2004	Establishes a National Energy Regulator for the regulation of the electricity, piped-gas and petroleum pipeline industries.
ELECTRICITY POLICIES		
Negotiated Pricing Agreements Short-Term Incentive Programme Framework in terms of position 14 of the Electricity Pricing Policy (EPP)	2008	Intends to sustain and grow the South African economy through increased electricity consumption.
Electricity Pricing Policy	2008	Establishes the electricity market structure, generation tariff methodology and power purchase agreement pricing, transmission and distribution regulated pricing, and third-party network access.
Free Basic Electricity Policy	2003	Seeks to address ways and means through which government interventions can bring about relief to poor electrified households and ensure optimal socio-economic benefits from the National Electrification Programme.
Free Basic Alternative Energy Policy	2007	Intends to provide poor households with alternative energy where electricity is not available.
ELECTRICITY REGULATIONS		
Electricity Regulations on Norms and Standards for Reticulation Services	2008	Sets up regulations on norms and standards for reticulation services, expropriation on behalf of a licencee, deviation from a set of approved tariff, and new generation capacity.
Electricity Regulations on Expropriation on Behalf of a Licencee	2008	
Electricity Regulations on Deviation from Set or Approved Tariff	2009	
Electricity Regulations on New Generation Capacity	2011	

Source: DMRE n.d.

Additionally, since 2015, South Africa has issued a variety of fixed national standards for electrical and electronic appliances, including factory-used storage water heaters (2015) and internal natural convection or forced air circulation (2015) (IEA 2019).

6.1.6/ CLIMATE AND CARBON-PRICING POLICIES

In its Intended Nationally Determined Contribution (INDC), published in September 2015, South Africa set its emission targets according to the "peak, plateau and decline" emission trajectory, where emissions will peak between 2020 and 2025, plateau for about a decade and then decline in absolute terms. According to the INDC, emissions will be in the range of 398-614 million metric tons of CO_2-equivalent between 2025 and 2030, which provides a useful benchmark for comparing avoided emissions from small-scale embedded generation (SSEG) (Government of the Republic of South Africa 2015).

South Africa's Department of Environmental Affairs drafted a Climate Change Bill in June 2018 that provides for the coordinated and integrated response to the climate crisis and its impacts by all spheres of government in accordance with the Paris Agreement. It aims to contribute to global efforts to stabilize greenhouse emissions but has yet to be finalized. South Africa's commitments from the IRP 2019 have been criticized as too low and "highly insufficient" to achieve its fair share to hold global warming below 2 degrees Celsius, according to Climate Action Tracker as of December 2019.

In alignment with the National Development Plan, Phase 1 of South Africa's Carbon Tax Act went into effect in June 2019 at a price of R120 per ton of CO_2-equivalent for big polluters in energy, mining, transport, manufacturing, construction, oil/gas, waste and other industry. Tax breaks in Phase 1, however, will limit the initial impact of the law by lowering the effective tax rate to just R6 to R48 per ton of CO_2 until 2023, when Phase 2 begins (Government of the Republic of South Africa 2019). Eskom is also exempt from the carbon tax in Phase 1, furthering limiting the initial impact of the tax.

Additional funding is expected to be made available from the New Development Bank (NDB) and the Development Bank of Southern Africa, which signed a US$300 million loan agreement for the Greenhouse Gas Emissions Reduction and Energy Sector Development project. The project targets the facilitation of investments in renewable energy, contributing to the diversification of the generation mix and to the CO_2 emission reductions in South Africa. The targets of the project are in line with the IRP 2010, aiming to reduce greenhouse gases as stated in the National Development Plan 2030 (NDB 2019). The funding also aims to unlock private sector investment and to increase the availability of long-term funds for clean projects in the country's energy sector (Liedtke 2019).

6.2/ RENEWABLE POLICY AND GOVERNMENT INCENTIVES

6.2.1/ THE INTEGRATED RESOURCE PLAN, 2019

The Integrated Resource Plan (IRP), first introduced in 2011 and updated in 2019 after a seven-year delay, outlines plans to retire 11.5 GW of ageing coal-fired power plants and to add 14.6 GW of new utility-scale wind generation, 6 GW of utility-scale solar PV generation and around 5 GW of distributed self-generation for electric customers, all supplemented by 3 GW of gas or power generation and 2 GW of battery storage (Yelland 2020). These objectives indicate that the authorities in South Africa have realized that renewable energy is a viable option in terms of cost, emissions, and power generation, contributing to economic, environmental and social sustainability. However, the IRP places artificial limits on the annual deployment capacity of wind and solar PV plants, of 1,600 MW per year for wind and 1,000 MW per year for solar PV (Yelland 2020).

6.2.2/ INDUSTRIAL INCENTIVES FOR RENEWABLE ENERGY

Although government incentives for renewable energy are limited, they include tax breaks and grants for some projects. Table 5 details the types of government incentives and renewable energy support instruments available in the country.

Table 5: Relevant industrial incentive schemes for renewable energy in South Africa

INSTRUMENT	POTENTIAL IMPACT
Tax	The Carbon Tax Act increases the competitiveness of clean technologies by placing a price on carbon emissions, which will increase over time. Phase 1 came into effect in June 2019 for big polluters in energy, mining, transport, manufacturing, construction, oil/gas, waste and other industry (see section 6.1.6).
Tax Break	Section 12B of the Income Tax Act of 1962 provides for a capital allowance for assets used in the production of renewable energy to improve the economics of the investment. It allows for a deduction of tax on a 100 per cent basis in the first year for installations with capacities over 1 MW, and on a 50 per cent / 30 per cent / 20 per cent basis for capacities under 1 MW over three years in respect to a qualifying asset owned by the taxpayer. It is recommended that a company applies for a binding ruling from South Africa Revenue Service before investment to determine if it qualifies.
Tax Break	Section 12I of the Income Tax Act of 1962 offers an incentive for additional investment and training allowances related to industrial policy projects. From 1 January 2015, a greenfield "industrial policy project" above R50 million (around US$3 million) may deduct an additional investment allowance equal to 55 per cent of the cost of its manufacturing asset, or up to R900 million (around US$62 million) until 31 December 2017. The time frame was later extended to 31 March 2020. Section 12J of the Income Tax Act of 1962 provides incentives for investors to invest tax-deductible equity in local small and medium enterprises. This has been a common vehicle for renewable energy companies to raise equity; however the incentive is scheduled to expire in June 2021.
Production Incentive Grant and Loan	The Manufacturing Competitiveness Enhancement Programme aims to improve and promote enterprise competitiveness and job retention. It consists of two programmes: **1.** Production Incentive through grants (managed by the Department of Trade and Industry) and **2.** Industrial Financing Loan facility (managed by the Industrial Development Corporation).
Grant	The Agro-Processing Support Scheme offers a 20-30 per cent cost-sharing grant up to a maximum of R20 million (around US$1 million) over a two-year investment period for interventions that provide production support.
Grant	The Production Incentive Programme targets the clothing, textiles, footwear, leather and leather goods manufacturing industries with funding assistance to invest in competitiveness improvement interventions. An upgrade grant can be used for the following qualifying expenditures: upgrading of existing plant and equipment, and acquisition of new plant and equipment that will have the effect of improving the overall competitiveness of the applicant.

Source: Council for Scientific and Industrial Research [CSIR] 2019

6.3/ RENEWABLE FEED-IN POLICIES

6.3.1/ RENEWABLE ENERGY FEED-IN TARIFF (REFIT) SCHEME, 2009

In 2019, South Africa's National Energy Regulator (NERSA) approved the country's first Renewable Energy Feed-In Tariff (REFIT) scheme. REFIT obliges Eskom to purchase the power of eligible renewable energy generators at a predetermined price based on the levelized cost of electricity. Eskom's Single Buyer Office has been designated as the Renewable Energy Purchasing Agency (REPA) and is responsible for purchasing electricity from licenced renewable energy generators. Licenced independent renewable energy generators may also sell electricity directly to buyers outside of the REFIT mechanism. The cost of electricity will be passed on to Eskom electricity customers (IEA 2013).

REFIT Phase I in March 2009 included four kinds of technology: 1) wind power: R1.25/kWh, or around US$0.87/kWh; 2) small hydropower (up to 10 MW): R0.94/kWh, or around US$0.07/kWh; 3) landfill gas: R0.90/kWh, or around US$0.06/kWh; and 4) concentrated solar power (CSP): R2.10/kWh, or around US$0.15/kWh (IEA 2013).

In November 2009, REFIT Phase II tariffs were approved for six new technologies: 1) CSP trough without storage: R3.14/kWh, or around US$0.22/kWh; 2) CSP tower with storage of six hours per day: R2.31/kWh, or around US$0.16/kWh; large-scale (1 MW or more) grid-connected solar PV systems: R3.94/kWh, or around US$0.27/kWh; solid biomass: R1.18/kWh, or around US$0.08/kWh; and biogas: R0.96/kWh, or US$0.07/kWh (IEA 2013).

The REFIT power purchase agreement will run for 20 years, and the tariff can be adjusted annually for inflation. The scheme will be fully reviewed annually for the first five years and every three years thereafter. The REFIT does not include off-grid generation (IEA 2013).

6.3.2/ RENEWABLE ENERGY INDEPENDENT POWER PRODUCER PROCUREMENT PROGRAMME

From 2011 to 2015, South Africa's Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) successfully procured around 6 GW from independent power producers in several bidding rounds, replacing the feed-in tariff system (2019). Each round took over a year to finalize Request For Proposal documentation, review bid submissions, sign power purchase agreements, and reach financial close, construction and finally commercial operations. Table 6 summarizes the REIPPPP timeline for Rounds 1-4, which began in 2011 and experienced a number of delays.

Table 6: REIPPPP timeline for Rounds 1-4

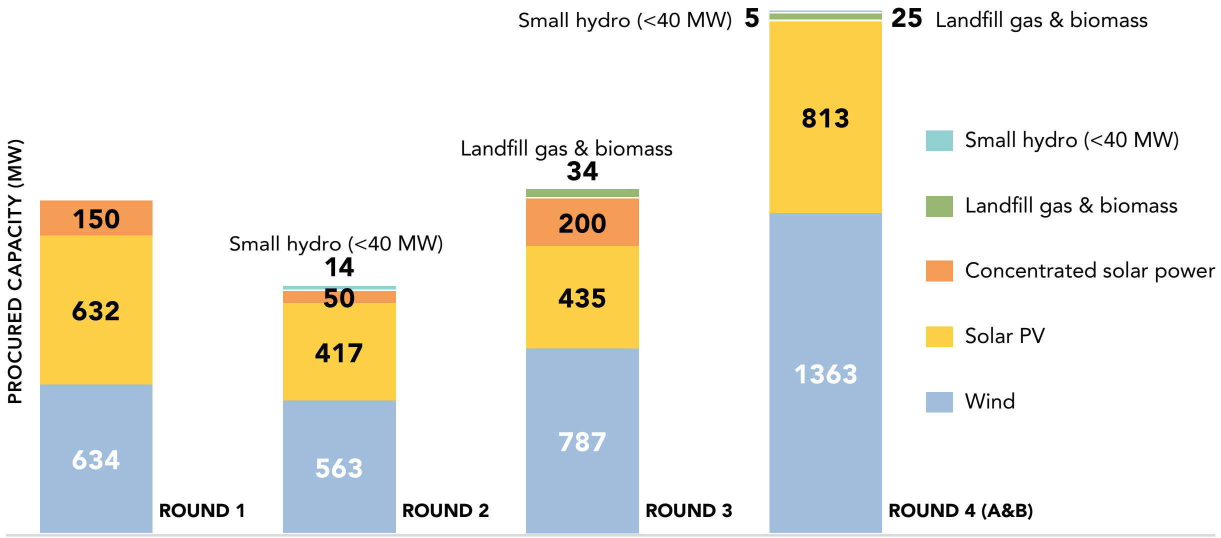
ROUND	RFP SUBMISSION DATE	PPA SIGNING
Round 1	Nov 2011	Nov 2012
Round 2	Mar 2012	May 2013
Round 3	Aug 2013	Dec 2014
Round 4	Aug 2014	Apr 2018

Source: GreenCape 2020

For the REIPPPP to be successful, the South African government guaranteed that Eskom would buy the electricity from independent power producers at agreed bid prices. Eskom has signed power purchase agreements for all the projects to date but then refused to sign these agreements in Round 4, delaying the programme for more than two years. The delay was attributed to grid connection issues (as the power purchase agreements were related to 37 large-scale renewable projects) and to Eskom's reluctance to sign the agreements awarded under the programme (Bellini 2017). Nevertheless, the biggest success story in this programme was the 55 per cent decline in the price for wind and the 76 per cent decline for solar PV from Round 1 to Round 4.

Figure 14 shows the procured capacity, by renewable energy resource, from the 92 utility-scale projects, which each signed a 20-year power purchase agreement with Eskom as the off-taker. Despite some delays and challenges with Eskom not wanting to sign the agreements in Round 4, the REIPPPP highlights South Africa's ability to secure affordable and clean electricity through a competitive auction approach and public-private partnership structure. Round 5 has also been delayed, and its current status is pending.

Figure 14: South Africa's REIPPPP rounds by resource capacity



Source: Department of Energy 2016

However, the urgent need for additional generation capacity is no longer being met by the current centralized plan of the Department of Mineral Resources and Energy (formerly the Department of Energy) and its Independent Power Producers Office to procure generation capacity. With Eskom unable to meet even declining demand, electricity consumers have increasingly realized that they would need to generate their own power to supplement the gap in on-grid electricity and to wheel power for their own use from external distributed generation sources (Yelland 2020), such as clean captive installations.

6.4/ LICENCING FOR CLEAN CAPTIVE GENERATION

The implementation of clean captive installations in South Africa requires a number of licences. The Electricity Regulation Act of 2006 is the principal piece of legislation governing the country's electricity supply industry and gives NERSA the authority to issue licences, including the terms (e.g., time frame, price and tariff rates, customer restrictions, obligations, etc.). Activities that require a licence include:

- generation of electricity
- transmission of electricity
- distribution of electricity
- import or export of electricity
- trading of electricity.

Activities exempt from a licence include generation facilities for demonstration purposes[6] only, those designed for own use, and non-grid-connected supply of electricity. In addition, an amendment to the Electricity Regulation Act of 2006 was passed in November 2017, which also exempts generation facilities from a licence if they are over 1 MW in size, assuming that they meet certain criteria such as having a use-of-system agreement in place with the local grid operator (Röhrs 2018). A use-of-system agreement is required by the local grid operator for projects over 1 MW to connect to the grid, and some may also require a wheeling agreement depending on the project structure and off-taker agreements.

In February 2021, the president of South Africa announced that the Electricity Regulation Act of 2006 would be amended within the next three months to increase the 1 MW licencing threshold for embedded generation in the country; however, as of April 2021 the new threshold had yet to be announced (Engineering News 2021).

6 *Demonstration plants are generally referred to as pilot-scale demonstration projects. These are generally not commercial projects, and the objective is limited to demonstrate the efficacy of a newly introduced technology or to prove techno-commercial viability.*

The sale and transport of energy over the grid from one party to another, also called wheeling, is currently allowed in South Africa for medium- to high-voltage connections (over 1 kilovolt (kV)). Wheeling allows for new clean captive business models and larger projects to be developed, beyond projects sized for own use. Under normal circumstances, the utility stipulates a separate "wheeling charge", which increases the cost of electricity in the hands of a consumer. Eskom requires supporting forms and documentation, in addition to the key conditions for projects to be eligible to wheel that are listed in Table 7.

Table 7: Key wheeling requirements according to Eskom

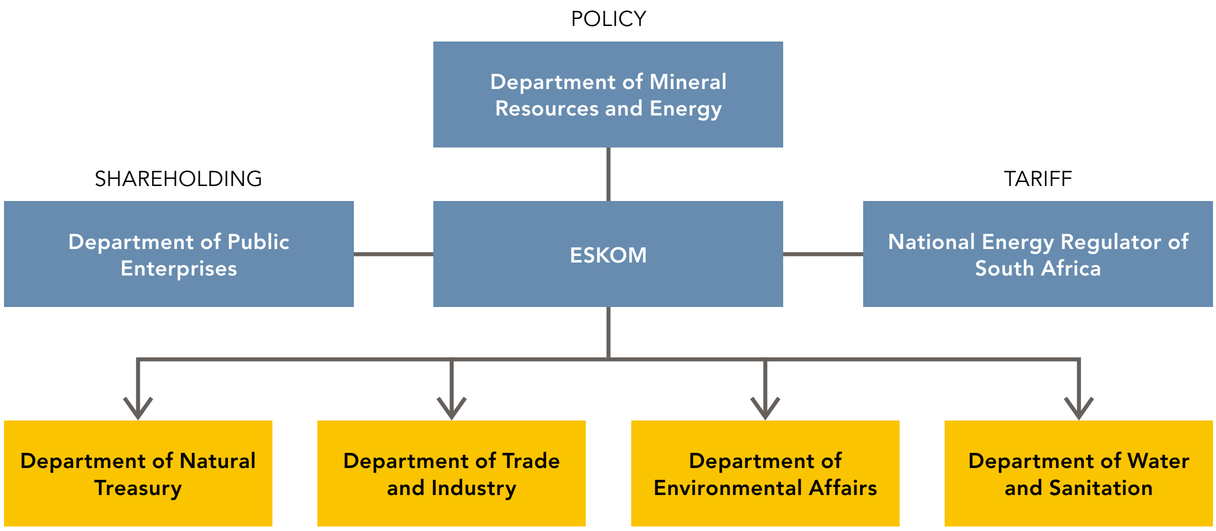
KEY WHEELING CONDITIONS FOR PROJECTS	RELEVANCE FOR CLEAN CAPTIVE POWER IN THE COMMERCIAL AND INDUSTRIAL SECTOR
The generator must have an approved licence to generate and trade or for registration from the NERSA.	Projects over 1 MW need a licence to wheel.
The generator must sign the Connection and Use of System Agreement (CUOSA) with the grid operator.	This agreement is required for all wheeling projects.
The third-party access will be implemented initially up to an overall limit of 300 MW (as per NERSA's current rules).	Projects must be less than 300 MW.
The generator/load must be on a voltage higher than 1 kV.	Low-voltage projects are not currently allowed to wheel.

Source: Eskom 2018

6.5/ INSTITUTIONAL FRAMEWORK

As shown in Figure 15, with Eskom (the national electricity utility) at the centre, a wide range of public sector participants operate in South Africa's electricity sector with policymaking, shareholding, tariffs and compliance. These include the Department of Mineral Resources and Energy (formerly the Department of Energy), the Department of Public Enterprises, the National Energy Regulator of South Africa (NERSA), the Department of National Treasury, the Department of Trade and Industry, the Department of Environmental Affairs and the Department of Water and Sanitation (as detailed in Table 8).

Figure 15: Legislative landscape of South Africa's electricity supply industry



Source: Eskom 2019a

Table 8: Public sector participants in the legislation of South Africa's electricity supply industry

ENTITY	CONSTITUTIONAL MANDATE	
NATIONAL PUBLIC UTILITY		
Eskom	Eskom is a strategic 100 per cent state-owned electricity utility, strongly supported by the government. It performed 191,595 household electrification connections during the 2019 financial year. It aims to provide electricity in an efficient and sustainable manner, including its generation, transmission and distribution, and retail. The company also has a developmental role to promote transformation, economic development and broad-based Black economic empowerment.	
POLICYMAKING		
Department of Mineral Resources and Energy (former Department of Energy)	The DMRE is the merger of the Department of Mineral Resources and the Department of Energy. It aims to regulate, transform and promote the minerals and energy sectors, providing sustainable and affordable energy for growth and development, and ensuring that all South Africans derive sustainable benefit from the country's mineral wealth. Its Mining, Minerals and Energy Policy Development Programme formulates and maintains an integrated minerals and energy policy to promote and encourage investment in the mining and energy industry.	
SHAREHOLDING		
Department of Public Enterprises	The DPE undertakes shareholder oversight for the government and is instructed by the Executive Authority to oversee core strategic state-owned companies. It is the primary interface between government and these companies and provides input into the formulation of policy, legislation and regulation.	
TARIFF		
National Energy Regulator of South Africa	NERSA's mandate is to regulate the electricity, piped-gas and petroleum pipelines industries under the terms of the Electricity Regulation Act, 2006 (Act No. 4 of 2006), the Gas Act, 2001 (Act No. 48 of 2001) and the Petroleum Pipelines Act, 2003 (Act No. 60 of 2003). It aims to regulate the energy industry in accordance with government laws and policies, standards and international best practices in support of sustainable and orderly development, and it reports to the DMRE.	
COMPLIANCE WITH LEGISLATION AND POLICIES		
Department of National Treasury	The DNT is responsible for managing South Africa's national government finances. Supporting efficient and sustainable public financial management is fundamental to the promotion of economic development, good governance, social progress and a rising standard of living for all South Africans. The Constitution of the Republic (Chapter 13) mandates the National Treasury to ensure transparency, accountability and sound financial controls in the management of public finances.	The DNT works closely with DMRE and is responsible for managing the expenditure and budget of energy.
Department of Trade, Industry and Competition (former Department of Trade and Industry)	The dtic aims to promote structural transformation towards a dynamic industrial and globally competitive economy; provide a predictable, competitive, equitable and socially responsible environment, conducive to investment, trade and enterprise development; broaden participation in the economy to strengthen economic development; and continually improve the skills and capabilities of the dtic to effectively deliver on its mandate and respond to the needs of South Africa's economic citizens.	The fields that the dtic works on have strong relationships with energy and electricity use.
Department of Environment, Forestry and Fisheries (former Department of Environmental Affairs)	The DEFF is mandated to give effect to the right of citizens to an environment that is not harmful to their health or wellbeing, and to have the environment protected for the benefit of present and future generations. To this end, the department provides leadership in environmental management, conservation and protection towards sustainability for the benefit of South Africans and the global community.	The operations of the energy system, and of the generation, distribution and transmission of electricity, need to meet environmental requirements.
Department of Water and Sanitation	The mandate of DWS is to ensure that the country's water resources are protected, managed, used, developed, conserved and controlled, by regulating and supporting the delivery of effective water supply and sanitation.	Hydropower and fuel use and water and sanitation are closely related.

6.6/ CONCLUSION

This section describes the existing regulations and policies governing the electricity industry in South Africa, with a focus on those related to renewable energy generation.

In light of South Africa's targets to reduce its CO_2 emissions between 2025 and 2030, the Carbon Tax Act was issued in 2019 and is being implemented in two phases, with Phase 1 already in effect. Additionally, South Africa proved its ability to generate clean electricity due to the success of the Renewable Energy Independent Power Producer Programme, which resulted in a significant decrease in the tariffs for solar and wind. Delays in signing power purchase agreements in Round 4 of the REIPPPP and in the commencement of Round 5 may be considered obstacles hindering the further success of the programme. The government also initiated measures to support renewable energy via tax breaks and grants managed by the National Cleaner Production Centre, which are considered limited.

Pursuant to an amendment passed in 2017, the Electricity Regulation Act supports captive installations: those below 1 MW of capacity are exempt from a licence, and the president announced plans in early 2021 to increase this threshold. Additionally, the sale and transport of electricity over the grid is allowed, subject to certain criteria.

While government goals and policy support growth in the renewable energy industry, implementation of regulations and programmes has limited growth in some markets, including clean captive installations. However, the landscape for the industry is changing as Eskom reforms its market structure and as load shedding persists in the country, creating opportunities for more clean captive installations.

Solar cells in Salmonsdam Nature Reserve, near Hermanus and Stanford, Western Cape. © *Shutterstock / PhotoSky*

Aerial photo of Constantia Village Shopping Centre, Cape Town. © *Shutterstock / Grant Duncan-Smith*

7/ OVERVIEW OF EXISTING CAPTIVE POWER FACILITIES

Captive electricity generation in South Africa is prevalent in segments, such as industry, commerce and wealthy households. Captive generation is less common for industrial facilities, due mainly to variable electricity supply and the large power demand of these facilities. Self-generation with genset-based captive power plants has historically been more common, as it provides business establishments with greater control over their power supply. South Africa has witnessed the rapid introduction of rooftop and ground-mounted solar PV.

7.1/ LICENCED CAPTIVE POWER PLANTS

South Africa has a considerable number of grid-connected captive power installations of less than 1 MW in size, which are referred to as small-scale embedded generation (SSEG). NERSA requires registration of plants both for: a) captive use and b) feeding surplus power to the grid. Electricity generation plants up to 1 MW capacity – which include stand-alone, grid-connected, demonstration plants and cogeneration plants – are eligible for registration with NERSA but do not require a licence. In contrast, power plants larger than 1 MW that feed surplus power to the grid need to secure a generating licence from NERSA.

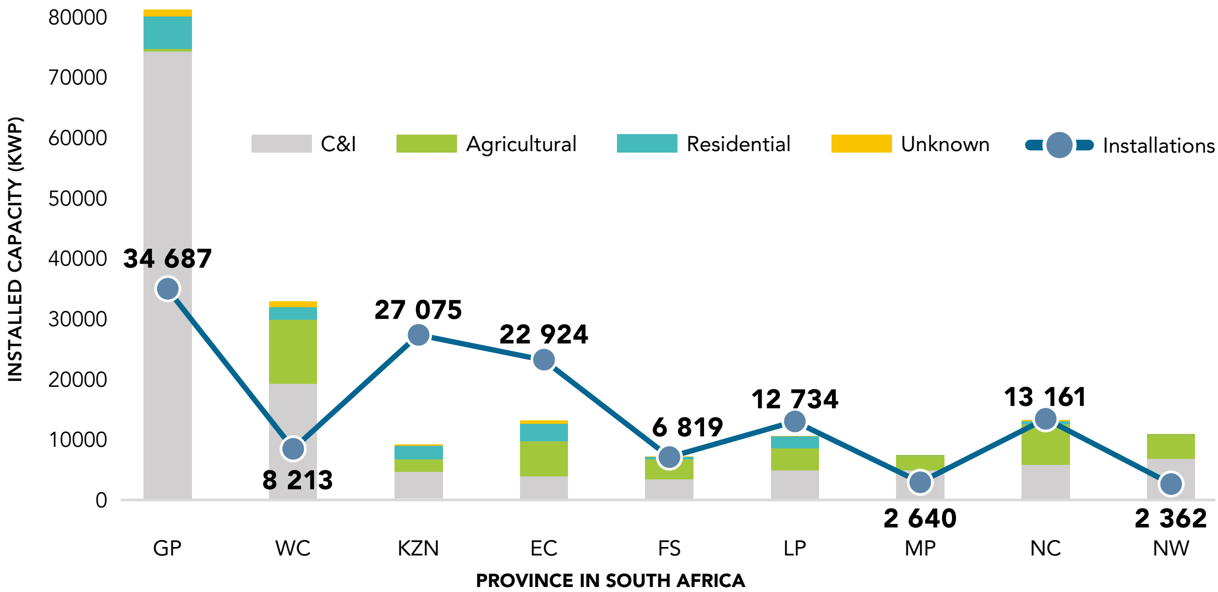
A number of mines in South Africa have installed or are considering installing larger solar PV installations, although the requirement to obtain a licence from NERSA for installations over 1 MW has delayed growth in this sector to some extent. In 2017, Gold Fields signed a 25-year power purchase agreement with an independent power producer for a 40 MW solar PV facility at one of its mines in South Africa (Gold Fields 2017). The country's mining sector recently renewed calls for regulatory reform for more self-generation, as mines have plans for 600 MW of new generation to be built by independent power producers, pending licencing approval from NERSA (Seccombe 2019). Likewise significant potential exists for agricultural installations and commercial and industrial projects over 1 MW, as NERSA expedites the licence approval process for these projects.

7.2/ SOLAR PV

Solar PV-based captive installations are gaining traction, due mainly to recurrent crises in electricity supply, rising tariffs and rapidly declining prices for solar PV systems.

In addition, growing municipal support for small-scale embedded generation (SSEG) of 1 MW or less has incentivized more solar PV installations in the commercial and industrial sector. This sector has the highest installed capacity for distributed solar PV in South Africa, with an estimated capacity of 130 MW by 2017 (see Figure 16 for a breakdown by province).

Figure 16: Small-scale solar PV installed capacity in South Africa as of year-end 2017



Source: PQRS data from Gross 2018

The Status of Small-Scale Embedded Generation (SSEG) In South African Municipalities - November 2020 report, estimates total official registered small-scale embedded generation installation numbers at 3,280 as of November 2020, with an estimated capacity of 282 MW, but the number may be larger due to unreported installations (Sustainable Energy Africa (SEA) NPC 2021). The commercial and industrial sector accounts for most of the small-scale solar PV capacity to date (over 60 per cent), largely on rooftops and car parks, while the residential and agricultural sectors account for a smaller share of the total installed capacity but for a higher number of projects.

The cost of solar PV has already reached grid parity (equal to or less than the cost of electricity purchased from the grid) for a number of customers in various municipalities across the country. Many of these installations for distributed solar PV were financed by the customers themselves. In addition, some engineering, procurement and construction (EPC) firms offer financing or are willing to enter into a power purchase agreement to reduce the upfront cost to the customer. One of the factors driving the demand for embedded solar PV is the desire for longer-term certainty of the electricity price, particularly for energy-intensive users. Solar PV installations are also facilitated via access to roof space in commercial and industrial parks and buildings.

As of 2017, there were more than 130,000 small-scale solar PV installations in South Africa (Figure 16). Table 9 summarizes a few sample case studies for reference.

Table 9: Examples of solar PV case studies

FIRM	ARBEIDSVREUGD FRUIT PACKERS	MALL OF AFRICA	INDUSTRIAL ROOFTOP
Location	Villiersdorp, Western Cape	Midrand, Gauteng	Cape Town, Western Cape
System	• 450 kilowatts-peak (kWp) system • Installed by Renewable Energy Design Engineering • 1 876 x 240 Watt-peak Trina Solar modules • 26 SMA Tripower 17000 three-phase inverters	4.7 MW-peak system installed by Solareff	• 784 kilowatts direct current • Installed by SOLA in 2017
Return on Investment	• Generating 743 megawatt-hours (MWh) / year • R38 million (around US$3 million) savings over 25-year lifetime • 733 tons/year of avoided CO_2-equivalent • ~6-year payback	• Generating 7 800 MWh/yr • Jointly funded by Attacq (80%) and Atterbury (20%) • Savings of 8 034 tons/year of CO_2	• Generating 1 224 615 kWh or 23% of annual demand • Reduces carbon footprint by 12%

Source: SAPVIA 2019

7.3/ OTHER RENEWABLES

While solar PV is the most widely used SSEG technology in South Africa to date, installations of other renewable technologies, including small wind turbines and biomass plants, also exist across the country.

Small wind turbines have been commercially available in South Africa for decades, with the most popular sizes ranging from 100 to 4,000 Watts. Their wide variety of applications include off-grid homes, telecommunication stations, water pumping, lighting, supervisory control and data acquisition (SCADA) and other low-energy-demand battery charging applications. The small wind energy industry has not experienced rapid decreases in levelized costs, so it is still small compared to the solar PV and larger wind turbine industries in South Africa (GIZ 2020).

Biogas projects have a higher installed capacity and are more prevalent than small wind turbines, but they similarly have not experienced as much growth as the solar PV industry in South Africa. The cost and business case for biogas plants and associated infrastructure are largely site specific and can vary greatly depending on the application, the use of waste heat, project size, avoided energy/processing cost and feedstock availability. Typical applications of SSEG biogas plants are at agricultural facilities (e.g., farms and abattoirs), municipal sites (landfills, wastewater treatment), schools, and restaurants, where the facility uses the biogas to generate electricity for self-consumption and potentially to feed back into the grid.

Table 10 provides a breakdown of the common applications for the biogas industry in South Africa, along with the associated feedstock. It also shows the estimated number of operational biogas projects in the country as of 2015.

Table 10: Biogas project size categories and common feedstock in South Africa

CATEGORY	SIZES (KW)	COMMON APPLICATION	TYPICAL AMOUNT OF FEEDSTOCK PER DAY	ESTIMATED NUMBER OF PROJECTS IN 2015
Rural	< 10	Self-consumption for household with two cows (e.g., biogas for cooking/heating)	< 1 ton of municipal solid waste (MSW), manure, sewage	200
Small Scale	10-30	Self-consumption (e.g., household)	0.1-2 tons of MSW, manure, sewage	100
Medium Scale	30-1 000	Self-consumption with possibility to feed into grid (e.g., restaurants, schools, farms)	2-15 tons of MSW, manure, agricultural, abattoir, sewage	10
Large Scale	> 1 000	Self-consumption and fed into the grid (e.g., agricultural processing, landfill, abattoir)	15-150 tons of MSW, manure, abattoir, waste water	10

Source: AltGen 2016

7.4/ RURAL ELECTRIFICATION

South Africa has one of the highest electrification rates in Sub-Saharan Africa, at around 91 per cent, and is still taking steps to provide electricity to customers that are not connected to the grid. Box 1 outlines efforts of the South African government to address rural electrification through the country's Integrated National Electrification Programme.

BOX 1. Addressing rural electrification through the Integrated National Electrification Programme

South Africa's Integrated National Electrification Programme (INEP) aims to achieve universal access to electricity by 2025. The INEP has a plan to reach 90 per cent of the population through grid connections and 10 per cent through non-grid renewable energy technologies. It intends to achieve this through subsidizing grid connections, off-grid systems and grid network infrastructure.

The INEP proposed an annual budget of US$400 million, with the subsidy to be used to establish 200,000 grid connections and to distribute 10,000 solar home systems per year. The government also provides 50 kWh of grid electricity per month to all households free of charge, in order to support poor households.

The government has been utilizing a concession approach for specific geographic locations to roll out solar home systems, with a predetermined number of systems allocated. A single concessionaire (tendered) is appointed to a designated area within which it has the exclusive right to supply solar home system services for five years. The concessionaire is responsible for maintaining installed systems under the terms of a 20-year contract.

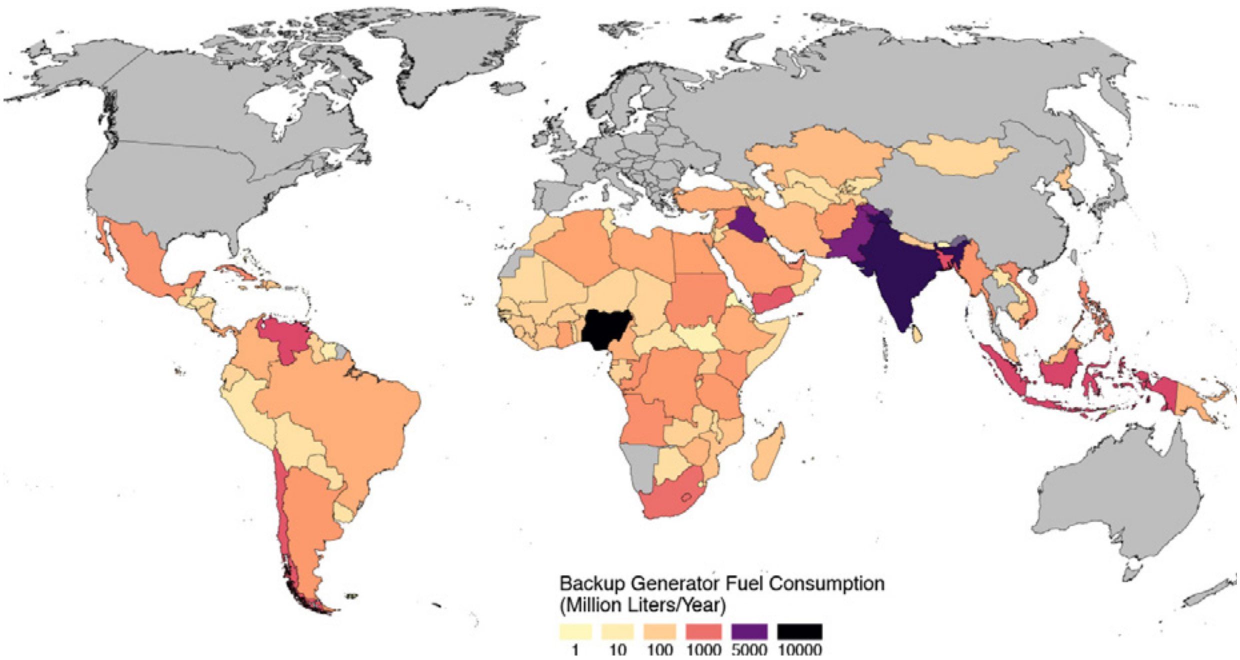
Source: GET.invest n.d.

7.5/ THERMAL BACK-UP POWER

Diesel generators are responsible for the majority of nitrogen oxide and fine particulate matter emissions from the power sector in Sub-Saharan Africa. A 2019 report from the International Finance Corporation (IFC) provides estimates on back-up generator use and capacity in developing countries, including the four focus countries in this study of clean captive power in Sub-Saharan Africa.

South Africa has a fairly high number of generators, with around 2 generators for every 100 people; this amounts to around 1.1 million generators, or 10 GW of installed capacity generating about 1,000 GWh per year. However, low usage of these units limits the energy generated from back-up generators in South Africa compared to Nigeria, as shown in Map 3 (IFC 2019).

Map 3: Total diesel and gasoline consumed in 2016 across countries (Million Liters/Year)



Source: IFC 2019

In South Africa, diesel back-up generators are used primarily when smooth, continuous access to grid electricity is lacking. In 2019, the use of diesel generator power in the country amounted to less than 1 per cent of the total energy supply, due to the limited amount of load shedding for the year.

The back-up generator market in South Africa is typically broken down into four power-generating capabilities: 5-75 kilovolts-ampere (kVA), 75-375 kVA, 375-750 kVA and more than 750 kVA. The most ubiquitous of these is the 5-75 kVA category, since generators in this group are best suited for retail establishments, residences, shops, telecommunication towers, offices and small-scale industrial facilities. However, despite the convenience of such generators, the electricity they generate can cost up to three times the price of grid electricity in the country due to fuel and maintenance costs (Energy Realpolitik 2019). The growth of the mining and oil and gas industries also accounts for a large portion of diesel back-up generator use, as generators are used to provide uninterrupted power in remote locations (GMI Research 2020).

7.6/ CONCLUSION

Currently, the market for small-scale embedded generation (SSEG) in South Africa is growing rapidly for capacities less than 1 MW, a trend that is further enabled by some municipalities that have feed-in tariffs. As a result, the commercial and industrial sectors combined accounted for around 60 per cent of the installed solar PV capacity in the market as of 2017, for projects of 1 MW or less. For power projects greater than 1 MW, there has been some recent progress in licence approvals from NERSA and rules that allow municipalities to procure from these projects. The slow growth in PV installations for heavy industries, such as the mining sector, prior to 2021 is expected to pick up as obstacles continue to be overcome.

Solar panels the flag of South Africa.
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8/ SOUTH AFRICA MARKET POTENTIAL FOR CLEAN CAPTIVE POWER

In this section, an analysis of the industrial sector is presented through assessing the energy demand of leading industrial customers and their suitability for clean captive installations. Alongside the commercial and industrial market space, a focus on the agricultural sector and on small and medium enterprises was added due to the market development stage and the potential impact of clean captive power in these sectors.

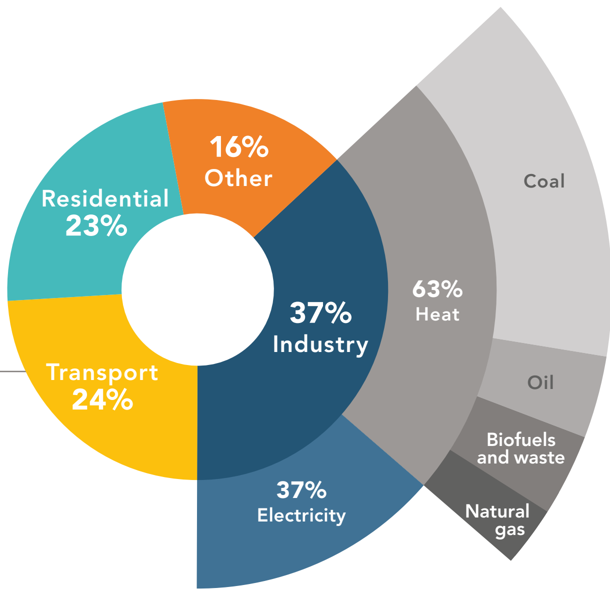
8.1/ INDUSTRIAL SECTOR

The industrial sector has historically accounted for the largest share of energy demand in South Africa. In 2015, the industrial sector consumed 37 per cent of the country's energy, well above the transport sector at 24 per cent, as shown in Figure 17. Around 63 per cent of energy use in the industrial sector goes to process heating, while around 37 per cent is for electricity applications (CSIR 2019). This 37 per cent has the technical potential to be offset with clean captive power, but market forces may limit the full potential due to associated costs and practical implementation.

Low economic growth and rising electricity tariffs have contributed to a reduction in demand from many industrial customers in recent years. In addition, some industrial customers have invested in energy efficiency to mitigate against rising electricity costs.

Figure 17:
South Africa's energy consumption by sector in 2015 (total: 3,131 petajoules) (per cent)

Source: CSIR 2019



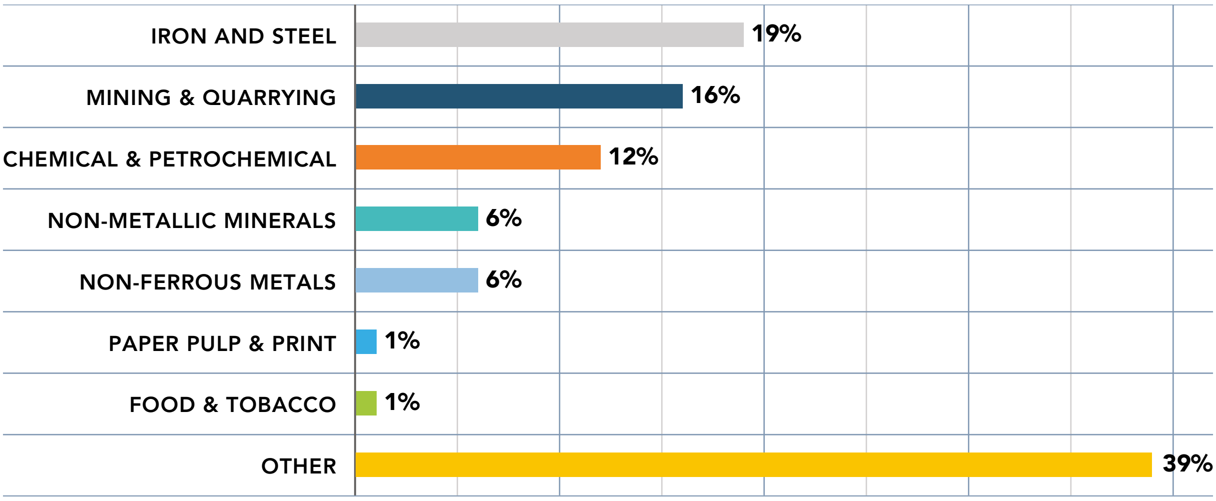
Most of South Africa's industrial activity takes place in the three most populated provinces: Western Cape, Gauteng and KwaZulu-Natal. Coal is still the primary fuel used for both process heating and electricity in the country, and coal mines are mainly concentrated in Mpumalanga province.

8.1.1/ ENERGY DEMAND AND CONSUMPTION BY LEADING INDUSTRIAL CUSTOMERS

Unfortunately, limited data exist on industrial energy demand in South Africa due to limited data collection by the government and the fact that some companies prefer not to share this information publicly. The Department of Energy published a report in 2018 on South Africa's energy sector, which uses data from 2015 to provide some high-level estimates on overall energy demand by industry. However, with slow economic growth and load shedding, the energy demand for 2019 has likely changed.

As shown in Figure 18, iron and steel manufacturing accounted for the highest energy demand in 2015, followed by mining and quarrying. Iron and steel smelters require large amounts of energy, but the around-the-clock demand profile of many of these customers makes them poorly suited for a clean captive power solution without large amounts of storage. Storage further adds to the costs of these installations, making the project less viable.

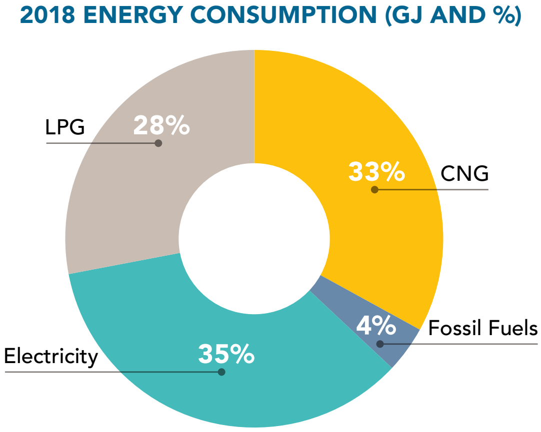
Figure 18: South African industrial energy demand by sector, share as of 2015

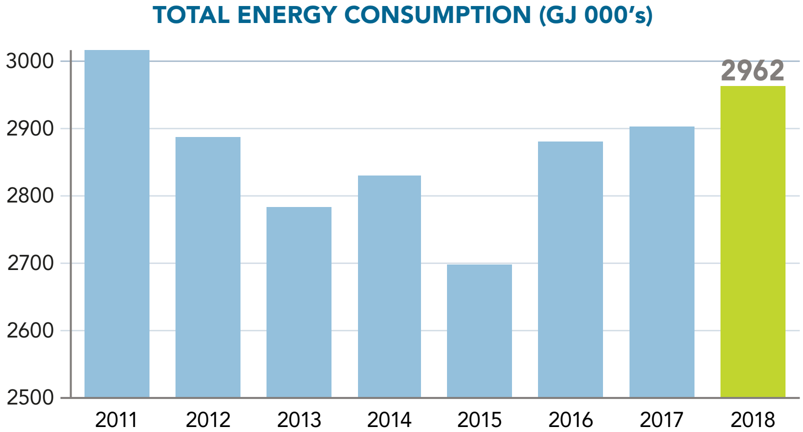


Source: Department of Energy 2019

For example, a large aluminium mill in South Africa consumes around 292 GWh per year, operating around-the-clock for 361 days per year. The share of electricity represents 35 per cent of the total, as shown in Figure 19, which translates to around 102 GWh per year. This high demand relative to the site size limits the mill's ability to install on-site clean captive power.

Figure 19: Energy consumption of a sample aluminium mill in South Africa





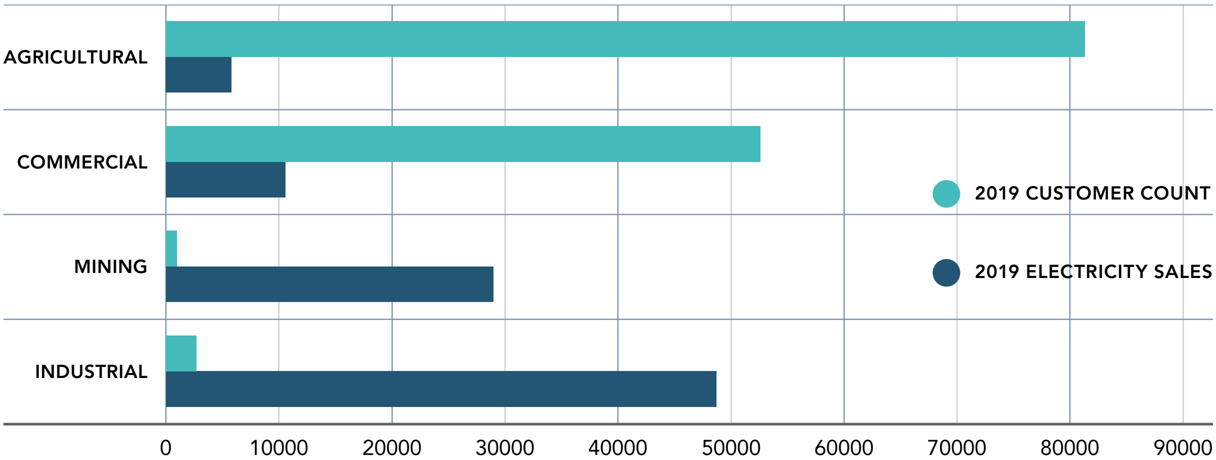
Source: Hulamin 2018

The demand profile of smaller commercial and industrial customers that operate during normal business hours is expected to be better matched with the size and output of some clean captive renewable solutions – such as solar PV, which generates electricity during the daytime hours, as illustrated in section 7. Therefore, rooftop-scale installations of solar PV for smaller commercial industrial customers are expected to continue to grow faster than the larger industrial market for clean captive installations.

8.2/ AGRICULTURAL SECTOR

Like the industrial sector in South Africa, limited updated information exists on the energy demand of the agricultural and small and medium customers in the country. Electricity sales from Eskom provide some insight into how much electricity the utility sells to these sectors and the number of customers (Figure 20); however, these figures do not include the amount of electricity also sold via municipal distributors to these sectors.

Figure 20: Eskom's direct electricity sales in 2019 for select customers (No. and GWh)



Note: Excludes electricity sales to municipal distributors and to residential, rail and export customers.

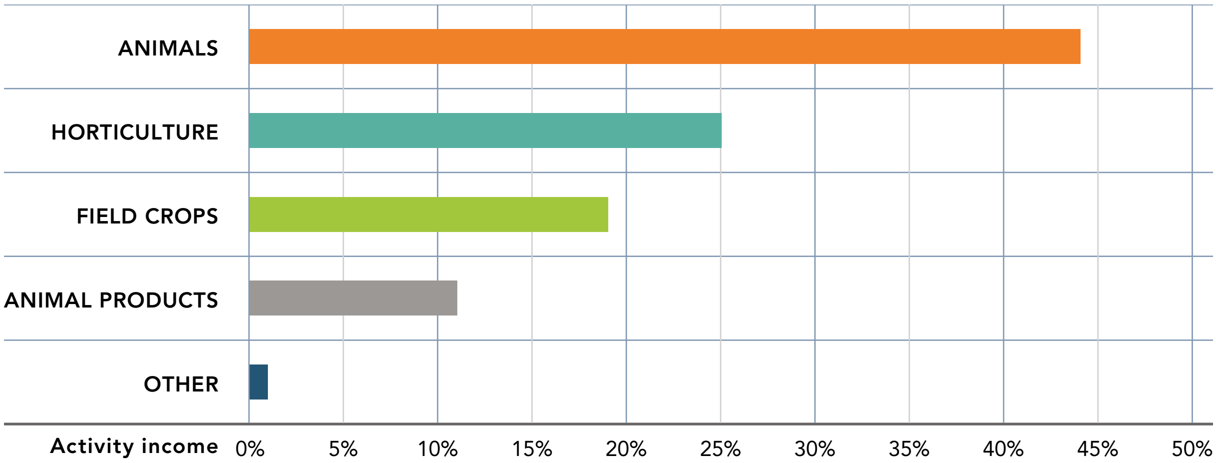
Source: Eskom 2019c

Figure 20 accounts for only 45 per cent of total electricity sales from Eskom. The other 55 per cent of sales went to municipal, residential, rail and international export customers for Eskom's reporting year ending in March 2019. Furthermore, it can be observed from the figure that even though the number of customers in the agriculture sector exceeds those in the commercial and industrial sectors, the electricity sales to the commercial and industrial sector exceed those to the agriculture sector. This implies that facilitating the requests made by the Energy Intensive Users Group to allow them to procure directly from independent power producers or to generate their own electricity will alleviate the burden on Eskom and may result in fewer load shedding events.

Interviews with some stakeholders in South Africa suggested that there is a need and scalable potential for clean captive power in the agricultural sector, but uptake has been limited so far due to a lack of creditworthiness for farmers dealing with economic challenges and drought. The seasonal nature of farming (e.g. six months out of the year with little energy demand) makes it more challenging to justify the business case for clean captive power without embedded generation tariffs that buy back excess electricity from the customer. As of October 2018, only 25 municipalities in the country had these tariffs. The interviews also identified a need for climate resiliency investment and potentially an insurance product for droughts to improve the bankability of clean captive power projects in this market segment.

Figure 21 shows the main market activities in the commercial agriculture sector and that around two-thirds of the income comes from animals and horticulture.

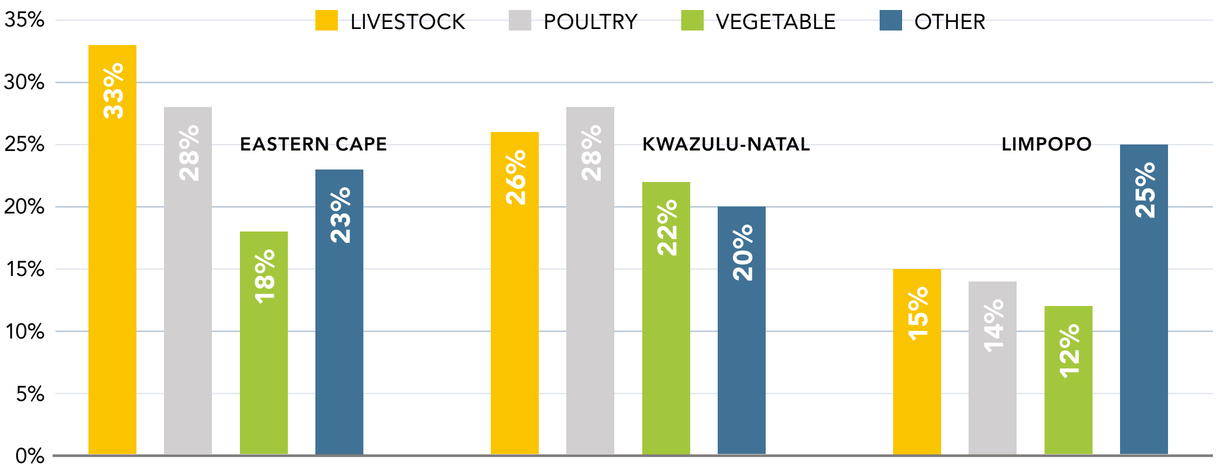
Figure 21: Commercial agriculture by subsector in South Africa



Source: Statistics South Africa 2011

According to the 2011 census, around two-thirds of agricultural households in South Africa are concentrated in three provinces: KwaZulu-Natal (24.4 per cent), Eastern Cape (20.7 per cent) and Limpopo (16.3 per cent), and the agriculture activity by household in these three provinces could be found in Figure 22.

Figure 22: Agriculture activity by household in key provinces (per cent)



Source: Statistics South Africa 2021

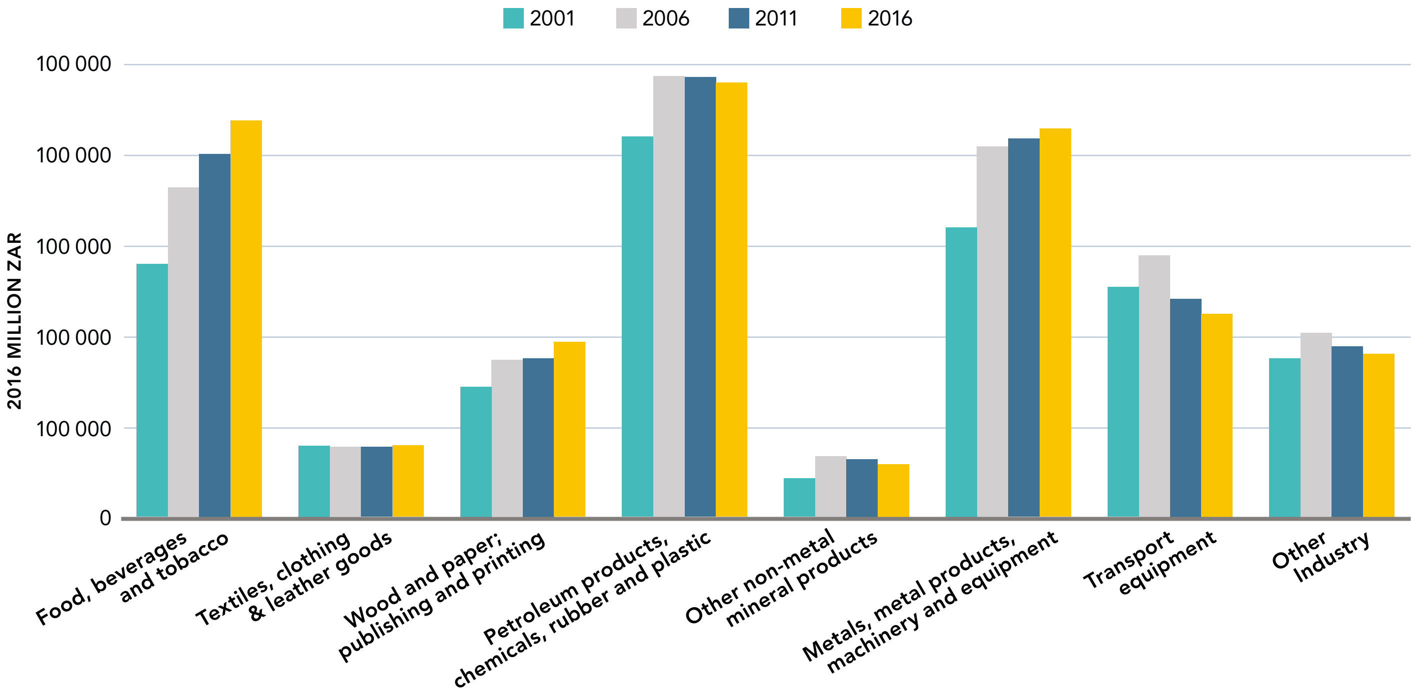
Likewise, farmers in the Eastern Cape and Limpopo are still under threat from severe drought, according to Agri SA, the agricultural industry association. Western Cape and Northern Cape farmers are also at drought risk, but there are fewer agricultural households in these provinces. According to Statistics South Africa, the farming economy is in recession, with production contracting by 3.6 per cent in the third quarter of 2019, and agribusiness confidence had dipped for the sixth consecutive quarter as of the third quarter of 2019. Agri SA has also highlighted the damaging impact of load shedding on irrigation-dependent and energy-intensive agricultural operations, including its disruption of the cold chain that is critical to maintain food quality standards for local and export sales (NEWS24WIRE 2019).

To support the sector, the South African government has implemented an Agro-Processing Support Scheme that offers a 20-30 per cent cost-sharing grant up to a maximum of R20 million (around US$1million) over a two-year investment period for interventions that provide production support, to help encourage growth in this market segment.

8.3/ ACTIVITIES OF SMALL AND MEDIUM ENTERPRISES IN SPECIAL ECONOMIC ZONES (SEZ)

This section reviews the relative importance of the small and medium enterprises in South Africa, providing an overview of the primary sectors and then identifying the main target areas for potential clean captive power installations. Figure 23 represents an overview of the South African manufacturing output by value. It can be observed that petroleum products, chemicals, rubber and plastic have the highest output by value but in descending trend. Food, beverages and tobacco have the second highest output by value, and its output is rapidly increasing, followed by metals, metal products, machinery and equipment. Transport equipment ranks the fourth, whose output by value is also above R2 billion (around US$0.14 billion). Wood and paper; publishing and printing could also be found an increasing trend, whose output by value is approaching R2 billion (around US$0.14 billion). In addition, there is textiles, clothing & leather goods, and other non-metal mineral products. Therefore, the huge and diverse demand for electricity can be predicted by the past output of small and medium enterprises in these manufacturing industries, where clean captives are needed.

Figure 23: Overview of South African manufacturing output by value, 2001 to 2016 (million ZAR)



Note: In 2016, R100 million = around US$6.5 million. Source: CSIR 2019 using 2017 data from EasyData

Stakeholder interviews also suggested that small and medium enterprises have a need for reliable and clean captive power to mitigate against load shedding (e.g., solar PV with a diesel genset). The electricity demand from this market segment varies but often corresponds to normal business hours during the day, which matches well with some clean captive power solutions such as solar PV that generate electricity during the daytime hours.

The fragmented and diverse nature of this sector will likely make it more challenging to disseminate project information and findings than other sectors. However, working with Special Economic Zones (SEZs) – geographically designated areas in South Africa set aside for specific economic activities (see Table 11) – can help overcome this challenge, since these zones have a variety of incentives to demonstrate the benefits of clean captive incentives. These incentives include:

- Preferential 15 per cent corporate tax – Businesses that are located in a Special Economic Zone may be eligible for tax relief, including the reduced rate of corporate income taxation.
- Building allowance – Businesses and operators operating within a Special Economic Zone may be eligible for tax relief, including the building allowance, subject to requirements contained in the Income Tax Act.
- Employment incentive – Businesses and operators operating within a Special Economic Zone may be eligible for tax relief, including the employment tax incentive subject to requirements.
- Customs-controlled area – Businesses and operators located within a customs-controlled area of a Special Economic Zone will be eligible for tax relief.
- 12I tax allowance – The 12I Tax Incentive is designed to support greenfield investments (i.e., new industrial projects that utilize only new and unused manufacturing assets), as well as brownfield investments (i.e., expansions or upgrades of existing industrial projects). The new incentive offers support for both capital investment and training.

Table 11: Special Economic Zones in South Africa

EXISTING SPECIAL ECONOMIC ZONES (SEZ)		PROPOSED BUT NOT DESIGNATED SPECIAL ECONOMIC ZONES
Coega SEZ – Eastern Cape East London SEZ – Eastern Cape Musina-Makhado SEZ – Limpopo OR Tambo SEZ – Gauteng Saldanha Bay SEZ – Western Cape	Atlantis SEZ – Western Cape Nkomazi SEZ – Mpumalanga Maluti-A-Phofung SEZ – Free State Richards Bay SEZ – KwaZulu-Natal Dube TradePort – KwaZulu-Natal	Bojanala SEZ – North West Tubatse SEZ – Limpopo Upington SEZ – Northern Cape

Source: The dti 2019

Some of these SEZs also focus on renewable energy businesses and operations. For example, the East London SEZ has a renewable energy training facility to upskill artisans and train recent graduates in both the construction and maintenance of renewable energy facilities. Likewise, the Atlantis SEZ was originally envisioned as a green tech manufacturing hub but has faced challenges realizing this goal due in part to delays from the utility-scale renewable energy procurement in the country, which has limited demand for locally manufactured renewable energy equipment.

8.4/ CONCLUSION

The energy demand of the industrial sector is regarded as the largest in the country. The demand is mainly for process heating, while 37 per cent is for electricity. The iron and steel industry is the highest energy consumer based on estimated data for 2019. Due to slow economic growth and the increasing tariff, electricity demand in the industrial sector has declined over the past few years. After the load shedding events of March and December 2019, there have been requests from industries for regulatory reform allowing self-generation or procurement of capacities greater than 1 MW from independent power producers.

For the industrial sector, captive installations are considered more suitable for those businesses operating within normal operational hours, whereas those operating around-the-clock are not considered suitable due to the large storage capacity required.

There is a great opportunity for captive installations in the agriculture sector; however, obstacles such as project financing are hindering their implementation. Additionally, the sector is facing a climate risk as a result of drought, which is generally hindering its growth. The small and medium enterprise sector is considered suitable for captive installations, as the demand often corresponds to normal operational hours.

Energy demand data for the industrial, agriculture, and small and medium enterprise sectors are limited; accordingly, it is difficult to estimate the electricity demand of these sectors and their potential for solar PV captive installations. Demand estimations, however, have been provided based on the most recent data available.

Durban Harbour, the largest commercial port in Sub-Saharan Africa. © *Pexels / Magda Ehlers*

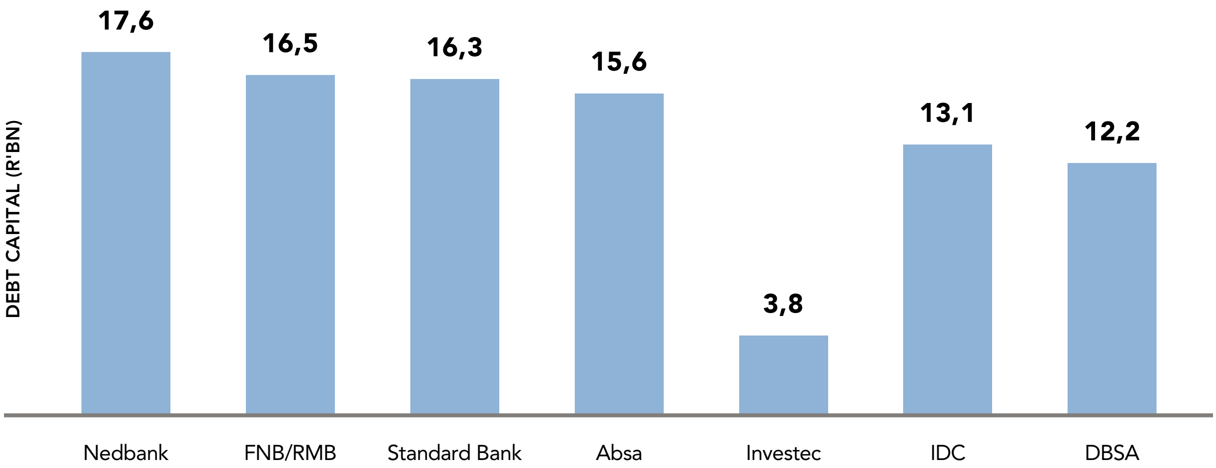
9/ FINANCING CAPTIVE POWER

This section looks at the banking sector in South Africa and presents the financing institutions and available financing schemes for renewable projects. An overview of the existing donor programmes for renewable energy is also provided.

9.1/ FINANCING FOR LARGE-SCALE RENEWABLE ENERGY PROJECTS

The renewable energy financing industry in South Africa is well established, and many of the major commercial banks have funded both large utility-scale solar PV projects (as part of the Renewable Energy Independent Power Producer Procurement Programme rounds) and smaller-scale PV systems. These include five private commercial banks – Absa, First National Bank / Rand Merchant Bank (RMB), Investec, Nedbank and Standard Bank – as well as two public development finance institutions: the Industrial Development Corporation and the Development Bank of Southern Africa (see Figure 24).

Figure 24: ***Major South African debt providers in REIPPPP Rounds 1-3 (billion ZAR)***

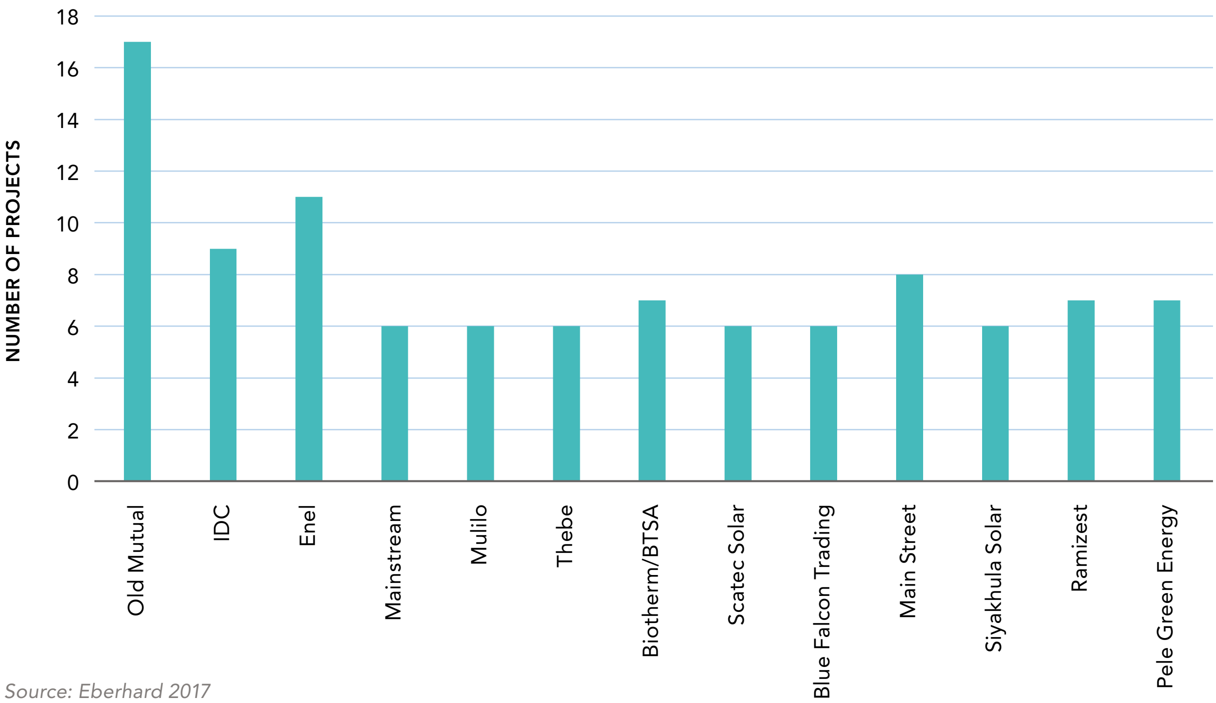


Source: Papapetrou 2014

South African banks offer a variety of financial mechanisms for renewable energy projects, such as senior debt financing, equity financing, subordinated debt financing in the form of "mezzanine" debt provision, hedging, risk management and corporate finance for construction companies.

The REIPPPP has also attracted a mix of local and international equity investors for projects in Rounds 1-4. Figure 25 shows the leading equity providers from the programme, which consists of international developers (e.g., Mulilo, Mainstream, Scatec Solar), international utilities (e.g., Enel), local investment companies (Old Mutual) and development finance institutions (e.g., Industrial Development Corporation).

Figure 25: ***Major equity providers in REIPPPP Rounds 1-4 (No.)***



Source: Eberhard 2017

9.2/ FINANCING FOR MEDIUM- AND SMALL-SCALE RENEWABLE ENERGY PROJECTS

Local commercial banks often evaluate renewable energy projects on a case-by-case basis, and while they have historically preferred larger-scale projects, some have started offering loans for smaller projects (under 1 MW) as well as corporate loans for developers and for engineering, procurement and construction (EPC) companies with a pipeline of projects. There are five main commercial banks in South Africa, all of which offer loan products to assist with financing renewable energy projects (see Table 12).

The rates for these loans depend on the project risk profile and tend to be fairly high relative to international standards. They are typically tied to the local prime lending rate[7], which was 10.25 per cent as of July 2019 (South Africa Reserve Bank 2019). Some projects can also be financed through corporate or personal loans. Some boutique financiers offer financing based on the installers' balance sheet and project pipeline.

*Table 12: **Financing schemes for small-scale renewable energy in South Africa***

RETAIL BANK	DEBT TERM	LOAN	SECURITY	LIMITS
ABSA	5-10 years	Funds up to 100 per cent of installation, with no down payment required.	Project-specific and additional security not necessarily required. Installation is part of collateral.	Typically individual projects from 30 kWp to 1,000 kWp.
Standard Bank	Up to 10 years	Finances at 60 per cent debt and 40 per cent equity. Also offers asset-based finance and term loans up to 100 per cent of the project cost.	Security is usually taken against the underlying balance sheet of the client, but can also use assets for security.	No minimum size, but must be the sole primary banker.
FNB/RMB	Up to 10 years	Funds up to 100 per cent of installation with no downpayment required; depends on borrowers' creditworthiness.	Collateral-based contractual agreement.	Typical finance f or projects up to 999 kWp; case-by-case evaluation for larger investments.
Nedbank	Up to 10 years	Up to R50 million (around US$3 million).	Utilizes equity in commercial property as collateral.	N/A

Source: GIZ 2019

The solar PV industry in South Africa is still characterized by high upfront system costs. Some incentives exist to help lower project costs and improve payback, such as those described in the Policy and Regulation section (section 6).

9.3/ FINANCING FROM EPC FIRMS FOR RENEWABLE ENERGY PROJECTS

Some developers as well as EPC firms also offer financing for their customer installations (typically <1 MW) through a lease agreement or power purchase agreement structure. There are more than 100 EPC firms in South Africa; the top six as of early 2017, in terms of installed capacity, were :

1. Solareff (15,829 kWp)
2. SOLA (10,679 kWp)
3. Dorman Projects (10,963 kWp)
4. Rhino Energy (8,739 kWp)
5. Sustainable Power Solutions (7,850 kWp)
6. Sunworx (7,691 kWp) (PQRS 2017).

7 *The prime rate is the interest rate that commercial banks charge creditworthy customers and fluctuates based on the South African Reserve Bank's repo rate.*

As of 2021, many of these companies have continued to grow, and more companies have entered the market, but limited data are publicly available on the broader market growth since 2017. Lease agreement terms vary by company and project, so they are often considered proprietary. Likewise, power purchase agreement terms vary by company, although in general they tend to be less than 10-15 years, as longer paybacks are often considered too risky in this market.

Many of the leading EPC firms have also formed partnerships with local private financial partners to provide upfront financing for their customers. For example, Mettle, which is owned by Tradehold Ltd, an investment holding company on the Johannesburg Stock Exchange, purchased 50 per cent of Sustainable Power Solutions in early 2016. Likewise, Centrafin (a subsidiary of Pinnacle Technology Holdings Group) purchased a 51 per cent stake in Solareff at the end of 2015 so it could offer operational rental/lease financing for technology-based equipment for its customers.

In addition, many EPC firms have taken advantage of Section 12J of the Income Tax Act of 1962 to raise equity. The Act provides incentives for investors to invest tax-deductible equity in local small and medium enterprises; however, it is scheduled to expire in June 2021. South Africa's Treasury announced in its Budget 2021 statement that the incentives' objectives had not been sufficiently achieved, since the majority of the investments were channelled to lower-risk property investments rather than higher-risk small and medium enterprises.

9.4/ DEVELOPMENT AGENCY PROGRAMMES

A number of development agency programmes for renewable energy have been implemented in South Africa with the support of international development finance institutions.

The French Development Agency (AFD) brought its green credit line SUNREF (Sustainable Use of Natural Resources and Energy Financing) to South Africa in 2012 to target the private energy efficiency and renewable energy sectors with both a credit facility and technical assistance. AFD initially offered €120 million (around US$145 million) to three South African banks. In 2016, it extended a fourth credit line of €60 million (around US$72 million) to the Industrial Development Corporation to finance small-scale energy efficiency and renewable energy projects in South Africa, where the Industrial Development Corporation could on-lend directly to small and medium companies. In addition, the credit line is available to companies that provide manufactured goods or services for renewable energy sectors.

Feedback from stakeholders suggests that it took a long time (about three years) to get the SUNREF programme started and that it had difficulty lending to corporations and small and medium enterprises. In addition, the administering of monitoring and reporting on small and medium enterprises back to AFD was challenging. The increased interest rates under SUNREF II and additional requirements brought complexity to the process, making it less successful than SUNREF I in South Africa.

Some stakeholders claim that additional credit lines and affordable financing could further help the clean captive power market. Another option would be to implement a pilot on-bill financing programme (e.g. Pay-As-You-Save) with a municipality in South Africa to help deploy the financing for clean captive power with targeted subsidies to customers.

In 2018, KfW Development Bank (KfW) and Rand Merchant Bank launched South Africa's first debt fund focused on small renewable energy projects (below 10 MW) to encourage small businesses and municipalities to produce their own electricity. The Facility for Investment in Renewable Small Transactions (FIRST) combines R350 million (around US$24 million) in first-loss equity from KfW with an R1 billion (around US$0.07 billion) loan fund from Rand Merchant Bank (RMB 2019). In early 2019, KfW also announced an R1.1 billion (around US$0.08 billion) credit facility to the Industrial Development Corporation targeting small and medium enterprises that invest in "green economy" projects that decrease greenhouse gases or have a beneficial environmental impact. As an implementation partner for KfW's programme, the Industrial Development Corporation made loans of R15.4 billion (around US$1.1 billion) in 2018 alone towards industrialization and development in South Africa (Paton 2019).

The South African National Energy Development Institute (SANEDI) was established in 2011 under the National Energy Act, 2008. SANEDI primarily conducts energy research and development (R&D), promotes energy research and technology innovation, and undertakes measures to promote energy efficiency throughout the economy.

SANEDI has established R&D centres to coordinate innovation, R&D, technology promotion, skills development and collaboration. One such centre, the Renewable Energy Centre of Research and Development (RECORD), envisages being recognized as the foremost institution for renewable energy research coordination and collaboration in South Africa. RECORD achieves this through collaborative projects and research platforms. Some of the collaborative projects include: 1) Implementing the Solar Energy Research Development and Innovation plan on behalf of the Department of Science and Technology (DST) (collaboration between SANEDI and DST); 2) solar resource measurement project (collaboration between the German International Cooperation Agency (GIZ), SANEDI, Stellenbosch University, Eskom); and 3) Renewable Energy Testing, Training and Demonstration Facilities (collaboration of SANEDI, GIZ, CSIR, Technical Innovation Agency, GreenCape, Cape Peninsula University of Technology, Stellenbosch University, Nelson Mandela University).

The Wind Atlas for South Africa (WASA) Phase 1 Project (2009-2014) was an initiative of the South African Department of Energy with the principal funder being the South African Wind Energy Programme (SAWEP). The initiative was funded by the Global Environment Facility (GEF) (R8 million, or around US$0.6 million) and the Royal Danish Embassy (DKK 9,985,441, or around US$1.62 million), with SANEDI as the executing partner. The main objective of WASA was to develop and employ numerical (modelled) wind atlas methods and to develop capacity to enable long-term planning of large-scale exploitation of wind power in South Africa (SANEDI 2020).

Likewise, the German International Cooperation Agency (GIZ) is working with the South African Photovoltaic Industry Association (SAPVIA) to develop national standards for rooftop PV installations, aimed at improving the safety and quality of installations. The intention is for the PV GreenCard to be issued alongside every small-scale solar PV installation up to 100 kWp by suitable qualified installers (SAPVIA 2021).

9.5/ CONCLUSION

Renewable energy financing in South Africa is well developed for both large-scale and small-scale solar PV systems. The five main commercial banks provide finance for renewable projects in addition to the public banks. The banks offer various financing schemes: alongside services such as hedging and risk management, they offer loans for projects with capacities below 1 MW, including corporate loans that are offered for developers and EPC companies with a pipeline of projects. Generally, these loans are characterized by having high rates compared to international standards.

Other financing schemes exist through the EPC firms that offer lease agreements to their customers in the form of power purchase agreements or rent-to-own agreements. Currently, there are more than 100 EPC firms in South Africa, which reflects the maturity of the market.

There are an extensive variety of existing donor programmes in South Africa, such as the French Development Agency (AFD) offering credit lines to energy efficiency and renewable energy projects since 2012. Also, KfW and Rand Merchant Bank launched a debt fund in 2018 to support small renewable energy projects (less than 10 MW). Additionally, KfW launched in 2019 a credit line through the Industrial Development Corporation to support small and medium enterprises to invest in projects targeting decreased greenhouse gas emissions or projects with a beneficial environmental impact. Future funding is also expected from the New Development Bank and the Development Bank of Southern Africa, which targets supporting private sector investment and increases the availability of long-term funds for energy sector projects in the country.

Financing for renewable energy projects exists in South Africa and is well established, although it faces challenges such as high rates. This indicates that financing for captive installations is possible, as financing schemes also exist for projects with capacities less than 1 MW; however, the high rates charged by the banks may hinder the implementation of captive projects.

Solar panels mounted on the roof of the Mall of Africa, Waterval City, Midrand. *© Shutterstock / Simon_g*

10/ CONCLUSION

This South Africa country report for clean captive installations for industrial clients in Sub-Saharan Africa has presented and analysed information on the electricity sector of the country, regulatory considerations, electricity tariffs, market potential, the financing landscape and stakeholders relevant to captive power in industry. The study was based on reports and data available at the time of writing and on interviews with key stakeholders.

While data limitations did not allow for in-depth analysis of specific industrial subsectors, the study has highlighted important findings and areas for consideration and, in some cases, further investigation. This will inform the design of interventions for the scale-up of clean captive installations in the industrial sector in South Africa, including the preparation of case studies, business models and financing structures, awareness raising, and identification and implementation of a pilot project.

Currently, South Africa has a severe undersupply of electricity production. This situation could benefit the clean captive installations market. However, the study highlights the following trends:

- Not all municipalities offer embedded generation tariffs for customers.
- The supply gap and occasional load shedding due to unplanned breakdowns at Eskom's coal plants suggest that there is an urgent need for on-grid renewable energy in the country.
- Eskom has plans to continue to raise its tariffs each year for the foreseeable future, but the amount depends on NERSA approvals.
- High-temperature requirements and near-constant demand limit potential for clean captive power for many large industrial customers (e.g., smelters) in South Africa, but smaller commercial and industrial customers and small and medium enterprises whose demand corresponds to daily solar resource have higher demand and potential for solar PV.
- Economic uncertainty for businesses limits interest in projects with paybacks longer than 3-5 years.
- Drought and water scarcity are a challenge with climate change, particularly for the farming sector in some parts of the country (e.g., Eastern Cape, Northern Cape).

On the financing side, the report drew attention to the following challenges:

- The financing sector is fairly advanced in servicing the formal sector but has limited capability to provide financing to the informal sector.
- There is a financing gap in the small to medium projects (less than R100 million, or around US$7 million) due to relatively high transaction costs for smaller projects.
- The seasonality of farming is a challenge in terms of bankability and energy demand. Likewise, small and medium enterprises struggle with bankability.
- The commercial banks are active in the market and want to provide more financing for clean captive power, but they need to find a funding solution that provides the corporate off-taker with 10-12 years of debt.
- Many of the leading EPC firms have access to affordable financing, but smaller energy service/supply companies and EPC firms face challenges accessing financing.

In South Africa, a key barrier in the market relates to policies and regulations:

- The main barrier relates to regulatory uncertainty including the bottleneck in approval of licencing for projects over 1 MW and the need for a streamlined wheeling approval process.
- The recently published IRP 2019 and Eskom Roadmap provide policy direction for the industry, but the government needs to move quickly to implement plans to address the capacity shortage and growing Eskom debt.
- Large industrial customers are already aware of the embedded generation opportunity, but key constraints include on-site land availability, the licencing bottleneck for projects over 1 MW and the lack of a streamlined wheeling application process.

Given the development state of the clean captive power industry in South Africa, a pilot installation of renewable energy technology should consider a nuanced approach beyond what is already commercially mainstreamed to maximize the potential impact of the project. Current projects in the planning phase mentioned by stakeholders are varied, including:

- solar PV installation at a recycling plant with environmental externality benefits;
- solar PV project on a farm;
- property developer building low-cost housing that wants to also install solar PV;
- vanadium mine that wants to install 2.5 MW of solar PV with a vanadium redox flow battery, with a project finance approach to demonstrate local bankability, and that could use help with developing a third-party report on bankability from a lender's technical advisor. The report could help prove the bankability of flow batteries for local financiers and support whether the project can do what it claims.

It is expected that the call for proposals will inform what type of projects could use support from this project. The South African government plans to increase the 1 MW licencing threshold and request for information to procure 2,000-3,000 MW of grid-connected power to meet the supply gap. This may also present opportunities for the pilot project to work with industries.

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CLEAN CAPTIVE INSTALLATIONS FOR INDUSTRIAL CLIENTS IN SUB-SAHARA AFRICA

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