Transmission Development Plan

2023-2032

FOREWORD BY GROUP EXECUTIVE

“We are committed to driving the implementation of the TDP, with a strong focus on the next five years.” – Segomoco Scheppers

The 2022 Transmission Development Plan (TDP) will share the transmission grid development plans for the period 2023 to 2032 with you. The TDP published this year comes against the backdrop of a severely constrained power system, which, regrettably, has necessitated the implementation of the longest round of rotational load shedding yet.

As you well know, load shedding remains imminent as a last resort to protect the integrity of the power system. Given that Eskom provides periodic updates on the state of the power system, we will focus on the challenges and opportunities flowing from the TDP.

You will be aware of the call by the President for “an ambitious, bold, and urgent response to the energy crisis”. We are heeding this call by doing everything in our power to avoid the crisis entering the transmission space, as this would dramatically compound the challenge we are facing.

In this spirit, as Transmission, we diligently continue to carry out the required maintenance on the transmission grid. For the financial year (FY) ended 31 March 2022, Transmission carried out an estimated 98,8% of the planned maintenance.

Regrettably, we continue to experience high levels of damage to, and vandalism of, our network assets, which occasionally lead to the collapse of one or more towers. This clearly presents a serious safety risk and may even lead to interruptions of supply. I do, however, wish to express our sincere appreciation to all our communities, farmers, and landowners, who are our eyes and ears and report defects or damage to our infrastructure.

While the levels of our maintenance performance execution are commendable, it is important to highlight that we are continuing with the focused implementation of our asset replacement and modernisation strategy. By monitoring obsolescence and focusing on asset condition assessment, we can proactively identify and plan for assets to be replaced or renewed.

The TDP Forum remains an important platform that enables us to give you as our key stakeholders updates on the development plans for the national transmission grid. Addressing South Africa's generation capacity challenges will continue to require a collaborative multistakeholder approach characterised by openness and transparency.

In this spirit of transparency, we recently developed and published the transmission network Generation Connection Capacity Assessment (GCCA) report, which is available on the Eskom website. This serves to guide potential developers of new generation capacity where transmission grid capacity is available. We trust that this information will contribute to the efficient development of new generation capacity, thereby contributing to the alleviation of the energy crisis.

It gives me pleasure to report that notable progress has been made in implementing identified capital projects since the TDP 2021 was delivered in October 2021. This is despite the negative impact of the COVID-19 pandemic in the last two years.

At a very high level:

• additional 400 kV transmission networks were commissioned to strengthen the grid in the Western Cape between the Ankerlig and Sterrekus substations;

• the same was done on the networks in the Bloemfontein area between the Everest and Merapi substations and the network strengthening projects between the Tugela substation near Bergville in KwaZulu-Natal (KZN) and the Sorata substation near Harrismith in the Free State;

• the addition of large new generation in the form of Medupi and Kusile Power Stations resulted in various plant items being identified as becoming underrated, presenting a safety risk if not operated without taking special precautionary measures. Various plans were implemented at the Witkop substation outside Polokwane and the Merensky substation near Tubatse in Limpopo to mitigate this safety risk;

• additional transformer capacity was commissioned at the Kronos substation (near Copperton) in the Northern Cape to facilitate Bid Window 4 renewable energy projects;

• a total of six independent power producer (IPP) projects, contributing 682 MW, were commissioned, bringing us to a total of 91 IPP projects, with a contribution of over 7 000 MW; and

• these IPPs were integrated into the national transmission grid in the Northern, Western, and Eastern Cape regions, underpinned by investments in new substations and enhancements of transformer capacity.

Coming to the TDP 2022:

The TDP remains a living document that takes new developments in the energy landscape into account. In formulating the TDP, we always endeavour to align ourselves with the country's energy policy as expressed through the Integrated Resource Plan, the latest version being the IRP 2019. We have, however, consciously made certain considered adjustments when formulating the planning assumptions for the TDP 2022, given that, with time, there have been significant shifts in the electricity landscape.

A few of the key adjustments in planning assumptions that we have made include the following:

• The energy availability factor (EAF) of the Eskom coal fleet, which was a critical input in the development of the IRP 2019, has since deteriorated. The net result is that a substantial amount of additional generation capacity, over and above what is reflected in the IRP 2019, will be required by 2032 to meet the needs of the country.

• Eskom's 2035 Corporate Strategy was taken into account, which reflects shifts in the rate and timing of the retirement of several Eskom coal-fired power stations.

• Consideration was also given to grid connection applications received from the various procurement programmes by the Department of Mineral Resources and Energy (DMRE) and applications received from the non-DMRE integration programmes.

We are mindful that the IRP is being updated, and we continue to work closely with the DMRE as this process unfolds. Naturally, the updated IRP will influence future versions of the TDP.

Based on these adjusted generation assumptions, approximately 53 GW of new generation capacity is required by 2032, mainly from renewable energy sources, especially solar and wind, including in areas with limited transmission infrastructure.

The TDP 2022 and the Grid Connection Capacity Assessment 2024 (GCCA 2024) have highlighted the significant constraints of transmission networks, mainly in the Northern, Eastern, and Western Cape regions of the country. Therefore, this will require accelerating investments in transmission infrastructure by developing new corridors and substations, while also strengthening existing substations. We are taking steps to fast-track what we call accelerated transformer projects to unlock grid capacity.

Working on the assumption that the potential hindrances to implementing the TDP are resolved, for example, servitude acquisitions and budget availability, the transmission grid would need to be augmented by approximately 14 200 km of extra-high-voltage lines and 170 transformers by 2032.

Given the uncertainty in the longer term, we have decided to focus on implementing projects in the next five years that we consider extremely critical from a security of supply perspective. Our analysis reflects a requirement of approximately 2 890 km of extra-high-voltage lines and 60 transformers, requiring a capital investment of R72,2 billion by FY2027.

The delivery of grid strengthening projects over the next five years requires us to collectively take extraordinary measures to expedite the roll-out of the grid. Undoubtedly, this will require careful planning on our part, as well as alignment, co-ordination, and support from all key stakeholders. We continue to participate in National Energy Crisis Committee (NECOM)/National Joint Operational and Intelligence Structure (NATJOINTS) initiatives, while collaborating and partnering with various key stakeholders.

We have included a new chapter titled “Ancillary Services”. As the energy mix changes, in particular as we retire more of the large synchronous generators and increase the portfolio of inverter-based renewable energy resources, the behaviour of the power system changes drastically. We must design and engineer the power system in such a way that we can provide assurance regarding the stability of the power system. In addition, we have commissioned further advanced power system modelling and analysis studies, focused specifically on system stability. We expect to conclude these studies during the first half of next year. This is a new and exciting chapter, which I am sure our network planners are looking forward to.

The process of the legal separation of the Transmission business as a wholly owned subsidiary of Eskom Holdings SOC Ltd is at an advanced stage, with the Transmission entity having been registered as the National Transmission Company South Africa (NTC) SOC Ltd.

A binding merger agreement has already been signed, with suspensive conditions to be fulfilled for the effective transfer of the business from Eskom to the Transmission entity. Following the fulfilment of suspensive conditions, the NTC will be operationalised, and employees will be transferred to the company on the same conditions of service, without disrupting their years of service.

Lender engagements for consent are at an advanced stage, with lenders expected to provide their decision in due course. The electricity licence application for the NTC was resubmitted to the National Energy Regulator of South Africa (NERSA) during September 2022 and is under consideration.

Eskom depends on the government and lenders for the conclusion of key requirements. The timeline for commencement of trade for the NTC is anticipated to be in the new financial year, on the proviso that all suspensive conditions are fulfilled.

I would like to conclude by restating that Transmission remains committed to providing non-discriminatory access to the transmission grid to generators and distributors, regardless of ownership. This position is fully supported by Eskom Holdings.

We will continue to provide regular updates on the state of the power system, while doing everything possible to recover our operations and supporting efforts to add new generation capacity to the grid.

Lastly, we are committed to driving the implementation of the TDP, with a strong focus on the next five years. It is absolutely imperative that we succeed. Considering the President’s call for “an ambitious, bold, and urgent response to the energy crisis”, I believe that your attendance and participation at the 2022 TDP public forum and future engagements are a reflection of your commitment to contributing to this exciting journey that we are on.

I thank you.

Segomoco Scheppers

GROUP EXECUTIVE: TRANSMISSION

DISCLAIMER

The purpose of publishing the TDP is to inform stakeholders about the proposed developments in the Eskom transmission network. These plans are subject to change as and when updated information becomes available. While considerable care is taken to ensure that the information contained in this document is accurate and up to date, the TDP is only intended for information sharing.

The content of this document does not constitute advice, and Eskom makes no representations regarding the suitability of using the information contained in this document for any purpose. All such information is provided "as is" without warranty, promise, or representation of any kind, expressed or implied, and is subject to change without notice. The entire risk arising from its use remains with the recipient. In no event shall Eskom be liable for any loss or damage, including (without limitation) direct or indirect damages and consequential, incidental, special, punitive, or any other damages whatsoever and howsoever arising, including, but not limited to, damages for loss of business profits, business interruption, or loss of business information.

Although the TDP is updated periodically, Eskom makes no representation or warranty as to the accuracy, reliability, validity, completeness, usefulness, or timeliness of the information contained in this document. Eskom does, however, endeavour to release plans based on the best available information at its disposal at all times to ensure that stakeholders are kept informed about developments in the transmission network. Therefore, the information contained in this document represents the most up-to-date information that was available at the time of publication.

The costs given in the document are, in general, high-level estimates and can change as global economic conditions change; that is, costs are sensitive to fluctuations in foreign exchange rates and commodity prices.

For the upstream transmission network strengthening projects required to enable the connection of future independent power producers (IPPs), Transmission will conduct the necessary feasibility assessment and develop these projects to the extent possible within the confines of the capital investment process of the approved transmission network service provider (TNSP). However, capital investment in these projects will only be considered if the related IPP projects are announced as preferred bidders in the DMRE IPP Procurement Programme. The TDP is not regarded, and should not be regarded, as investment commitment, and all IPP or other connections will be treated on merit on the basis of actual information and feasibility outcomes.

EXECUTIVE SUMMARY

The transmission network is the primary network of interest covered in this publication. This mainly covers electrical networks with voltages ranging from 220 kV to 765 kV and the associated transmission substations. A few subtransmission networks are included due to their strategic nature or when Transmission owns them.

The purpose of the TDP is to assess network requirements and propose plans to meet the load demand and generation integration forecasted in the subsequent 10-year period. This publication contains information about projects intended to extend or reinforce the transmission system that have been completed in the past year as well as about projects that are planned for the next 10 years.

The TDP 2023 to 2032 was formulated to address the following:

- Attain Grid Code compliance by resolving both substation and line constraints.
- Determine new network infrastructure requirements to sustain the current customer base and allow for future demand growth.
- Determine new network infrastructure requirements to integrate new generation (Eskom-owned as well as IPPs, conventional, and renewable).
- Evacuate and dispatch power to the load centres from the power stations connected to the grid.

Eskom Transmission also carries out projects in respect of the refurbishment of ageing infrastructure, strategic projects, environmental authorisations and acquisition of sites and servitudes, facilities, production equipment, and strategic capital spares. The rationale for the aforementioned project categories can be outlined as follows:

- The transmission system requires regular planned maintenance, as well as renewal or replacement of plant that has reached the end of its operational or economic life, to ensure that the network continues to perform its role safely, reliably, and efficiently.
- Strategic projects include the upgrading of the energy management system (EMS) used by the System Operator to monitor, control, and optimise the performance of the power system and respond to network emergencies.
- The acquisition of sites and servitudes and the associated environmental impact assessments (EIAs) and other statutory approvals are necessary in order to construct transmission infrastructure.

- Facilities consist of buildings and associated works located at sites other than substations that Transmission uses for offices, the operation and control of the system, or as maintenance depots and workshops.
- Production equipment consists of office furniture and equipment, computer hardware and software, tools and other equipment used by maintenance staff, and vehicles.
- Strategic capital spares are items not available from suppliers out of stock, for example, large power transformers and circuit breakers. These are kept as strategic stock to allow for units that fail and cannot be repaired on site to be replaced as soon as possible, thereby minimising long-duration outages to customers.

These types of projects are not detailed in this document, but a summary of their costs appears in the chapter on capital expenditure.

Eskom's liquidity position, as well as the National Energy Regulator of South Africa's (NERSA) decision on Eskom's future tariff determination, will have an impact on the execution of the TDP. In the event of capital expenditure restrictions due to any of the above, the plan will have to be revised to fit in with the available budget by reprioritising projects. This will be done in a way that minimises the impact on customers and the national economy due to any delays arising from a shortage of funding or any delays in obtaining environmental authorisations, servitude acquisitions, and other statutory approvals.

It is regrettable, but unavoidable, that the funding constraints will result in more time being taken to bring the transmission system into compliance with the reliability and redundancy requirements prescribed by the South African Grid Code. The effects on customers and the national economy will be minimised through consultation with customers and activation of risk mitigation measures.

TABLE OF CONTENTS

ABBREVIATIONS AND DEFINITIONS

ASTR Ancillary Services Technical Requirements

BA basic assessment

The process of collecting, organising, analysing, interpreting, and communicating information that is required to examine the environmental effects of the proposed activity in accordance with the National Environmental Management Act (NEMA), EIA Regulations.

BAR basic assessment report

A report describing the process of examining the environmental effects of a development proposal, the expected impacts, and proposed mitigation measures.

BESS battery energy storage system

BQ budget quotation/quote

A quotation giving customers the costs and scope at an 85% accuracy level.

CA competent authority

The authority designated by the Minister that authorises the development of electricity grid infrastructure in terms of the NEMA.

CAGR compound annual growth rate

CCGT combined-cycle or closed-cycle gas turbine

An open-cycle gas turbine (OCGT) fitted with a waste heat recovery boiler and steam turbines to increase electricity output by using the exhaust gases of the combustion turbine to raise steam.

CLN customer load network

The network within a specific geographical area, which, in turn, is a subdivision of a grid; for example, Johannesburg CLN falls within the Central Grid in Gauteng.

CO commercial operation

CoCT City of Cape Town

CSIR Council for Scientific and Industrial Research

CSP concentrated solar power

DFFE Department of Forestry, Fisheries, and the Environment

The CA identified by the Minister for the authorisation of activities undertaken for electricity grid infrastructure projects.

DMRE Department of Mineral Resources and Energy

DoE Department of Energy

EA environmental authorisation

Authorisation for implementation of a listed activity as listed in the EIA Regulations by the competent authority.

EAF energy availability factor

EAP environmental assessment practitioner

An independent consultant who meets the requirements of the Environmental Impact Assessment Regulations to conduct the application and process for the environmental authorisation.

ECO environmental control officer

An independent person appointed on a construction project to monitor and report on compliance with the conditions of an EA and the environmental management programme (EMPr).

EGI electricity grid infrastructure

EHV extra-high voltage

EIA environmental impact assessment

The process of collecting, organising, analysing, interpreting, and communicating information that is required to examine the environmental effects of the proposed activity in accordance with the EIA Regulations.

EIR environmental impact report

A report describing the process of examining the environmental effects of a development proposal, the expected impacts, and proposed mitigation measures.

EL East London

EM emerging market

EMPr environmental management programme

A process that seeks to achieve a required end state of the environment and describes how activities that could have a negative impact should be managed/monitored and affected areas rehabilitated.

EMS energy management system

FCLR fault current limiting reactor

FS Free State

FY financial year

GAU Grid Access Unit

GCCA grid connection capacity assessment

GDP gross domestic product

HV high voltage

HVDC high-voltage direct current

I&APs interested and affected parties

Individuals or groups concerned with, or affected by, an activity and its consequences.

ICE indicative cost estimate

A cost estimate giving a non-binding indication of the order of magnitude costs.

ICT information and communications technology

IDZ industrial development zone

IPP independent power producer

These are power stations owned by independent parties other than Eskom.

IPPO Independent Power Producers Office

IPS integrated/interconnected power system

IRP integrated resource plan

ISED integrated strategic electricity demand

KSACS Key Sales and Customer Service

KZN KwaZulu-Natal

Landowner For the purposes of this document, a landowner is defined as the owner of the land, registered as such in the Deeds Office, and/or his/her assignee.

MI market intelligence

MVA megavolt-ampere

A million volt-amperes of apparent power, which is the vector sum of real power (MW) and reactive power (Mvar).

Mvar megavolt-ampere reactive

A million volt-amperes reactive – a volt-ampere reactive is a unit of the electrical power required to maintain electromagnetic fields.

MW megawatt

A million watts – a watt is a unit of electrical power production or demand.

MYPD multi-year price determination

A multi-year price determination for tariff increases awarded to Eskom by NERSA.

NATJOINTS National Joint Operational and Intelligence Structure

NDP National Development Plan

NECOM National Energy Crisis Committee

NEMA National Environmental Management Act

NERSA National Energy Regulator of South Africa

The body established by an Act of parliament to regulate the production, sale, and pricing of electricity, liquid fuels, and fuel gas in South Africa.

NMD notified maximum demand

NTC National Transmission Company

The body that is licensed as the national provider of transmission services.

OCGT open-cycle gas turbine

A combustion turbine fuelled by liquid fuel or gas, used to drive a generator.

PE Port Elizabeth

PPA	power purchase agreement
PV	photovoltaic
RE	renewable energy
REBID	Renewable Energy Bid Programme
REDZ	renewable energy development zone Areas identified in terms of a strategic environmental assessment where it is optimal to develop renewable energy projects for wind and solar energy.
RE IPP	renewable energy independent power producer
REIPPPP	Renewable Energy Independent Power Producer Procurement Programme
RMIPPPP	Risk Mitigation Independent Power Producer Procurement Programme
RTS	return to service A previously mothballed power station undergoing recommissioning.
SADC	Southern African Development Community
SAGC	South African Grid Code
SAPP	Southern African Power Pool
SCO	synchronous condenser operation
Scoping/ Screening	The process of identifying the significant issues, alternatives, and decision points that must be addressed by a particular EIA/BA and may include a preliminary assessment of potential impacts during the screening process applied in the SEA corridors and REDZs.
SEA	strategic environmental assessment (corridors) Corridors identified through a process of strategic assessment for the development of electrical grid infrastructure that links to the REDZs.
SG	surveyor-general
SO	System Operator
SOC	state-owned company
SOW	scope of work

SSEG small-scale electricity generation

SVC static var compensator

TDP Transmission Development Plan

A development plan produced annually by Eskom Transmission detailing how the network will develop in the next 10 years. This comprises the proposed new projects listed in this document and the customer projects omitted from this document due to their commercial sensitivity.

TNSP transmission network service provider

A legal entity that is licensed to own, operate, and maintain a transmission network.

TOSP time of system peak

TS transmission system

1 INTRODUCTION

Eskom Holdings is the major producer of electricity in South Africa. It also transmits electricity via the transmission network, which supplies electricity at high voltages to a number of key customers and distributors. Eskom is a vertically integrated company licensed to generate, transmit, and distribute electricity in South Africa. The transmission licence is held by Eskom Transmission, which is the National Transmission Company (NTC). Planning for the expansion of the transmission network is the responsibility of the Grid Planning and Development Department in the Transmission Group.

1.1 CONTEXT OF THE TDP

According to the Grid Code, NERSA requires the NTC to publish a minimum five-year-ahead transmission system (TS) development plan annually, indicating the major capital investments planned (but not yet necessarily approved). The requirements, furthermore, stipulate that the plans shall include at least:

- the acquisition of servitudes for strategic purposes;
- a list of planned investments, including costs;
- diagrams displaying the planned changes to the TS;
- an indication of the impact on customers in terms of service quality and cost; and
- any other information as specified by NERSA from time to time.

A further requirement is for the NTC to host a public forum annually to disseminate the intended TS development plan to facilitate a joint planning process.

This is the 13th publication of the TDP, which was shared at a public forum hosted via Microsoft Teams and at Megawatt Park on 27 October 2022.

The TDP, which covers a 10-year period from 2023 to 2032, seeks to meet the long-term requirements of electricity consumers in South Africa by maintaining the legislated adequacy and reliability of the transmission grid. The objective is to produce a plan containing the expected development projects for the TS for this 10-year period. These expected projects consist of approved projects that are currently in execution, projects in the developmental phase, and projects that are in the inception phase based on a desktop assessment of the transmission requirements, with further engineering feasibility assessment to be conducted during the TDP period.

The projects contained in the TDP can be classified into three categories:

(i) Those that are in implementation and will be commissioned within the next three years or so (projects in execution)
(ii) Those that are in the detailed studies/design phase with business cases being concluded, aimed for implementation within the next seven years (projects in development)
(iii) Projects beyond the seven-year horizon that still have a level of uncertainty and are most likely to be revised in terms of scope (concept projects)

1.2 MAJOR CHANGES FROM THE 2021 TDP

The major change from the 2021 TDP to this revision of the 2022 TDP is associated with assumptions about the future generation capacity of the country. The 2021 TDP was informed by the IRP 2019, which was gazetted in November 2019. The IRP does not have capacities per annum beyond 2030; as a result, values for 2032 were assumed for wind, photovoltaic (PV), battery storage, and gas.

The bulk of the changes in this version of the TDP can be attributed to two main factors, namely, utility-scale renewable energy (RE) integration and its executability. These factors necessitated the reprioritisation of the plan based on need criticality assessment and readiness to implement.

1.2.1 CAPITAL CONSTRAINTS

Due to capital constraints emanating from Eskom's liquidity position, projects had to be reprioritised to fit in with the available budget. The reprioritised projects maximise the benefits accruing from the available capital investment budget, while minimising the risks to security and reliability of supply. The high-priority projects were accelerated, provided that the enabling factors were in place. The reprioritisation process will be repeated after each tariff increase ruling by NERSA and Eskom's Corporate Plan approval to ensure optimal allocation of the available budget.

1.2.2 LAND AND SERVITUDES ACQUISITION

The procurement of land and servitudes for substation and line construction projects is one of the essential transmission infrastructure development enablers. The projects affected by challenges in the land acquisition process were mainly deferred in line with the revised project schedule.

1.3 STRUCTURE OF THE DOCUMENT

The document is structured in the following manner:

Chapter 2, **GENERATION ASSUMPTIONS**, outlines generation assumptions for the 2022 revision of the TDP, which was primarily informed by the IRP 2019.

Chapter 3, **DEMAND FORECAST**, provides the location and magnitude of electricity demand forecasted (MW) to be supplied within the TDP period.

Chapter 4, **COMPLETED PROJECTS**, summarises the completed projects since the 2020 TDP was published.

Chapter 5, **CUSTOMER APPLICATIONS**, provides a summary of the grid connection applications processed by Transmission during the 2020/21 financial year (April 2020 to March 2021).

Chapter 6, **NATIONAL OVERVIEW**, is a high-level description of the planned transmission infrastructure. This is intended to give a national overview of the major projects planned for the entire period of the TDP and a high-level summary of the planned transmission infrastructure.

Chapter 7, **PROVINCIAL DEVELOPMENT PLANS**, focuses on the planned generation integration and reliability projects per province.

Chapter 8, **ANCILLARY SERVICES**, is a new chapter that has been included in this version of the TDP in order to provide an overview of the obligations bestowed on the System Operator (SO) to ensure system reliability, security, safety, and efficient operation of the interconnected power system (IPS).

Chapter 9, **CAPITAL EXPENDITURE PLAN**, outlines the forecasted costs of implementing the TDP. The costs provided in this publication are high-level costs intended to illustrate the financial requirements of the current revision of the TDP. The actual costs per individual project in the TDP will be refined after feasibility assessment and will be followed by approval of the associated business case before projects advance to execution.

Chapter 10, **CONCLUSION**, provides the concluding remarks on the 2022 version of the TDP.

2 GENERATION ASSUMPTIONS

The main source document for the generation assumptions is the Integrated Resource Plan (IRP 2019) endorsed by government in late 2019. The generation assumptions are primarily based on the preferred scenario as indicated in Table 5 (p. 42) of the IRP document (shown in Table 2-1 below). The generation assumptions for TDP 2022 also considered Eskom's 2035 Corporate Strategy (Just Energy Transition (JET)) outcomes, under which more renewable energy than what is indicated in the IRP is envisaged. To construct these assumptions, the IRP 2019 and the JET strategy outcomes were combined. In those cases where the capacity values were different, the higher of the two capacity values was used for each generation technology. Where a lower value was used, it was due to practical considerations because, in some cases, it would not be possible to implement certain capacity in the near term.

The Risk Mitigation Independent Power Producer Procurement Programme (RMIPPPP) preferred bids (announced in March 2021) were used for 2022, as the contracted commissioning was August 2022.

Table 2-1: IRP 2019 capacity per technology (Source: DMRE)

	Coal	Coal (Decommissioning)	Nuclear	Hydro	Storage	PV	Wind	CSP	Gas & Diesel	Other (Distributed Generation, CoGen, Biomass, Landfill)
Current Base	37149		1860	2100	2912	1474	1980	300	3830	499
2019	2155	-2373					244	300		Allocation to the extent of the short term capacity and energy gap.
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	6830	
% Total Installed Capacity (% of MW)	43		2.63	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	

Grey	**Installed Capacity**
Yellow	**Commited / already Contracted Capacity**
Red	**Capacity Decommissioned**
Green	**New Additional Capacity**
Blue	**Extension of Koeberg Plant Design Life**
Peach	**Includes Distributed Generation Capacity for own use**

The decommissioning of coal plant was adjusted for alignment with the decommissioning plan that Eskom Generation envisages, including the decommissioning of Tutuka in 2030. Because of this, the decommissioning in the assumptions deviates slightly from that given in the IRP. This is necessary for alignment with the “Consistent Data Set” produced by Eskom Generation.

The Renewable Energy Independent Power Producer Procurement Programme (REIPPPP), which is supposed to implement the IRP, is running late by up to 24 months for some technologies. The dates have been adjusted accordingly in the assumptions, and adjusted dates have also been obtained from the DMRE IPP Office.

The major outputs from the generation assumptions are as follows:

(i) The generation capacity that will be installed by Eskom in the next 10 years

(ii) The generation capacity, by technology type, that will be installed by IPPs in the next 10 years

(iii) The generation that is expected to be decommissioned in the same period

(iv) The spatial locations of the generation represented by the substation where the technology is allocated

The assumptions allocate capacities for each technology type in spatial and temporal domains. “Technology type” refers to the primary generation technology that will provide the energy, including, but not limited to, solar photovoltaic (PV), wind, open-cycle gas turbines (OCGTs), closed-cycle gas turbines (CCGTs), nuclear, and coal. Because of the different types of profiles from different generation supply-side options, it is important to specify the technology used in order to allocate the correct capacity for the time of the study; for instance, all the PV generation should be OFF at the time of system peak, as the sun is typically not irradiating at that time.

The spatial allocation requirements are met by indicating the closest transmission substation where the generation has been allocated. The time is given in the form of yearly generation capacity allocations per type in those substations. The rationale behind this allocation of different technology types is as follows:

i. PV and wind technologies are allocated according to the Council for Scientific and Industrial Research (CSIR) strategic environmental assessment (SEA) study, which shows spatially where wind and solar technologies are prevalent after taking other environmental restrictions into consideration**.** Figure 2-1 shows the areas with high solar and wind potential.

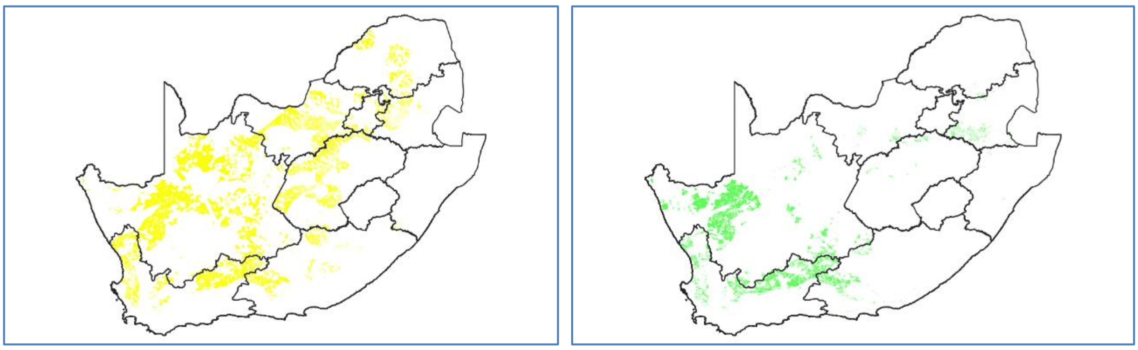
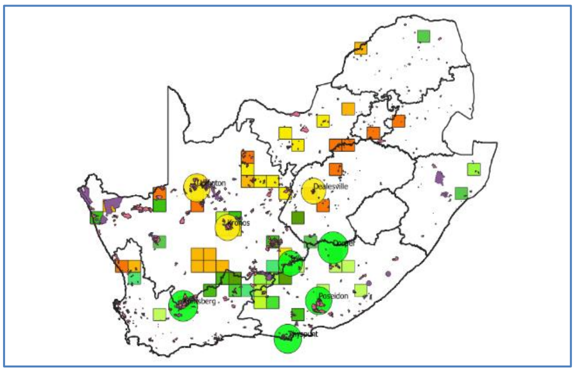


Figure 2-1: Areas of high solar irradiance (yellow) and wind potential (green) after environmental restrictions

ii. Areas where there is high interest as indicated by the large number of applications

iii. Areas where there have been many EIA applications by prospective IPPs

Figure 2-2 indicates areas of high interest as well as the EIA applications.



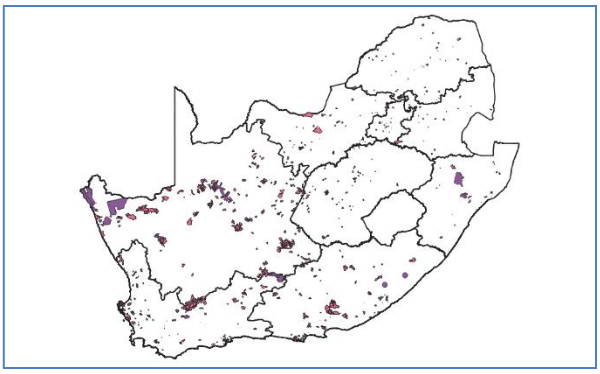


Figure 2-2: Areas of interest (left) with the yellow indicating solar and the green indicating wind, and EIA applications

iv. Areas where there is network capacity in the short term

At the time of producing the generation assumptions, the Grid Connection Capacity Assessment (GCCA 2023) indicated that there was no capacity in the Northern Cape, and very little capacity was available in the Western and Eastern Cape grids. Because of this, there is very limited capacity allocated in the Greater Cape area before 2027. Figure 2-3 and Figure 2-4 show the GCCA and the allocation in different years up to 2027, respectively.

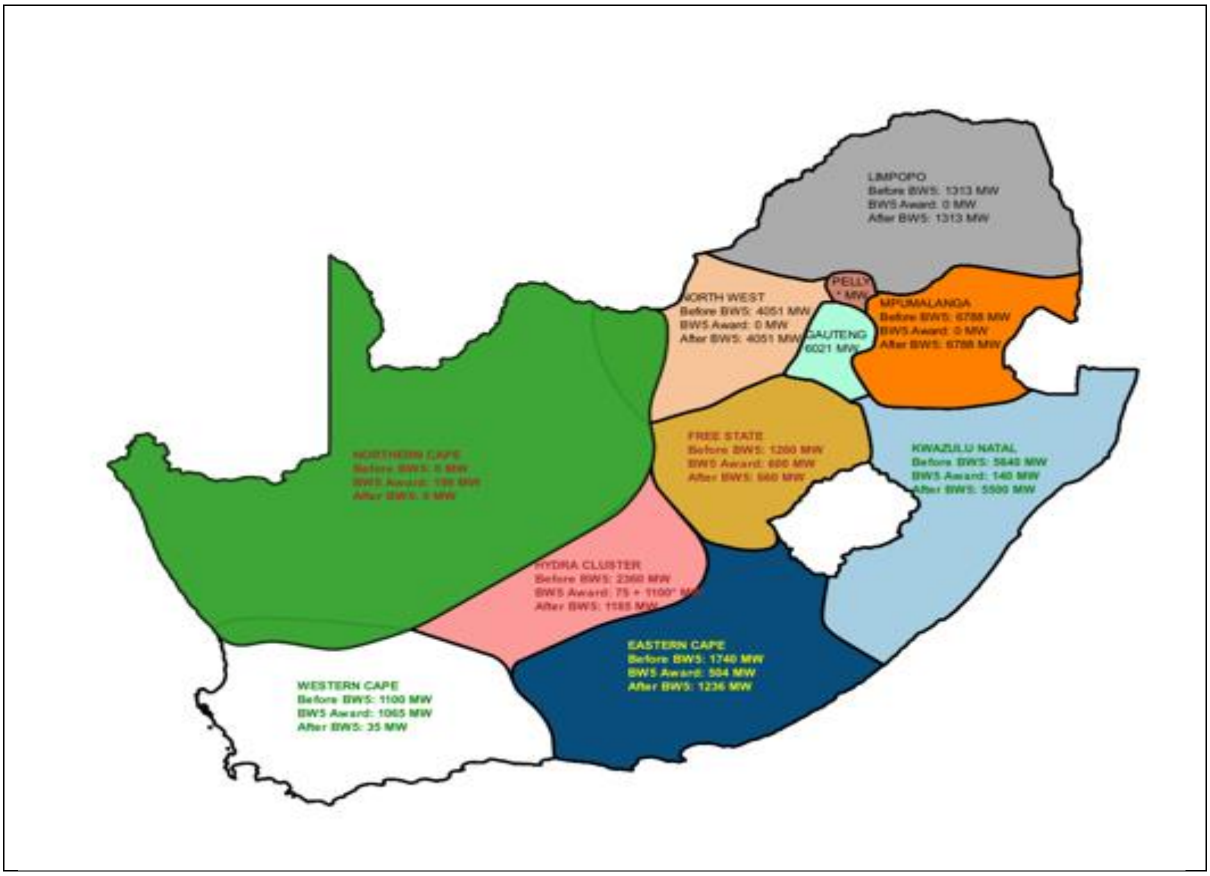


Figure 2-3: GCCA 2023 outcomes indicating little to no capacity in the Greater Cape area

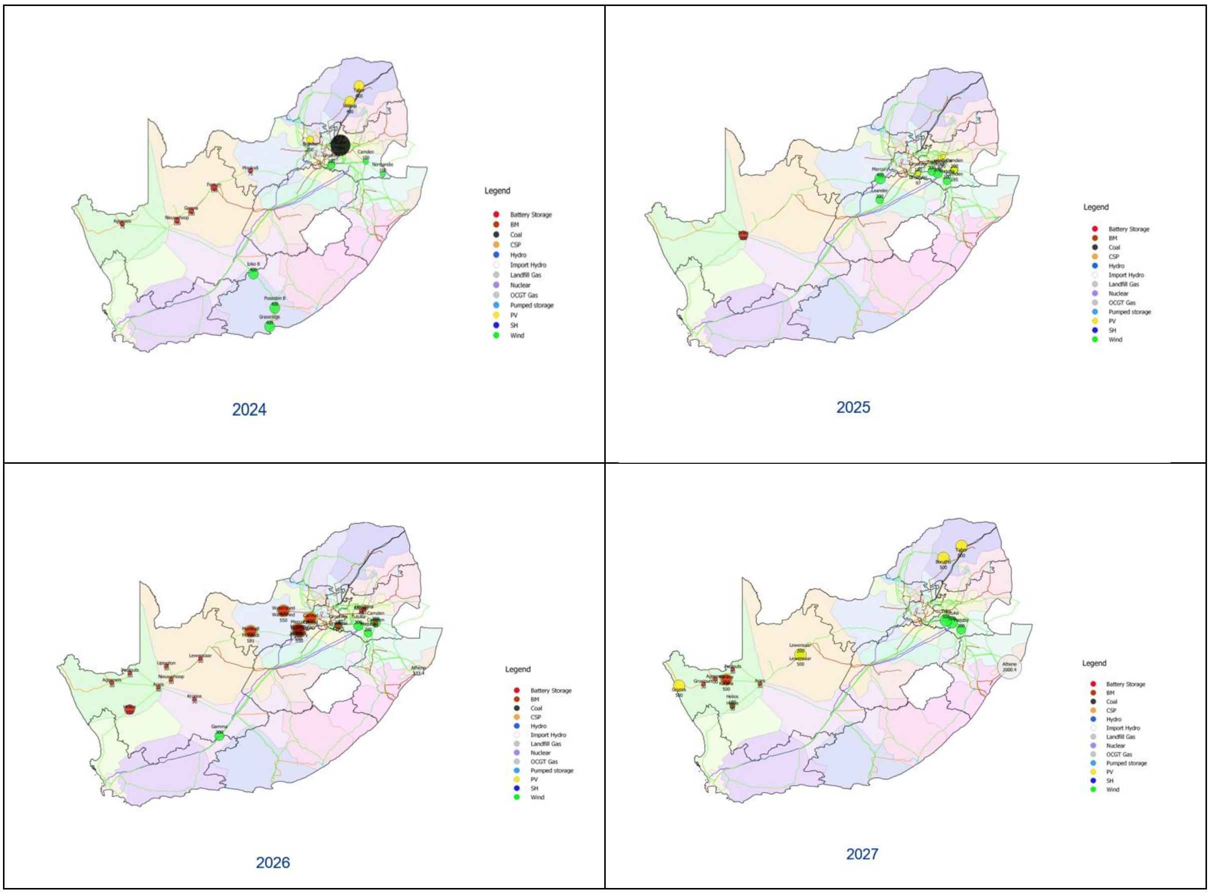


Figure 2-4: Allocation of renewables from 2024 up to 2026 – mostly battery storage (red) and minimal wind (green) and solar PV (yellow) allocated in the Greater Cape due to capacity constraints

2.1 GENERATION FORECAST

The generation composition of all the technologies forecasted at the end of this TDP period is presented in Figure 2-5. It is anticipated that there will be a total of approximately 45 GW of RE, 27 GW of coal, and 8,5 GW of gas installed in the system by 2032. Some of these plants exist, while others are in execution or are to be executed in the future. It is anticipated that there will be 6,6 GW of battery storage by 2032.

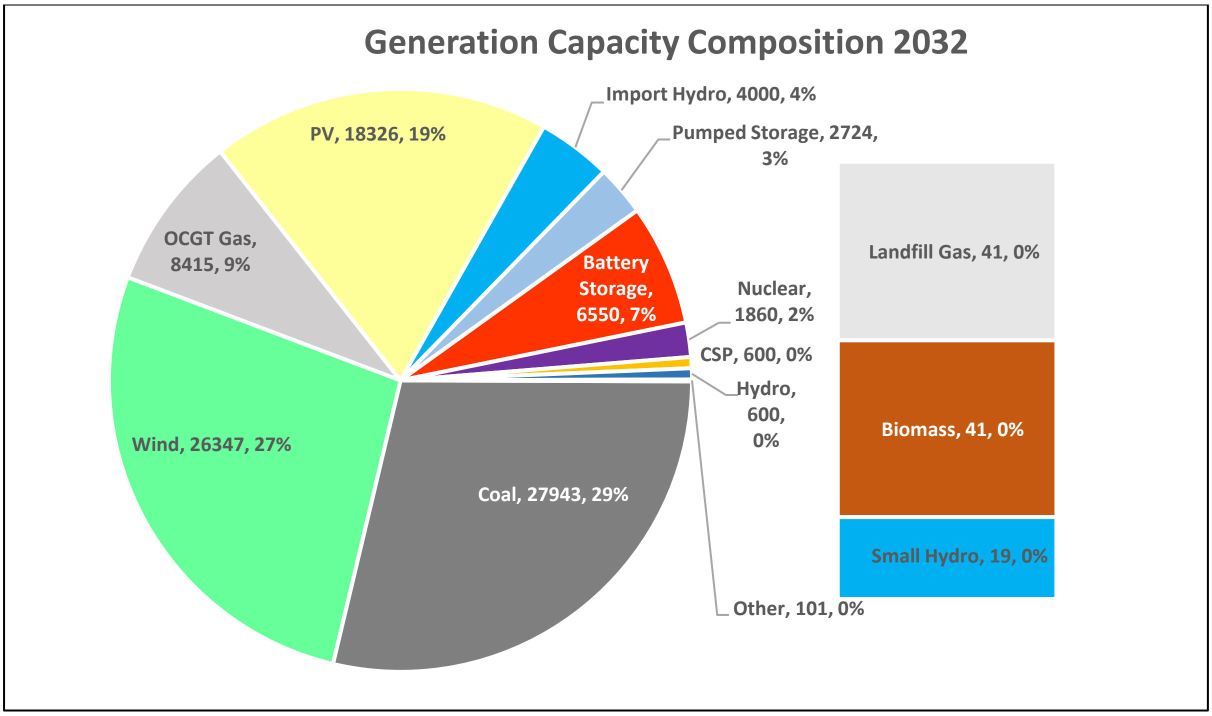


Figure 2-5: Generation capacity composition of all the technologies forecasted in 2032

Renewable capacity as a percentage of total capacity is expected to accelerate from 13% in 2022 to 46% in 2032, whereas conventional generation is expected to decrease by 5 GW and decrease as a percentage of the total energy capacity from 87% in 2021 to 47% in 2032. By this time, renewable energy capacity in the network will have increased approximately fivefold. Figure 2-6 shows the contribution of conventional and renewable capacity in the energy mix.

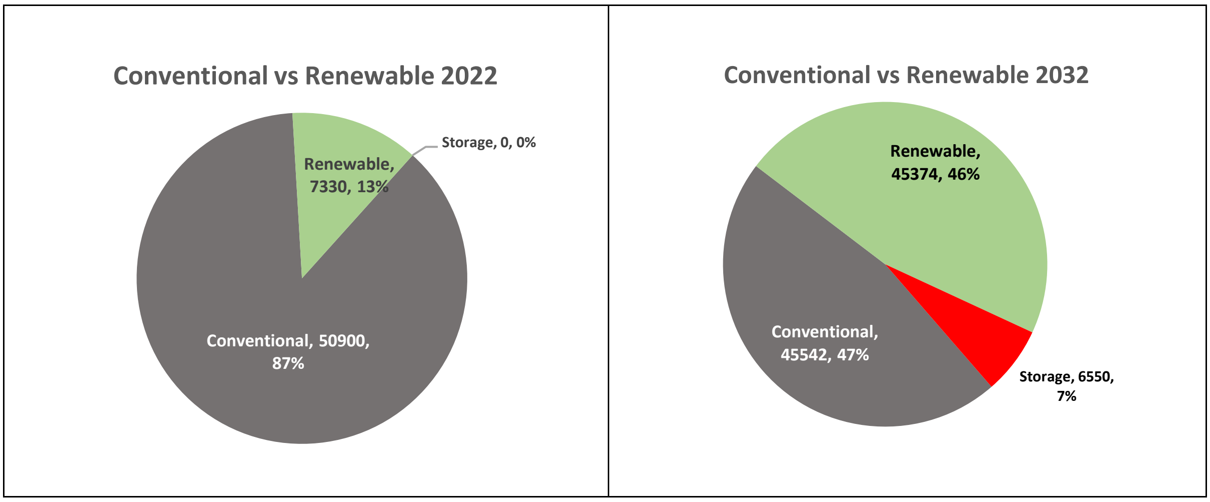


Figure 2-6: Conventional energy, storage, and renewable energy in 2022 and 2032

2.2 CONVENTIONAL GENERATION

Figure 2-7 indicates the cumulative conventional capacity allocation per substation. The total for conventional capacity that will be added to the system (including units from the inception of the Eskom build programme) is 17 809 MW by 2032.

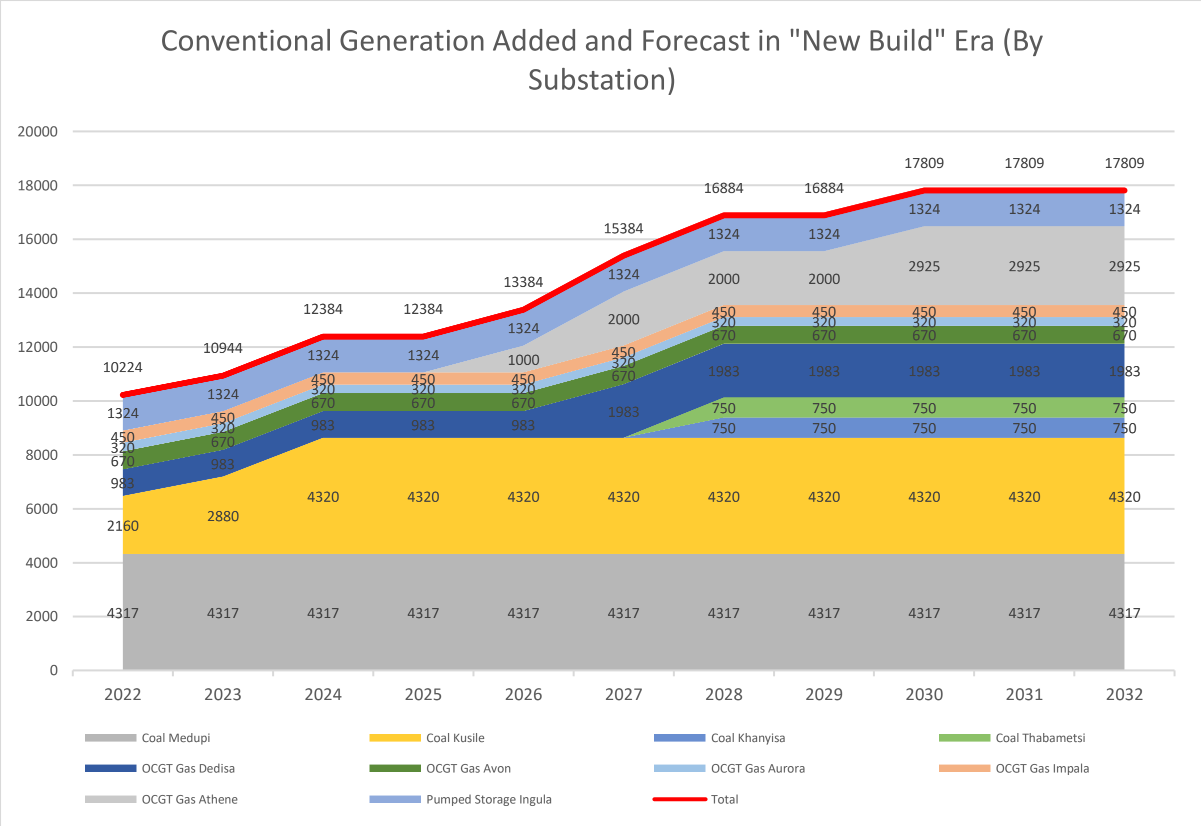


Figure 2-7: Conventional generation cumulative capacity schedule (by substation)

Coal has been the most substantial addition by far during this period, but has also been outpaced by the decommissioning rate of the same technology, as will be discussed later. The conventional import hydro of 2 500 MW has been shifted out of the TDP period, as Inga is not likely to materialise, and gas has been reduced from the previous TDP by approximately 2 GW. It is also doubtful that the envisaged coal IPPs of Khanyisa and Thabametsi will materialise, given that funding for coal has depleted, however, the two power stations have been left in the assumptions pending the revision of the IRP.

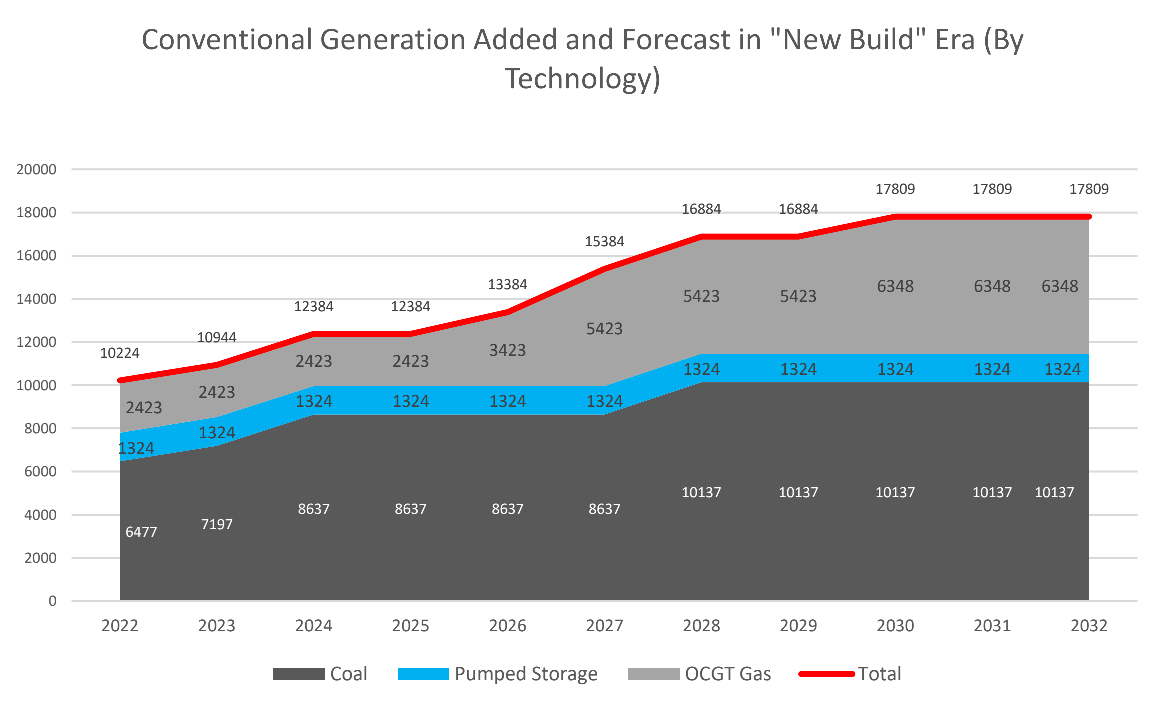


Figure 2-8: Conventional generation cumulative capacity schedule (by technology)

During the TDP period, 7 586 MW of conventional generation will be added to the system, as indicated in Figure 2-9. This is dominated by the new gas, which is increasingly needed as more renewables are installed. The additional coal in the graph is expected to drop when the IRP is revised. This is due to funding challenges experienced by the coal IPP projects.

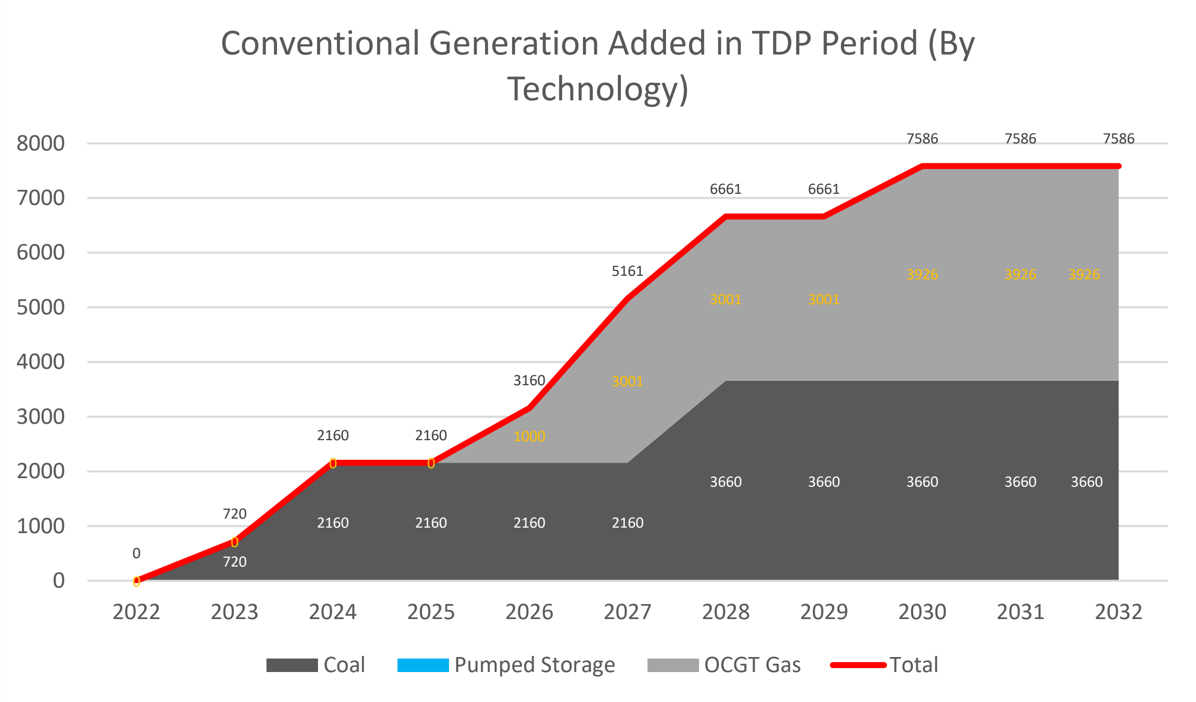


Figure 2-9: Conventional generation cumulative capacity schedule (by technology installed in the TDP period)

2.2.1 Nuclear Generation

There is no new nuclear generation in the TDP period in the IRP 2019. Thus, the generation assumptions do not have nuclear generation either. Possible high-level integrations of nuclear have now been tested at all possible sites, so it is unnecessary to test nuclear again in the current TDP period.

2.2.2 Gas Generation

The IRP 2019 allocated 3 000 MW of gas up to 2030. The Risk Mitigation Independent Power Producer Procurement Programme (RMIPPPP) approved 1 418 MW of additional gas to be installed by 2022. The total additional gas generation capacity catered for in the generation assumptions is 3 926 MW, excluding the RMIPPPP gas allocation in 2022.

2.2.3 New Coal – Highly Doubtful

The new coal stations are those that have been approved in the coal procurement programme, that is, Khanyisa and Thabametsi. The generation assumptions allocated 750 MW each to the two power stations in 2028. The funding for carbon-dioxide-emitting technologies is constrained, and the two projects in the IRP are experiencing funding challenges and are expected to be cancelled in future iterations of the IRP.

2.3 RENEWABLE GENERATION

The total renewable generation capacity added to the system (including units from inception) is 43 336 MW by 2032, excluding battery capacity, and 51 905 MW, including battery capacity, as shown in Figure 2-10. The total renewable capacity that will be added in the TDP period is 38 044 MW, excluding battery storage.

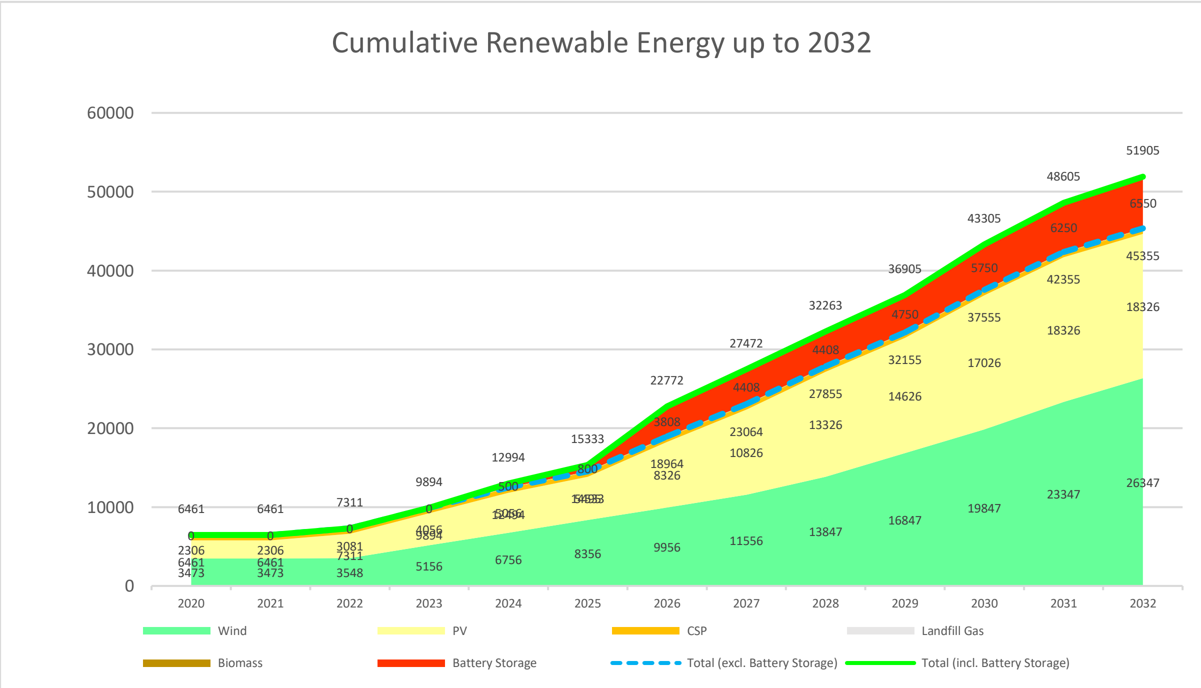


Figure 2-10: Renewable generation cumulative capacity schedule (by technology since RE build inception)

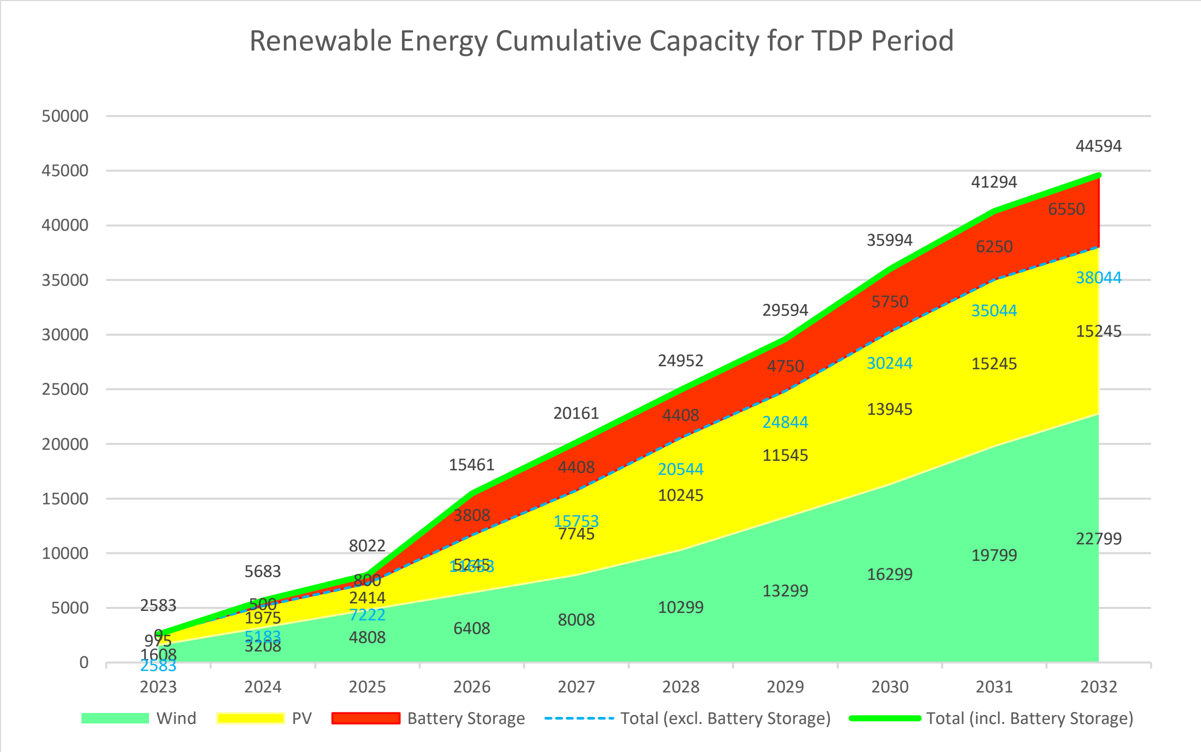


Figure 2-11: Renewable generation cumulative schedule (by technology for TDP period)

2.3.1 PV GENERATION

Solar PV is expected to reach 18 326 MW by 2032. Figure 2-11 indicates that 15 245 MW of PV capacity will be added in the TDP period. This may be dwarfed by the self-generation that will be installed because of the zero cap announced by the President of South Africa in 2022, according to which customers can install any amount of generation without the need for licensing and bidding into the REIPPPP.

2.3.2 WIND GENERATION

Wind is expected to reach 26 347 MW by 2032. In 2022, 75 MW of wind capacity was added because of the RMIPPPP. Figure 2-11 shows that 22 799 MW of wind capacity will be added in the TDP period. This may be dwarfed by the self-generation that will be installed because of the zero cap announced by the President of South Africa in 2022, according to which customers can install any amount of generation without the need for licensing and bidding into the REIPPPP.

2.3.3 CSP GENERATION

Concentrated solar power (CSP) is expected to reach 600 MW by 2032. This is the same as the previous generation assumptions.

2.3.4 BATTERY CAPACITY

Battery capacity is expected to reach 6 550 MW by 2032. This has more than trebled from the 2 088 MW in the previous generation assumptions.

2.3.5 CAPACITY BUILD-UP

Figure 2-12 provides the generation build-up according to different categories. The total generation capacity in the final year of the TDP will be 110 GW. It is apparent from the graph that there is a huge increase in gas and renewables and an overall decline in coal. Values beyond the TDP period have been given to allow for strategic planning considerations beyond 2032

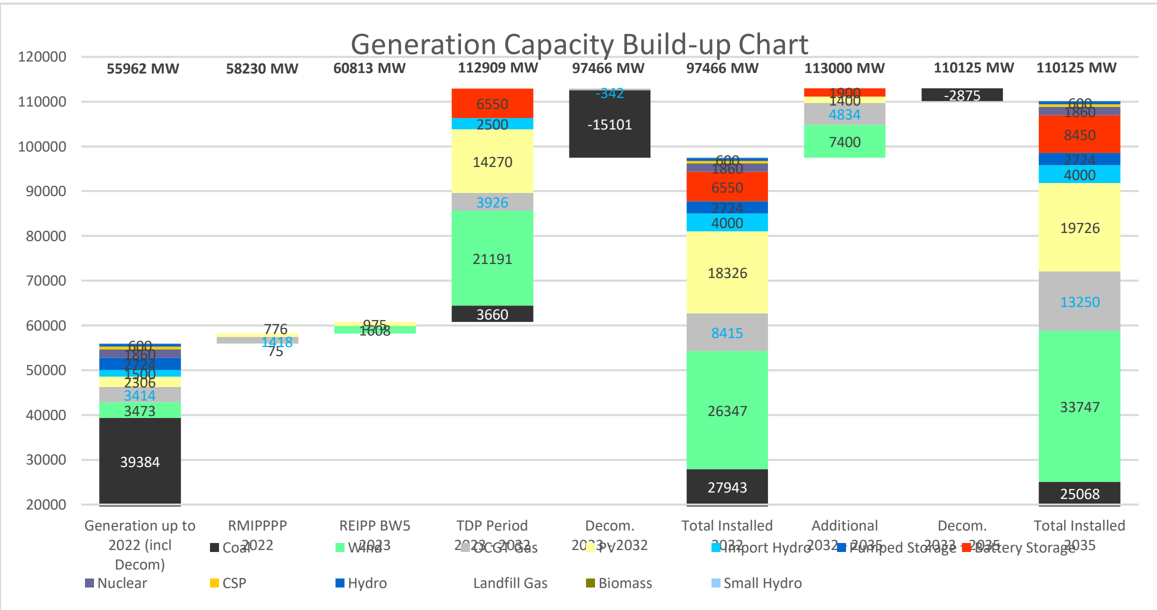


Figure 2-12: Generation build-up in different technology categories

2.4 DECOMMISSIONING OF POWER STATIONS

Figure 2-13 and Figure 2-14 show the decommissioning of plant up to 2035. The former shows the decommissioning from the beginning of the decommissioning period and the latter the decommissioning from 2023 for comparison in the TDP period. Compared to the amount of new coal that has been added in the new build era, it can be seen that the decommissioning of the coal-fired stations removes much more coal capacity than was added, leading to an overall decline in coal capacity at the end of the TDP period. Port Rex and Acacia gas generators will also be decommissioned during the TDP period; however, more gas stations will be added.

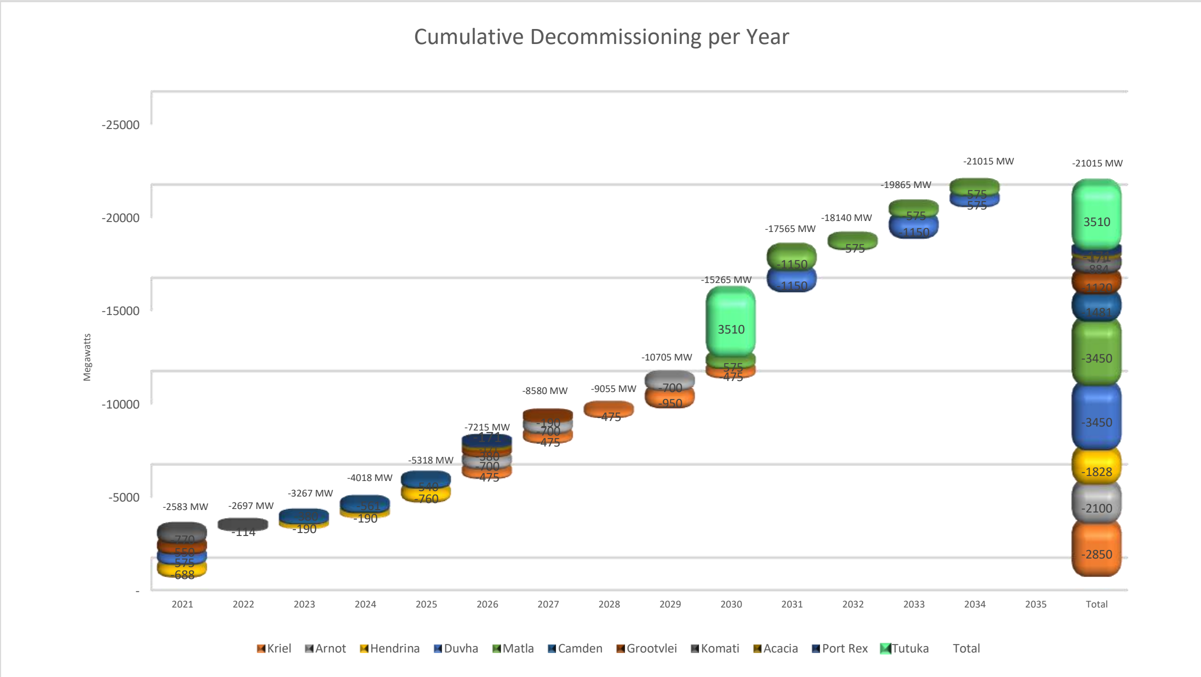


Figure 2-13: Decommissioning of generation (from decommissioning programme inception)

By the conclusion of this TDP period, approximately 18 GW of capacity will have been decommissioned, and 15,4 GW of that will have been in the TDP period. The main change from the previous assumptions is the decommissioning of Tutuka (3,5 GW) in 2030. This was previously not factored in, but has been included in the current assumptions.

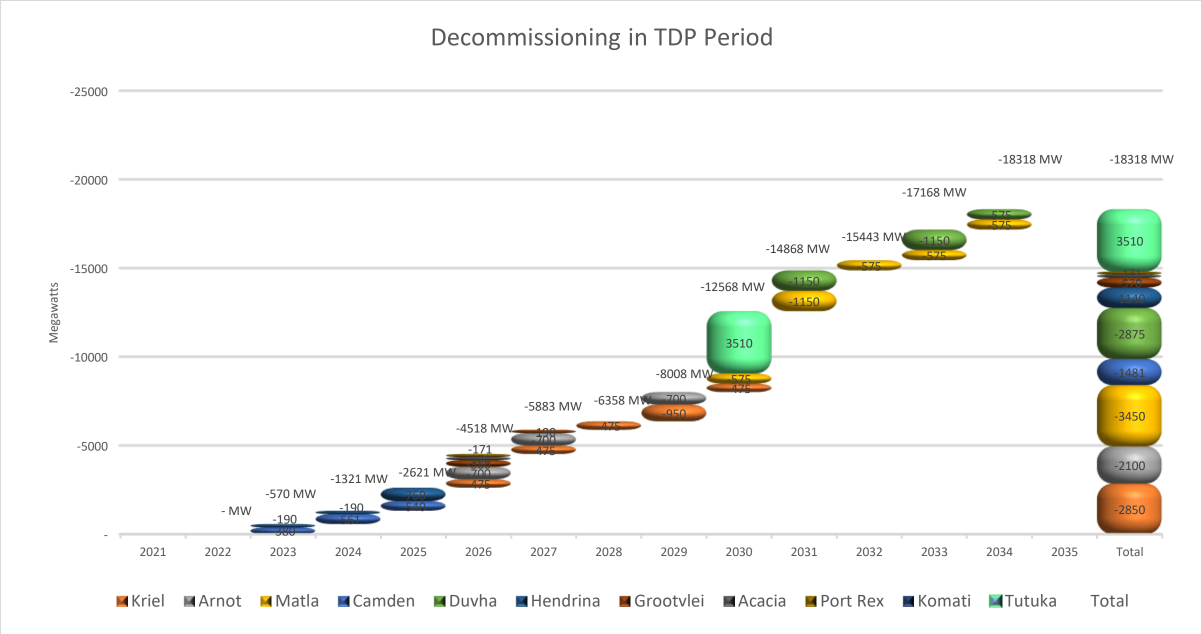


Figure 2-14: Decommissioning of generation (TDP period)

2.5 MAJOR DIFFERENCES FROM PREVIOUS ASSUMPTIONS

As mentioned in the introductory sections of this chapter, the assumptions for the TDP 2022 are a blend of the IRP and the JET strategy outcomes. The IRP was released in 2019 and the JET strategy in late 2021. This strategy considered the latest information concerning the performance of the generation fleet. As a result, it was clear that there was a need to add more renewable generation to cater for the declining performance. Figure 2-15 shows the differences that resulted in different technology categories. The delta bar in each graphic shows the differences.

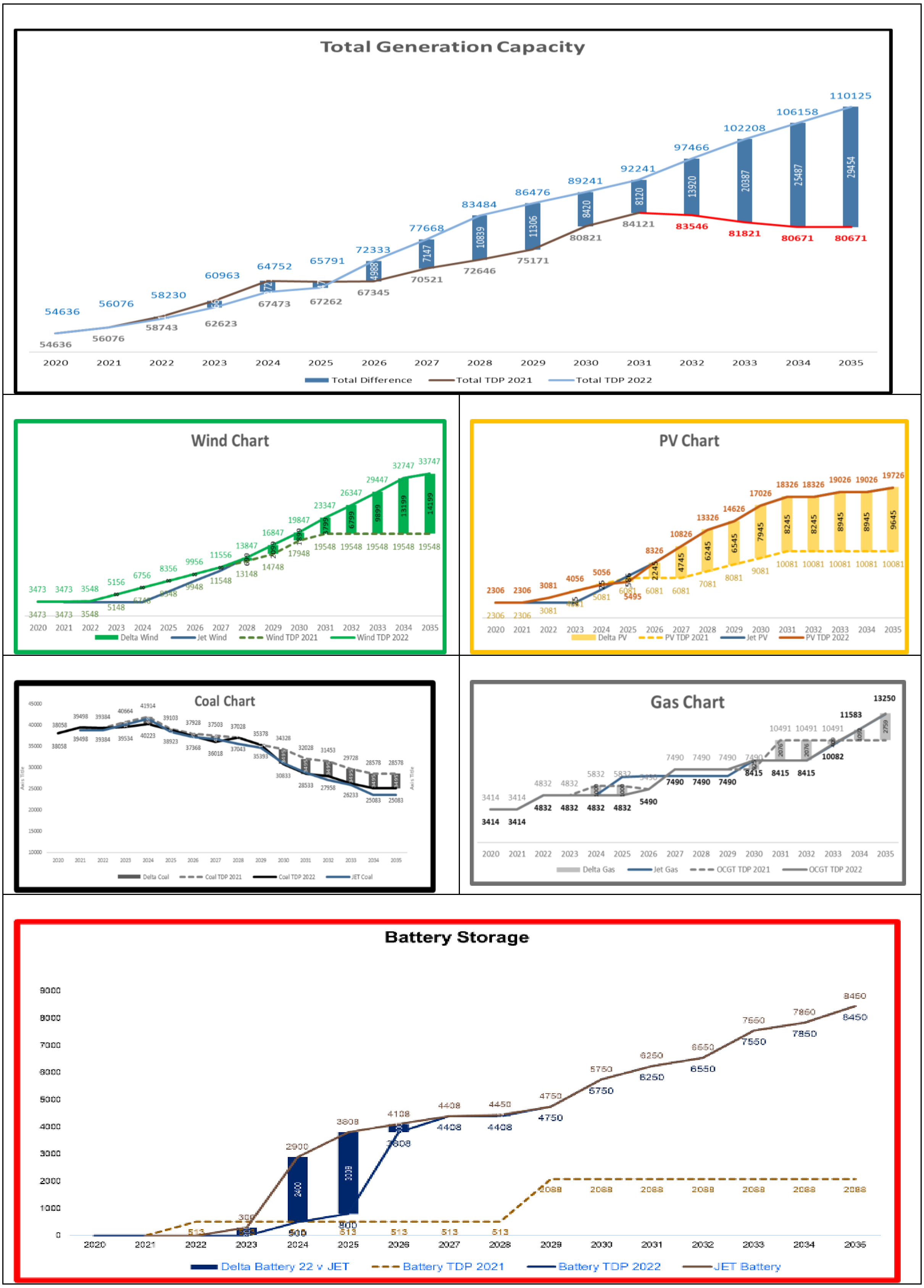


Figure 2-15: Differences in major technology categories

2.6 SPATIAL ALLOCATION

The spatial allocation of the generation capacity considers different attributes to ensure that the allocation is sound and can be reasonably implemented in the period under review. The factors that were considered are as follows:

a) Outcomes of the SEA regarding areas suitable for solar and wind after sensitive areas have been excluded (see Figure 2-16)

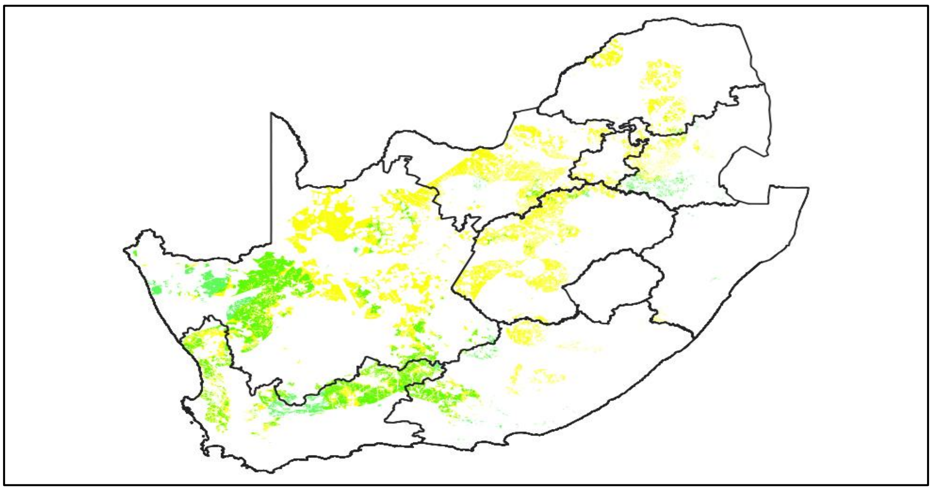


Figure 2-16: Areas suitable for PV (yellow) and wind (green)

b) Maximum PV that can be installed within a 60 km radius of a substation (see Figure 2-17)

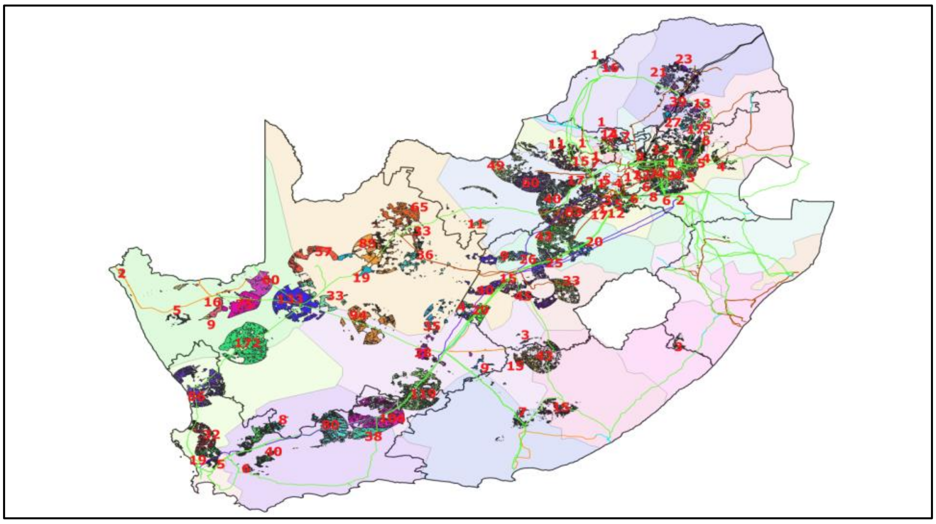


Figure 2-17: Maximum PV capacity (GW) that can be installed within a 60 km radius of a substation

c) EIA applications from IPPs in the past few years (see Figure 2-18)

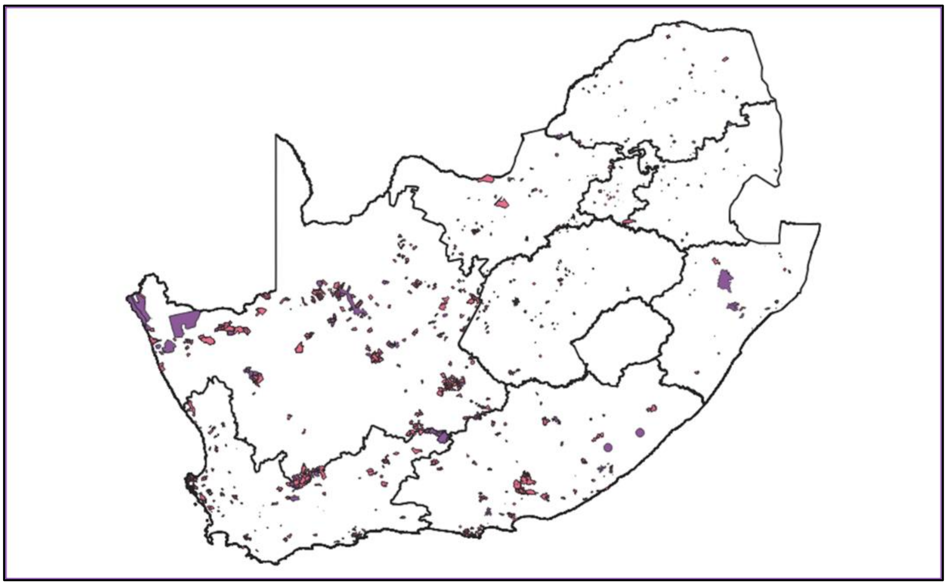


Figure 2-18: EIA applications from IPPs

d) Applications for grid connection by IPPs in the past few years (see Figure 2-19)

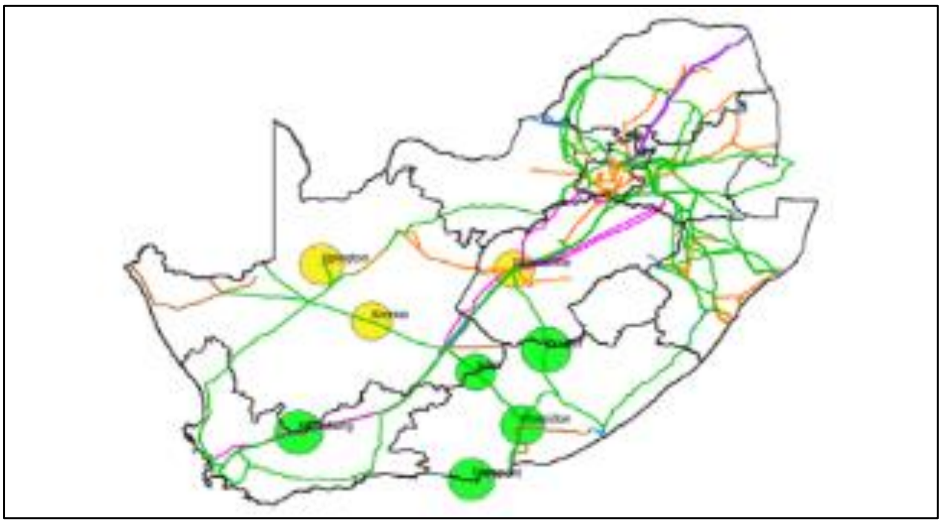


Figure 2-19: Substations with high concentrations of grid applications

e) CSIR survey (see Figure 2-20) of IPPs regarding which technologies may be installed at different locations in the next few years

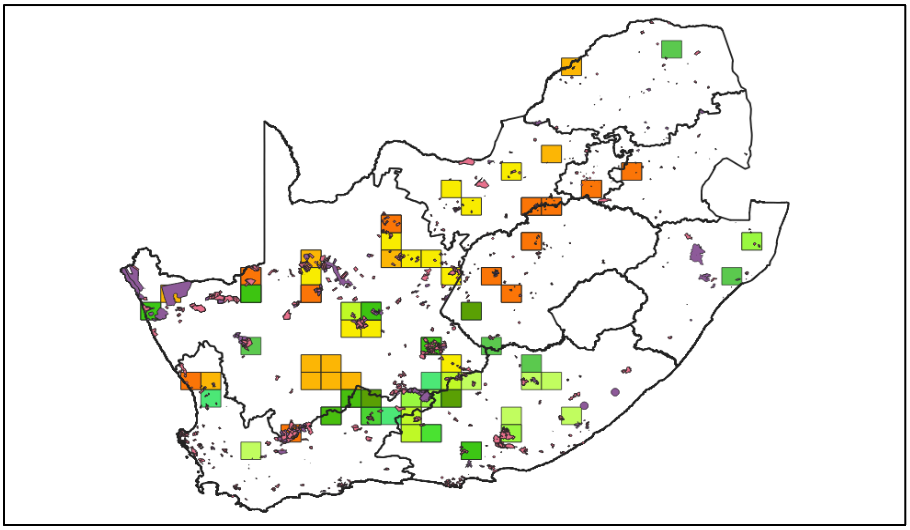


Figure 2-20: CSIR IPP survey of possible areas for PV and wind

f) GCCA 2023 results (see Figure 2-21) indicating where there is capacity on the grid

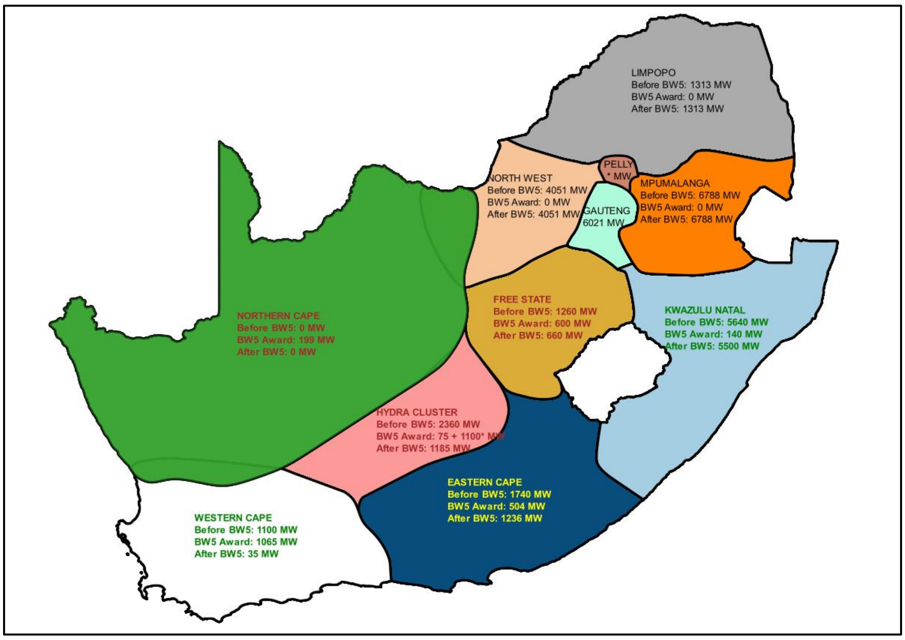


Figure 2-21: GCCA 2023 results per grid

g) Projected dates of major strengthening projects

After considering the combined effect of the above factors, the allocation results shown in Figure 2-22 were obtained. It can be observed that the traditional coal areas of Mpumalanga also contain wind and solar generation. This is in alignment with the JET strategy and the fact that capacity has been exhausted in the Greater Cape region in the short to medium term.

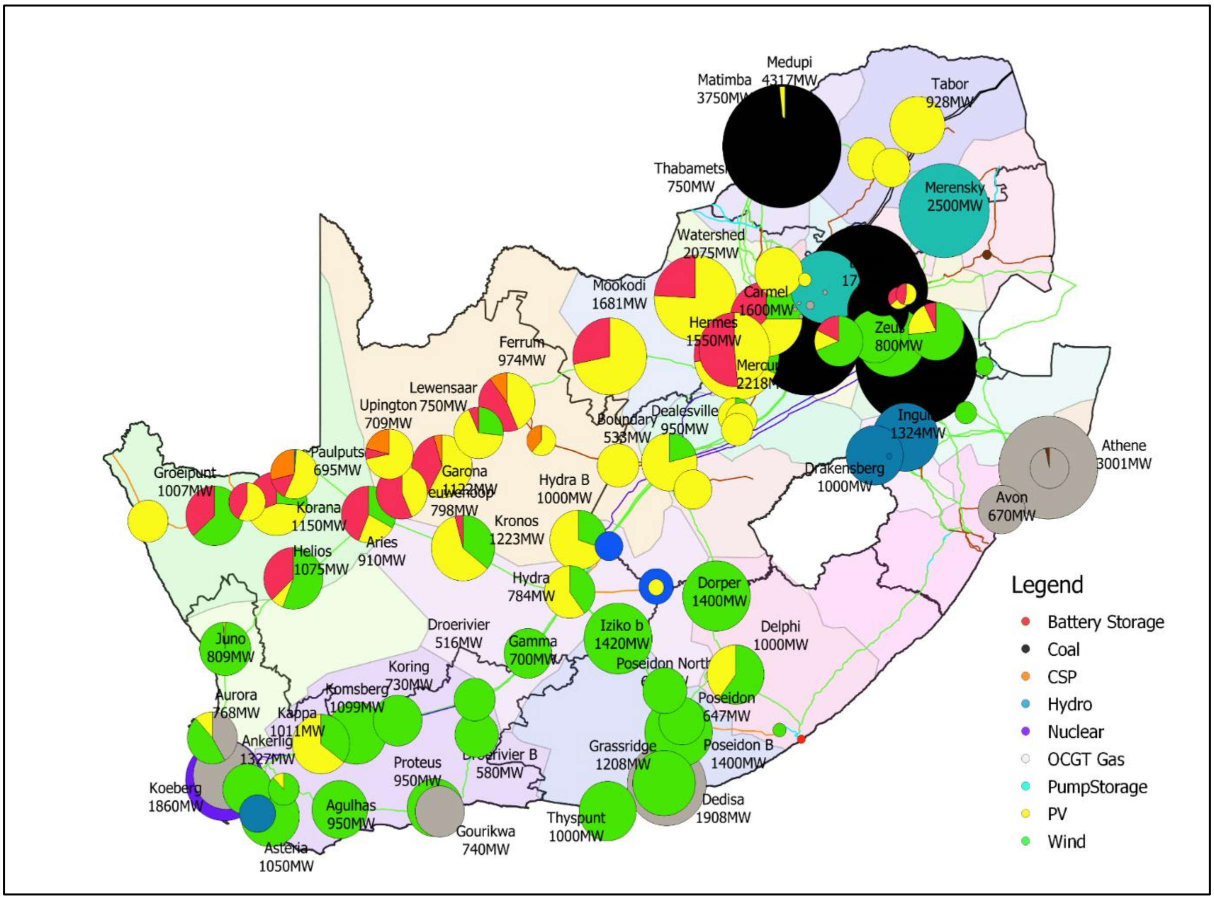


Figure 2-22: Spatial allocation of generation by technology

2.7 PROVINCIAL ALLOCATIONS PER TECHNOLOGY

The cumulative provincial allocation for the different technologies by 2032 is shown in Figure 2-23. Mpumalanga has the highest installed capacity, followed by the Northern Cape, and Gauteng has the least amount of capacity, comprising mainly import hydro at Apollo.

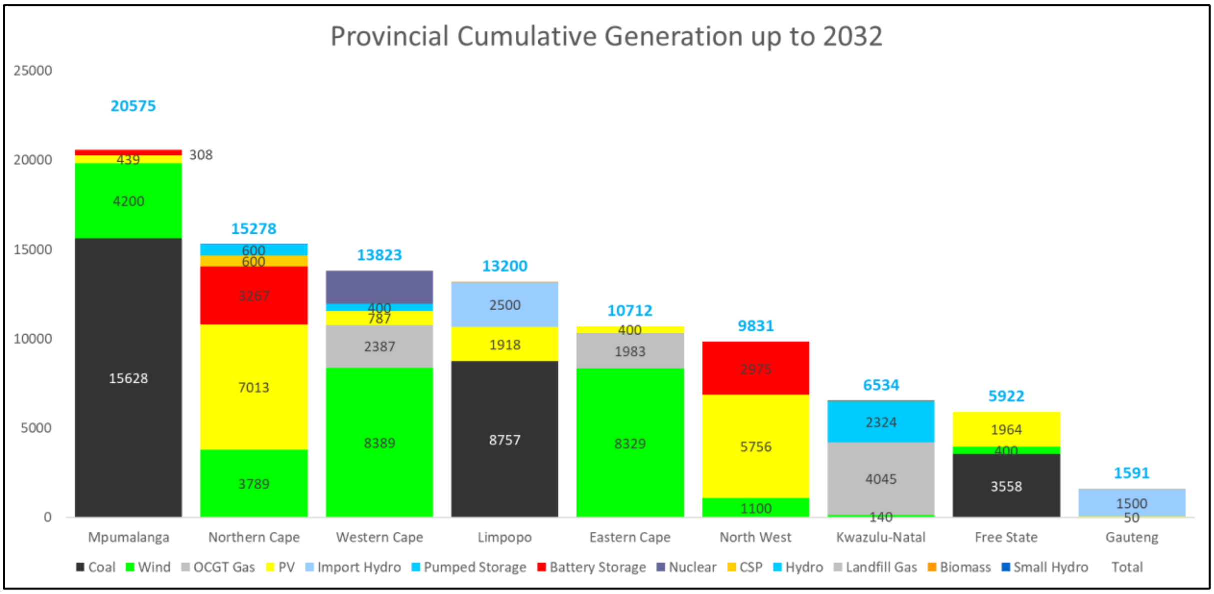


Figure 2-23: Allocation of generation by technology

3 DEMAND FORECAST

The global energy transition is imperative for human survival on our planet. Globally, all energy enablers are migrating towards a cleaner energy future. By enabling cleaner energy generation sources, the demand for electricity is increasing exponentially. Although energy efficiency is still a high priority, the vision of cleaner sources is increasing electricity demand continuously. Cleaner energy sources will have an impact on every industry on the planet. Therefore, all associated sector and technology changes are closely monitored to establish the electricity demand needed to sustain economic growth. Energy sector trends are monitored and tracked for continuous improvement and to gain in-depth insight into the changing paradigm that the electricity industry is currently experiencing. A continued decarbonisation focus on energy generation sources underlines the importance of renewable integration into the energy power system to support the demand for clean energy in the use and transportation of everyday electricity to meet the demand.

The transmission grid is one of the most profound human-made systems ever built and plays a significant role in the transportation of electricity throughout a country to serve each of the sectorial industries. Defining the electricity capacity demand for optimal transmission network design is of paramount importance. The purpose of the Transmission demand forecast is to provide an overview of the national grid electricity demand in South Africa that serves as input to the Eskom Transmission Development Plan.

The Transmission demand forecast period covered is from 2022 to 2050 to provide a relevant long-term strategic forecast. However, this report is focused on input to the Transmission Development Plan (TDP) for 2023 to 2032.

3.1 ELECTRICITY DEMAND OUTLOOK

In 2021, significant progress was made towards the COP26 commitments globally as was emphasised by the international meeting held in Glasgow. Commitments were strengthened, and this increased the already steady growth of renewable integration into the energy sector. Decarbonisation targets are hindering demand growth; however, a steady uptake of renewable generation sources will soon enable the supply to additional demand driven worldwide.

The year 2021 also showed good economic progress after the initial COVID-19 pandemic in 2020. Several market returns could be observed; however, near future growths are conservative. Electricity systems will have to radically evolve as the world transitions towards a low-carbon future as laid out in Net Zero by 2050: A Roadmap for the Global Energy Sector. New turmoil and uncertainty have emerged, as the Russian/Ukrainian war conditions have disrupted the worldwide economy and introduced a number of new supply challenges.

3.1.1 GLOBAL DEMAND DRIVERS

In 2020, the world economy was crippled by the COVID-19 pandemic. However, as documented by the World Energy Outlook 2021, renewable sources of energy are on a strong rise. Renewable sources such as wind and solar PV are continuing to grow rapidly, and electric vehicles are experiencing new sales records. At the moment, the speed of change in energy sources is countered by uneven economic recovery from a COVID-induced recession status worldwide. Following a strong rebound in 2021, the global economy is entering a pronounced slowdown amid fresh threats from COVID-19 as well as the continued pressure caused worldwide by supply chains driven by the ongoing Russian/Ukrainian war.

Global growth is expected to slow down to 3,2% in 2023 from 5,5% in 2021. This is due to ongoing difficulties in fiscal and monetary support around the world (World Bank, August 2022). Major strain can be perceived in parts of energy systems, leading to sharp rises in natural gas, coal, and electricity markets (World Energy Outlook, 2021).

The World Bank (2022) expects a growth rate of 4,4% globally and 4,8% in emerging markets (EMs) for the year 2022, from 5,9% and 6,5% in 2021, respectively. It, furthermore, drives increased clean energy investment in emerging markets, Africa specifically. It is expected that the share of total energy demand of electricity will grow, as sectors from transport to heating are electrified. As mentioned, growth in electric car sales has been particularly impressive in recent years, even as the global pandemic shrank the market for conventional cars and as manufacturers started grappling with supply chain bottlenecks. In 2019, electric cars represented 2,5% of global car sales. In 2020, the overall car market contracted, but electric car sales bucked the trend, rising to 4,1% of total car sales. In 2021, electric car sales more than doubled, representing close to 9% of the global car market.

According to the International Monetary Fund (IMF, 2022), the current global economy is extraordinarily uncertain. When the global economy is struggling to persevere, the effect on the local economy, especially in developing countries, is adverse.

Due to worldwide supply chain turmoil, commodity prices have seen a rather extensive boost for the export market. Shortages in some imported commodities also indicate a rise in demand for local production, which gives rise to local demand and commodity beneficiation. Electricity demand is set to rise due to changes in heating and fuel and transportation choices, rising urbanisation, and a sharp increase in technology and accessibility to it for all people. The rise in digitalisation leads to increased electricity usage, with additional data storage, air conditioning, and digital device maintenance. Worldwide drives to reduce carbon emissions have also provided an exponential rise in demand for cleaner electricity generation sources. Decarbonisation can provide a platform for reducing CO_2 emissions in some sectors by advancing electricity-based fuels such as hydrogen and synthetic liquid fuels. Incorporating renewable clean electricity sources in the future plays a significant role in balancing the demand and supply functions of the electricity supply chain (IEA, World Energy Outlook 2020).

Shortages in gas supply around the globe due to conflicts and war situations are creating electrification of more sectors than originally planned for, and where there was a notion to lean towards switching over to gas, due to the shortage, electricity (preferably clean) is starting to become a viable necessity again. Energy is at the forefront of the development of a country and is also the vital force that powers businesses, manufacturing, and the transportation of goods and services to a nation. Moreover, it is the sustained source of modern living, as it affects all population activities. Energy is, therefore, considered an essential enabler for economic growth and stability (World Bank, 2019). Leading sectors include the industrial, transport, agricultural, residential, commercial, and public services sectors (Energy Sector Report, Department of Energy (DoE), 2019).

3.1.2 LOCAL DEMAND DRIVERS

In South Africa, demand is highly focused on consumer behaviour in the residential sector and investment policies in the industrial sector. Additionally, electricity price structures play a fundamental role in consumer behaviour. Population statistics and economic behaviour are closely monitored to relate these to the qualitative and quantitative models of the forecast.

Figure 3-1 shows the different driving factors contributing to demand growth for the South African electricity grid. A growing population and urbanisation lead to a future need for digitalisation. Data centres in main city centres are a large demand driver, as a data centre needs to function on highly reliable and energy-intensive data. The sudden supply chain crisis worldwide, as well as the need to mine new metals for the manufacture of renewable technology, has boosted the possibilities of localised beneficiation of the ample mineral resources South Africa still has. This leads us to another main driver, which is the development of more decarbonised energy sources and fuel alternatives. These will improve the uptake and development of electric vehicles, hydrogen fuel manufacturing, and gas-to-fuel production. All are in dire need of electricity, whether from grey, brown, or green electricity sources.

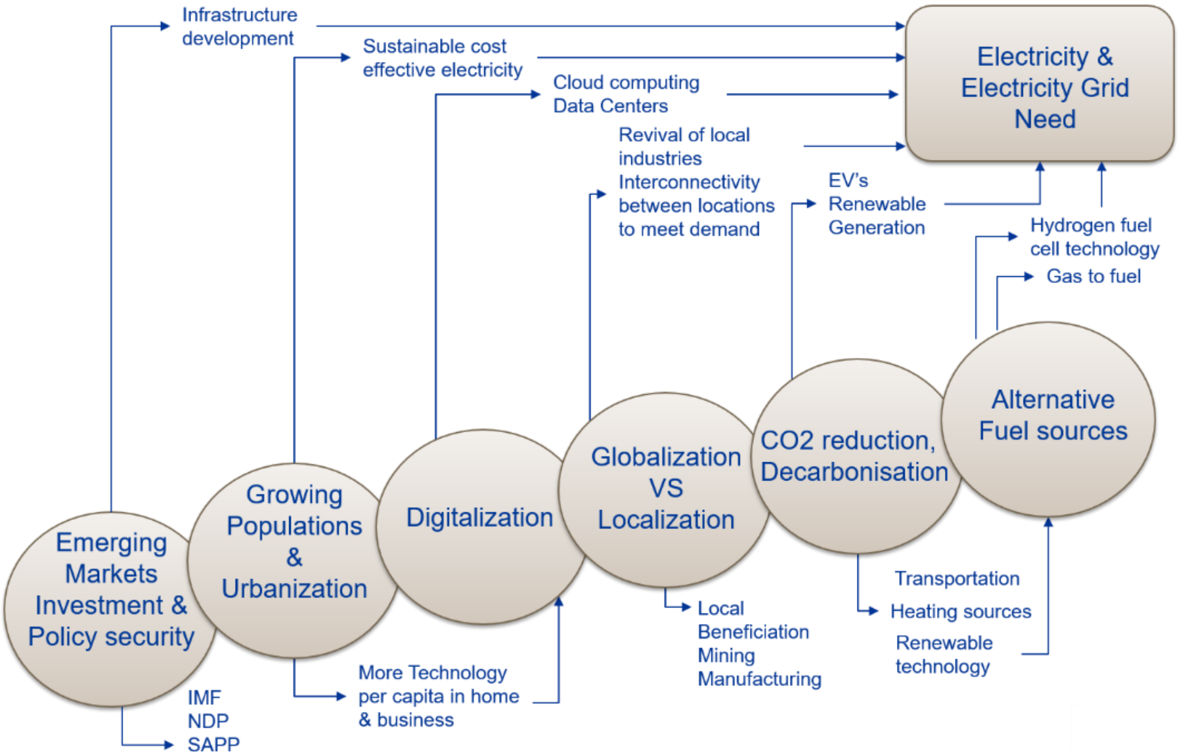
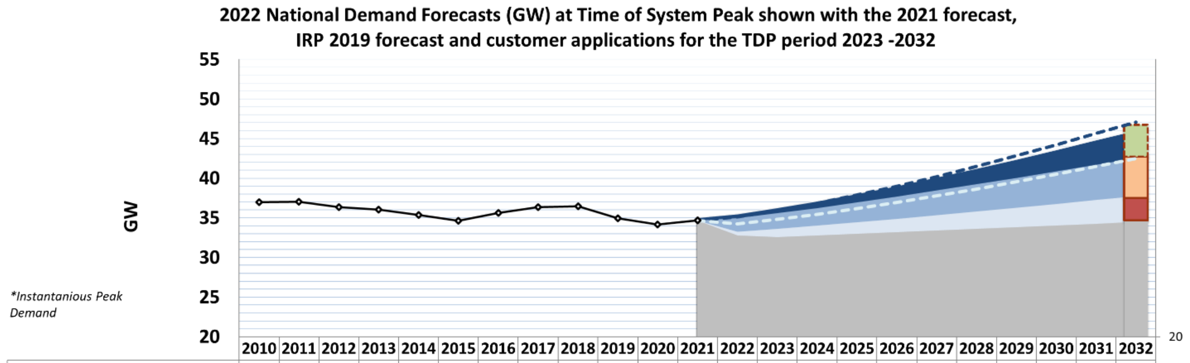


Figure 3-1: Primary driving factors for electricity demand in South Africa

Within the Eskom business, customer applications are an essential input to validate statistical growth patterns from the past and enhance growth possibilities qualitatively into the future. Short-term committing budget quotation (BQ) applications, indicative cost estimates (ICEs) and a rigorous process of market intelligence (MI) gathering are used to quantify future demand in the various regions of South Africa. Figure 3-2 shows the estimated cumulative customer applications per type overlaid on the TDP forecast from the base case of no additional natural growth. This is a steady indication of the applications knocking on Eskom's door, that demand growth is inevitable, and that electricity is a pivotal point in catalysing growth.



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
2022 Tx High												35	35	36	37	38	39	40	41	42	44	45	46
2022 Tx Moderate High												35	35	36	36	37	38	38	39	40	41	42	43
2022 Tx Medium EE / EI												35	33	34	34	34	35	35	36	36	37	37	38
2022 Tx Low												35	33	33	33	33	33	33	34	34	34	34	34
Market Intelligence																							4
Indicative Cost Estimates																							5
Budget Quotes																							3
Actual peak																							35
2021 Tx High												35	35	36	37	38	39	40	41	43	44	46	47
2021 Tx Moderate High												35	34	35	35	36	37	38	39	40	41	42	43
Actual Peak Demand (GW) *	37.0	37.1	36.3	36.0	35.3	34.6	35.6	36.4	36.4	35.0	34.2	34.7											

Figure 3-2: TDP national forecast indicating BQs, ICEs, and MI estimated for TDP period 2022 to 2032

Figure 3-3 shows a spatial representation of BQs, ICEs, and market intelligence on potential loads. It can be observed that most of the confirmed load development is in the northern parts of the country, mostly Limpopo and Gauteng, with the supplementary applications spread between the Northern Cape, the Western Cape, and KwaZulu-Natal (KZN). The total accumulated potential load is more than 12 GW of potential load waiting to be unlocked. The proposed transmission moderate-high Scenario 2 expects just more than 6 GW growth, which includes natural growth and is in line with the observations from the bottom-up accumulation of quotations.

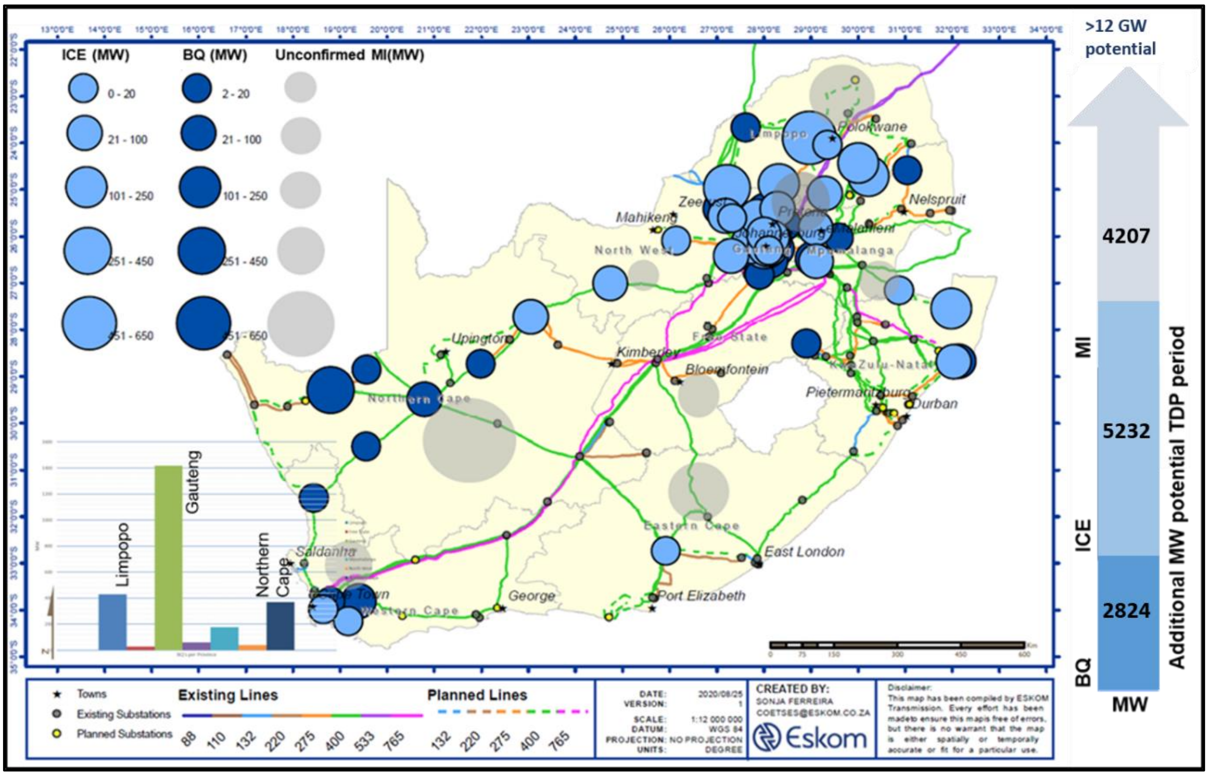


Figure 3-3: Spatial map of customer applications and demand interest location in South Africa

3.1.3 DEMAND IMPEDIMENT

Demand growth and the possibilities of a growing economy are evident in the number of natural resources available in South Africa and the Southern African Power Pool. However, the possibilities need to be unlocked with sufficient investment and the availability of critical resources.

Eskom's role is pivotal in the growth of a sustainable future economy. Regrettably, Eskom's fleet has not performed as planned, resulting in an energy capacity deficit. Eskom currently has insufficient reliable generation capacity to power a post-COVID-19 economic recovery in the short to medium term (2023 to 2025). The energy availability factor (EAF) has deteriorated from 78% to a year-to-date performance of 63,15% in the past five years (Eskom Corporate Plan, 2022). In the 2019 Integrated Resource Plan (IRP), a supply gap was identified over the next three years based on the generation EAF projections and the fact that capacity planning did not adequately address the risk of the ageing fleet in balance with the new generation planned to serve demand. The deteriorating demand profile is directly correlated with the lack of available energy supply to meet the required demand. In addition to the available supply, investment prospects are also heavily weighed against a stable political environment in South Africa. The electricity crisis is immensely damaging to demand enablement and detrimental to economic growth in South Africa, as most sectors are reliant on electricity.

The Independent Power Producers Office (IPPO) has initiated further procurement of renewable sources to supplement the deteriorating supply situation. However, in the short to medium term, the supply outlook is still uncertain, and a range of possible scenarios is available that shows a further capacity gap of between 4 000 MW and 6 000 MW by 2026.

The demand scenarios in this report are focused on the possible load growth as determined by demand outlooks and customer interest. Two additional scenarios have, however, been produced that are in line with the capacity constraint and lag in economic growth expected in the next three to five years. The two scenarios describing these outcomes are explained as the constrained forecast and allow for a lag in demand uptake, which will then have to increase steadily towards the original demand the country needs to enable economic growth and stability. Details can be found in the scenario sections.

Adequate investment in generation capabilities, as well as network strengthening, is key in enabling electricity demand in South Africa. Demand and prospects for growth and development in our country are evident and need to be satisfactorily enabled.

3.2 PRIMARY FORECAST ASSUMPTIONS

The following principle assumptions are made regarding demand growth in the country and the role of Transmission planning:

- Transmission responsibilities will remain similar to the current operations in the Eskom structure, regardless of the pending restructuring.
- Eskom remains a going concern as the primary utility for South Africa.
- Construction of additional generation capacity remains on target and is implemented on time.
- Maintenance and construction of sufficient transmission network equipment are available.
- Fair recovery on the energy availability factor (EAF) is assumed.
- Additional renewable sources included in the national generation supply will address the current capacity gap to enable real demand.
- The sociopolitical environment will stabilise or improve in the medium to long term.

- International and local governmental and private investment in the growth of the South African economy is a vital requirement for enablement of potential demand growth.

3.3 PRIMARY INPUT PARAMETERS AND INFORMATION FLOW

Figure 3-4 shows the interlinking of information sets used as inputs and the subsequent outputs that are key receivers of the forecast information sets. Each subset process block has its process and is followed through to ensure that well-researched, -aligned, and -tested information is used in the forecast. Detailed analysis of the factors from the framework is reworked into scenario assumptions. These are then quantified as far as possible to adjust S-curve parameters on the national scenarios. The S-curve formula is used for trending forecast scenarios, considering quantitative and qualitative factors for modelling. Input parameters are classified into quantitative and qualitative, and modelling needs to incorporate both of these parameters.

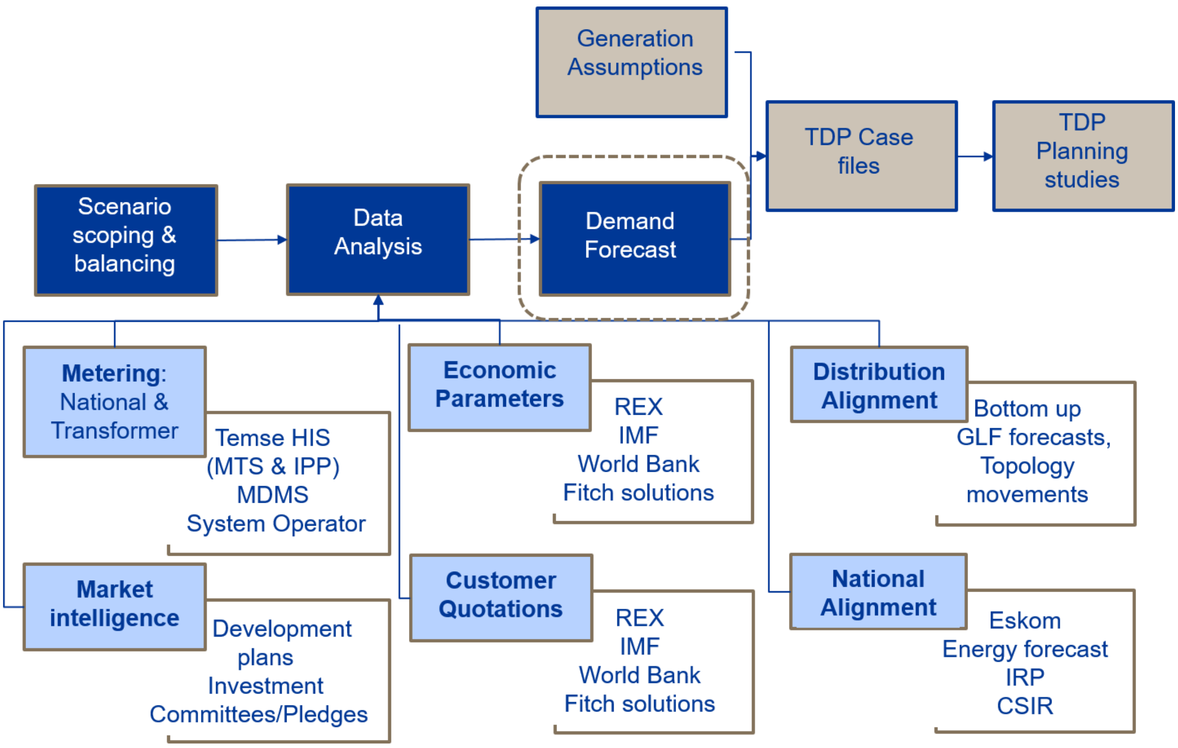


Figure 3-4: Information flow of forecast data

Key input parameters include global trends and effects on local trends and indices, local investment drives and development plans, economic parameters, and other forecasts such as Eskom energy, the IRP, and the CSIR as benchmarks. Distribution forecasts and master plan network topology updates are used in conjunction with actual metering. Customer behaviour and demand are monitored by tracking applications as well as market-related trends from market intelligence.

3.4 SYSTEM DEMAND PERFORMANCE 2021/22

The following observations have relevance to the forecast and the report that follows. A brief overview of demand from 2021 is summarised below and was used in the analysis of the 2022 forecast:

- COVID-19 resulted in downward economic activity worldwide. Economies contracted, with gross domestic product (GDP) growths ranging between -2% and -10% in 2020.
- South African growth contracted by 7% in 2020. In 2021, South Africa recovered to 5% growth.
- System peak was reached in July 2022 under Level 1, with a peak value of 34,6 GW, according to System Operator verification. The original system peak forecasted at 35 GW included 3 300 MW of load shedding; therefore, the true system peak was estimated on 27 July 2022.
- There was a significant difference in the 2020/21 energy (-10%) and the peak system capacity (+0,9%), largely driven by the decrease in energy consumption during lockdown and the increase in load shedding.
- Overall, a notified maximum demand (NMD) increase in both Distribution and Key Sales and Customer Service (KSACS) customers was observed for the 2022 forecast.
- There was an increase of > 1 300 MVA of load in indicative cost estimates (ICEs), as well as a > 500 MVA increase in budget quotation (BQ) customer applications, in the total submissions for 2021.
- Load shedding reached record high proportions in 2022, up to Stage 6, with an energy availability factor (EAF) of 62,8%.

An overview of the yearly profile for the past four years can be seen in Figure 3-5. The COVID-19 downturn is clearly visible in the light blue line. Demand for 2021 reached similar values to 2018/19 levels in the system peak week; however, lower demand can be seen in the later months of the year. This shows the need to strengthen the network to enable peak demand conditions that can increase should suitable capacity be available.

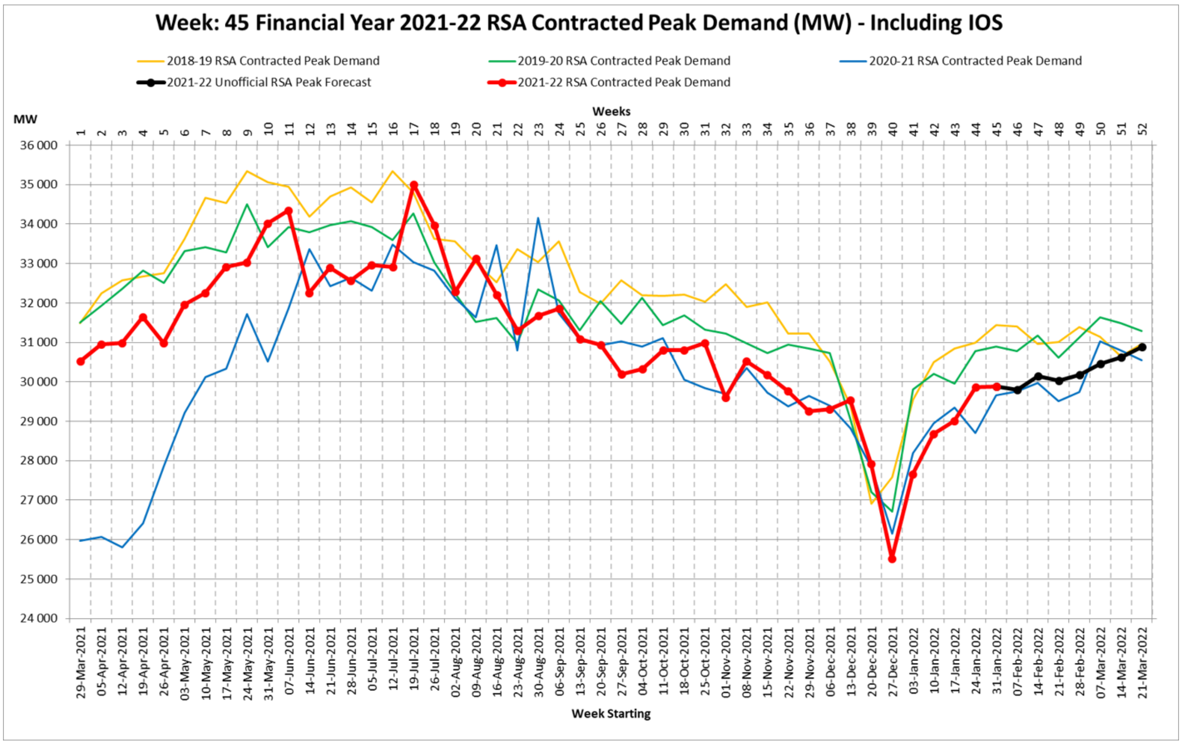


Figure 3-5: South Africa contracted peak 2018 to 2021 (Source: Eskom System Operator)

3.5 FORECAST METHODOLOGY

Policy guidelines are conformed to and in line with Grid Code requirements to deliver an annual transmission forecast. The forecast methodology is focused on scenario planning by looking at different perspectives of the future. A double S-curve methodology, combined with quantitative and qualitative techniques, produces the national forecast scenarios. The scenarios are tested against external forecasts such as the IRP and aligned with Eskom Distribution's bottom-up formulated forecasts.

The demand forecast is based on the collaborated modelling of both quantitative and qualitative techniques. Quantitative analysis is done on actual data received from in-house metering systems, customer quotations processes, and economic forecasts from service providers. Qualitative analysis is conducted using scenario exploration and external market information sourced from assigned platforms. Other forecasts are obtained from research to assist with assumptions on new technologies such as electric vehicles and the implementation of renewable generation sources throughout different countries. Continuous scanning and monitoring of market information are, furthermore, used to forecast likely future demand. Such projections are subject to market influences and contingent on matters outside the demand forecasters' control, and assumptions are valid until input variables cause them to change.

Historical demand growth patterns do not guarantee future performance, as future trends change concerning technological advancement and customer preference. The availability of generation supply is closely correlated with demand growth in the country and will have a significant influence on future demand realisation. The forecast is continuously monitored, and any financial decisions should be based on sensitivity analysis encompassing all relevant and the most recent information sets.

Six distinct steps are used in formulating and monitoring the forecast:

1. Strategic scenario scoping
2. Market intelligence and customer behaviour monitoring
3. Demand analysis
4. Modelling of demand forecast from national to substation nodal level
5. Alignment of forecast with other forecasts and forecast validation
6. Forecast integration and implementation

3.5.1 Forecast methodology framework – ISED forecast framework

Figure 3-6 contextualises the forecast scoping framework – the integrated strategic electricity demand (ISED) forecasting framework – used to strategise the initial national scenarios. This is the framework used to set the strategic direction to enable strategic scenario scoping and direction for information gathering. It explains how the demand drivers and disruptive factors are linked to governance aspects as well as mechanisms driving change in the energy environment. The energy environment is still subject to an internal process; however, care must be taken to consider both top-down and bottom-up perspectives when analysing the future needs of the grid and, in particular, the difference brought about by customer connection configuration (grid-dependent, grid-tied, or off-grid). This is then interlinked with the execution and business strategy followed by the utility and reflected in how the demand in the utility is driven.

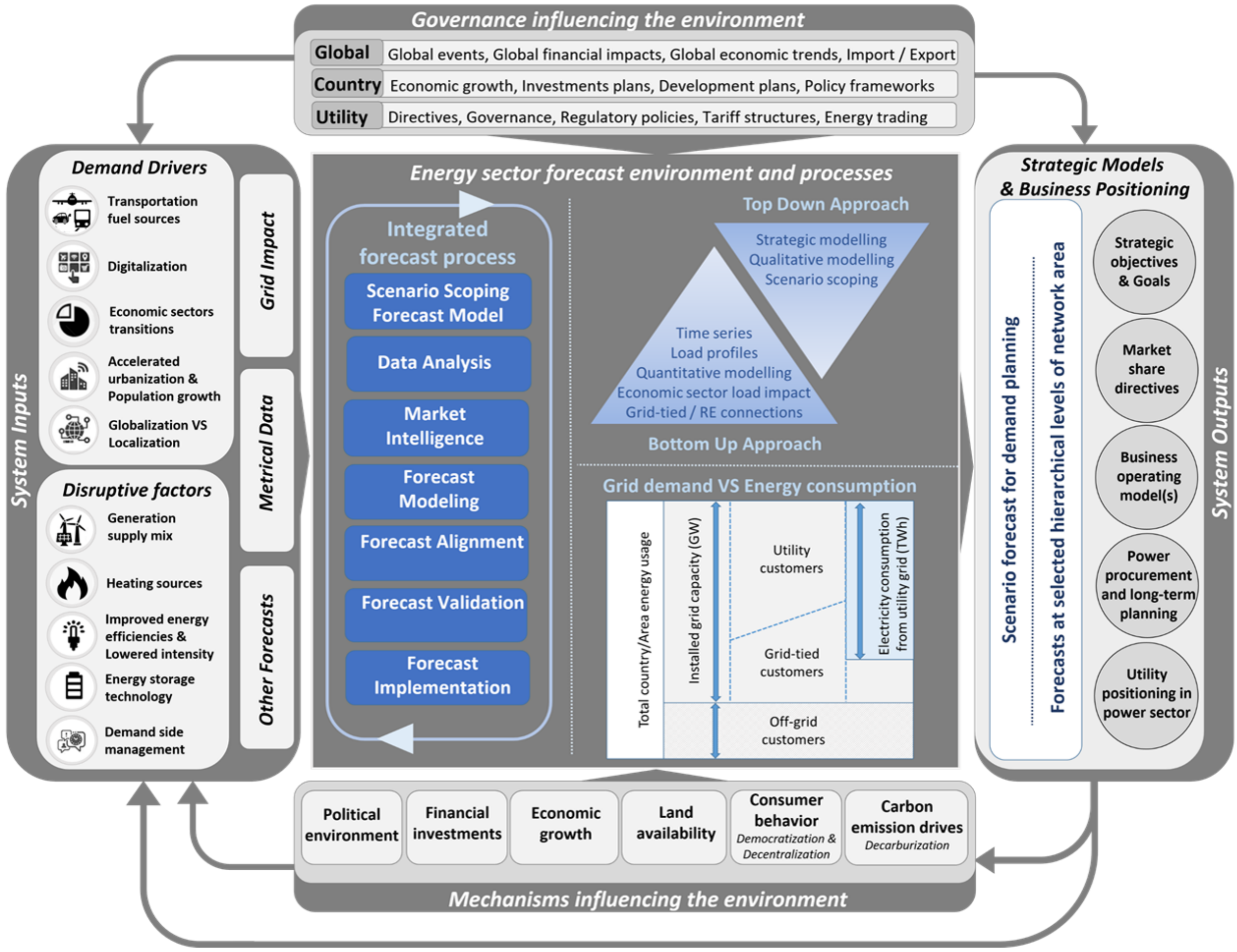


Figure 3-6: ISED forecast framework

3.5.2 Scenario scoping

The scenarios are sequentially built by assumption sets applied to the base metered data. Figure 3-7 shows the base data sets used to analyse the scenarios sequentially, from the driving factors to the disruptive factors in the changing electricity paradigm to the implications these can have for the grid requirements. Then a subset of four main scenarios is built, and these are correlated with the business model strategies to ensure that execution is possible. Assumptions on grid connectivity are made for each scenario. Grid connectivity relates to the customer base being grid-connected, being grid-tied (backup supply mixed with other generation sources), and off-grid solutions. The outcome of these scenarios will depend on the consumer's development and adoption rate for alternative electricity sources. Therefore, it will strongly depend on consumers' choices and the connectivity with the centralised utility grid.

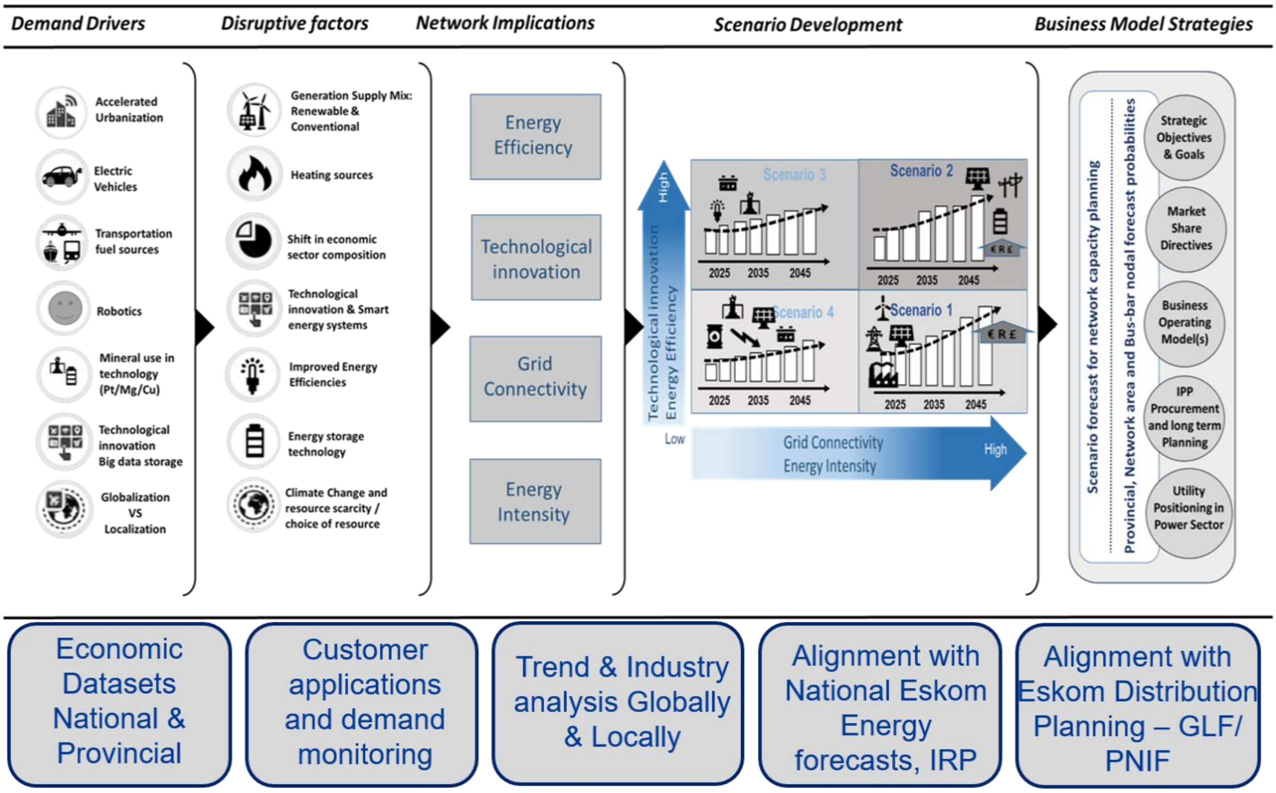
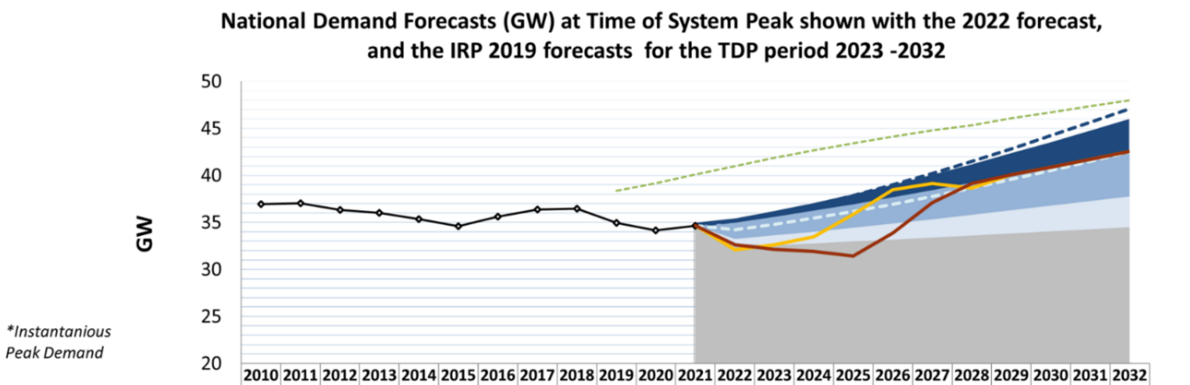


Figure 3-7: Scenario scoping framework

3.6 TRANSMISSION NATIONAL FORECAST SCENARIOS

Four distinct national scenarios were updated, each with its own set of assumptions. In addition to the four scenarios, two constrained scenarios have been retained and are focused on simulating the low demand uptake expectation for the next two to five years due to continued uncertainty in the security of generation supply. The lowered demand uptake is due to two distinct factors: the economic lag caused by the COVID-19 pandemic as well as the commodity turmoil caused by the Russian/Ukrainian unrest, and the continued generation constraints experienced by Eskom. Thus, six future scenarios, with accompanying assumption sets, were developed. The preferred scenario for the TDP 2023 to 2032 planning cycle is the moderate-high scenario, which was used as the primary input to model the provincial and substation forecasts. This is the same scenario as was proposed in 2021. The scenario was adjusted to suit the current baseload and has not significantly changed from the 2021 forecast. The remaining scenarios are recommended for sensitivity studies to consider future possibilities in a highly volatile forecast space with considerable uncertainty. Figure 3-8 shows the six scenarios and the actual system peak values.

The system peak recorded for 2021 was 34,66 GW, up 1,5% from 34,2 GW in 2020. This takes the system peak back to the levels experienced in 2015. A significant decrease in energy totals recorded for the year can be observed, although capacity liability is still in place, and peak capacity requirements from the network are still required.



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
2022 Tx High												35	35	36	37	38	39	40	41	42	44	45	46
2022 Tx Moderate High												35	35	36	36	37	38	38	39	40	41	42	43
2022 Tx Medium EE / EI												35	33	34	34	34	35	35	36	36	37	37	38
2022 Tx Low												35	33	33	33	33	33	33	34	34	34	34	34
2019 IRP HLI Demand (GW)										38	39	40	41	42	43	43	44	45	45	46	47	47	48
2021 Tx High												35	35	36	37	38	39	40	41	43	44	46	47
2021 Tx Moderate High												35	34	35	35	36	37	38	39	40	41	42	43
Actual Peak Demand (GW) *	37	37	36	36	35	35	36	36	36	35	34	35											
Constrained Scenario 1												35	32	33	33	36	38	39	39	40	41	42	43
Constrained Scenario 2												35	33	32	32	31	34	37	39	40	41	42	43

Figure 3-8: 2022 national demand forecast scenarios, with constrained forecast scenarios, actuals, the 2021 forecast, and the IRP 2019 demand forecast as reference

Figure 3-9 describes the four Transmission demand forecast scenarios, depicted in a four-quadrant matrix indicating the relation of each scenario to grid connectivity versus energy efficiency and technological innovation. In addition, the prescribed Scenario 2 is considered for TDP 2023 to 2032 input. All scenarios are summarised below, and detailed assumptions are given later in the document.

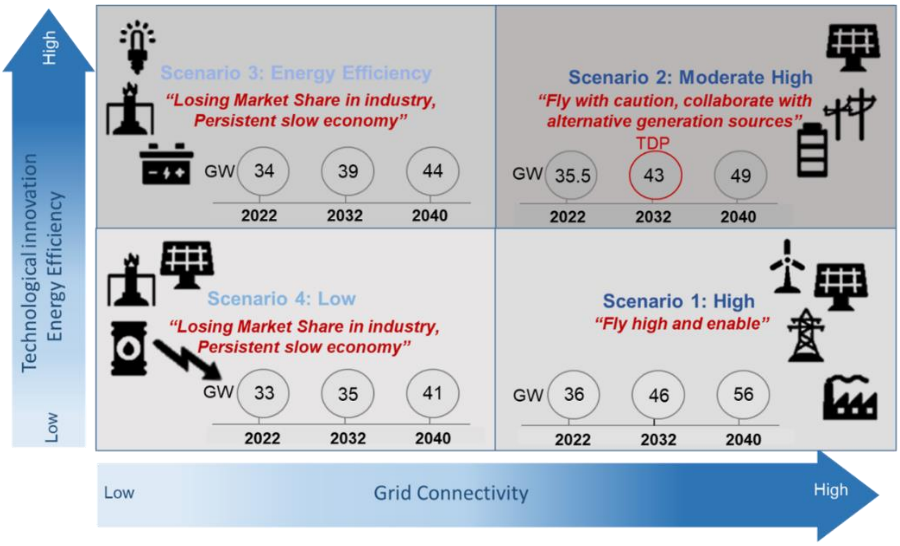


Figure 3-9: Summary of Transmission demand forecast scenarios

3.6.1 Scenario 1: High scenario: "Fly high, and enable"

The high scenario is based on assumptions that make South Africa a developed country as aimed for by the National Development Plan (NDP) derived by the government specialist task force in 2010 and indicates optimistic growth figures. The high scenario is in line with projected GDP growth of greater than 4% average year-on-year growth for the TDP period 2022 to 2032. This scenario is optimistic and assumes the return of current suppressed industries due to world economic conditions and trade contracts influencing imports, exports, and local production and, therefore, a move from globalisation to localisation. This scenario is driven by technological innovation and investment in electricity sources such as electric vehicles and an accelerated increase in electrification of all sectors.

This scenario is governed by national development targets as set out in the NDP. It assumes that the generation capacity gap is addressed by the Eskom turnaround plan and an aggressive and successful renewable integration. The scenario satisfies a high amount of grid connectivity caused by many renewable connections for energy trading and connecting supply to the central transmission grid. This scenario needs high capital investment for grid expansion and maintenance to ensure grid sustainability.

The average annual growth in demand over the TDP period is estimated at 3%, with a total increase of 10 GW required from the system. A margin of growth is recovery to original demand levels before 2010. From 2023 onwards, the generation of Ingula, Medupi, and Kusile Power Stations will be increasingly available to the system. It is assumed that the combination of direct and foreign investment, together with new potential generation sources, will become available to meet the future demand to enable economic growth for the country. This scenario leads to a nominal capacity forecast of 46 GW by the end of the TDP period and 65 GW in 2040.

3.6.2 Scenario 2: Moderate-high scenario: "Collaborate with off-grid solutions"

The moderate-high scenario is based on an explorative approach. The scenario assumes collaboration with renewable sources, with a high number of grid connections. Low to medium grid deflection is expected, with the transmission grid still utilised as both a backup supply source and main transmitter of electricity across the country. Therefore, this scenario remains highly dependent on grid stability. Growth trends experienced in the past are simulated in the future.

The scenario foresees the return of leading industries in South Africa at a slower, steady pace and the capacity gap being addressed, with a higher energy availability factor. A high uptake of electricity is expected in sectors such as information and communications technology (ICT) with data centres, transportation, and the migration towards electric vehicles connected to the grid for charging. It, furthermore, expects a rising number of customers connecting their sources of generation, but keeping their grid connection as a backup to supply, thus still needing the grid capacity to a large extent, even though electricity usage from the central utility might decrease.

The economic recovery plan presented by President Cyril Ramaphosa, combined with investment in public and private infrastructure developments, is assumed to enable demand uptake successfully. Average year-on-year demand growth of 1,7% to 2% is expected, and it is forecasted that the load will reach 43 GW by the end of the TDP period and 49 GW by 2040. The GDP growth coinciding with this forecast is 2% average annual growth for the 10-year TDP period. This scenario is deemed feasible for TDP implementation plans without constraints.

3.6.3 Scenario 3: Energy-efficient scenario: "Sharing the energy market"

The energy-efficient scenario assumes an increase in the uptake of alternative energy generation associated with increased energy efficiency. This scenario speaks to the phenomenon where technology advances in storage and alternative energy generation solutions become increasingly affordable and may surpass the rising cost of electricity provided by the country's power utility. Medium to high grid deflection, low grid-tied connections, and an increase in energy efficiency are envisaged in this scenario. Increased penetration of localised PV and small-scale electricity generation (SSEG) and so-called "behind-the-meter" generation, supplemented by battery storage, causes higher grid deflection scenarios. With the loss of customers through sustainable alternative electricity and heating solutions, fewer people will be dependent on the central transmission grid. This scenario leads to a nominal capacity forecast of 38 GW by the end of the TDP period, a network capacity average growth rate of 1,3%, and a final forecasted value of 47 GW in 2040, around 15 GW less than initially forecasted in the NDP. A GDP growth of 1,9% average annual growth for the TDP period is associated with this scenario. With a future banking on renewable generation and a decarbonised environment, the energy efficiency should decrease to bring down the baseload currently fuelled by fossil fuels.

3.6.4 Scenario 4: Low scenario: "Losing market share in the industry, lagging economy"

The low scenario is based on assumptions that there will be a continued suppressed development rate in the country and that most industries will not return to their original status. Degrading economic status and political distrust will cause development to decay, and very little to no growth is expected. This scenario is pessimistic, with a year-on-year growth rate of 0,6%, and relates to a low economic growth of below 1% in GDP. This forecast leads to 34 GW towards the end of the TDP period and 38 GW in 2040.

3.6.5 Constrained forecast scenarios

One of the hurdles to unlocking economic growth is the lack of generation supply to meet the demand. A shortage of generation capacity and a decrease in the EAF percentage ensure slow demand uptake. The constraints in generation, as well as the worldwide economic turmoil post-COVID-19, predict a slowdown in demand uptake. This is the actual utilised demand expected; however, the country shows an increased demand needed for growth as explained by the four main scenarios. Two constrained forecasts were required to simulate the delayed and constrained demand scenarios. The forecasts were modelled with global and local assumptions based on turnaround strategies and increased structural reforms and infrastructure investments. The business identified some critical aspects that lowered demand expectations. These included increased unplanned unavailability, increased planned maintenance, severe capital constraints, and governance and decarbonisation requirements. The two constrained forecasts were modelled on past cycles multiplied by the forecasted S-curve trends. Past cycles with increased investment and generation capacity showed significant growth in the forecast. These cycles from 1994 to 2001 were used, as this was a period in history where several successful investment drives were executed and allowed for good growth stimuli. Turnaround plans are planned to have an impact both globally and locally between three and five years.

Constrained Scenario 1

Constrained Scenario 1 expects a V-shaped recovery and predicts that the forecast will decline for the following two years and then start to regain momentum towards the original enabling environment of demand growth catalysed by sufficient investment in electricity generation and transmission.

Constrained Scenario 2

Constrained Scenario 2 assumes a slower U-shaped return of industry with a more severe knock to the economy in South Africa, which will see a downward trend in demand that only regains momentum around the year 2024/25. The suggestion is that the current TDP inputs remain as planned, with sensitivity analysis done in each area affected by the industry. Capital constraints due to harsh economic circumstances also have to be considered when making strategic investment decisions.

Scenario recommendation

It is recommended that the preferred moderate-high forecast scenario still be adopted with sensitivity analysis done using the constrained forecast, especially where the impact on the commercial, industrial, and mining sectors is significant. Due to the harsh economic circumstances, capital constraints also have to be considered when making strategic investment decisions. Therefore, the long-term effects are still under investigation and will have to be closely tracked and monitored to establish the exact impact on future forecasts.

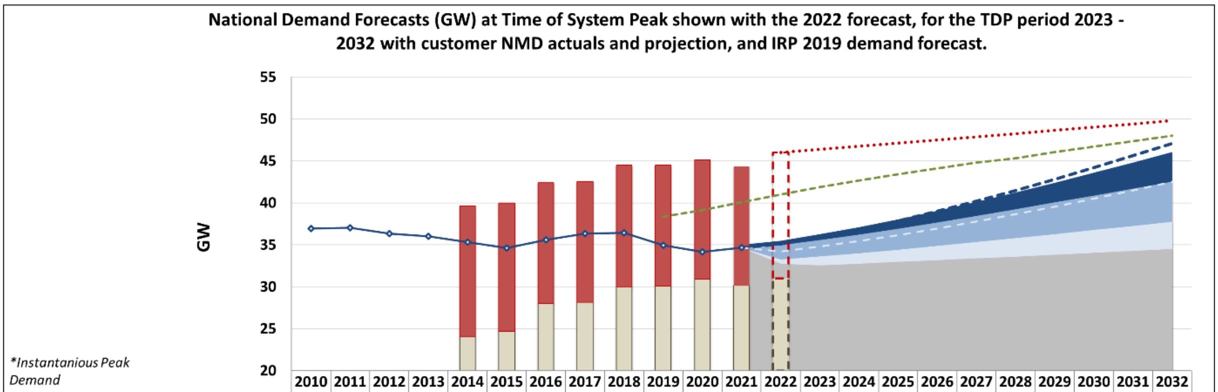
3.7 FORECAST VALIDATION

Two sets of validation processes are followed. The first alignment is done with forecasts external to, and independent from, Eskom; then internal divisional alignment is performed with other forecasts internal to Eskom.

In Figure 3-10, the notified maximum demand (NMD) bar graphs of the Transmission (red bar) and Distribution (aquamarine bar) customers show that steady growth is still anticipated. Customers are using less electricity due to financial, economic, and energy efficiency reasons for reduction. However, they continue to maintain the NMD levels for production planning.

Distribution customers in total have been growing at an average annual rate of 4% from 2014 to the present, with Transmission customers also showing a slight increase in NMDs with the addition of a new load from 2021 to 2022, resulting in overall growth of 2% in NMDs. The red dotted line shows a conservative prediction of customer NMDs at a lowered 0,5% average annual growth rate projected from the actual NMD values. The graph shows the NMD of current customers still committed to Eskom supply and future applications (BQs and ICEs) and potential applications (MI). No lowered NMDs were reported.

The green dotted line represents the IRP 2019 forecast released in 2012 as an updated version and is clearly outdated compared to current baseload values. However, the final forecasted demand at the end of the TDP period correlates with the forecasted load scenarios by the end of the TDP period. Should the lag in load uptake be considered, the final forecasted load levels should correlate well with the Transmission moderate-high scenario. There is, therefore, good alignment throughout internal and external sources.



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
2022 Tx High												35	35	36	37	38	39	40	41	42	44	45	46
2022 Tx Moderate High												35	35	36	36	37	38	38	39	40	41	42	43
2022 Tx Medium EE / EI												35	33	34	34	34	35	35	36	36	37	37	38
2022 Tx Low												35	33	33	33	33	33	33	34	34	34	34	34
KSACS Customer NMD (GW)					16	15	14	14	14	14	14	14	15										
Distribution Customer NMD (GW)					24	25	28	28	30	30	31	30	31										
2021 Tx High												35	35	36	37	38	39	40	41	43	44	46	47
2021 Tx Moderate High												35	34	35	35	36	37	38	39	40	41	42	43
Actual Peak Demand (GW) *	37.0	37.1	36.3	36.0	35.3	34.6	35.6	36.4	36.4	35.0	34.2	34.7											
Customer Growth Projection at 0,8%													46	46	47	47	47	48	48	49	49	49	50
2019 IRP HLI Demand (GW)										38	39	40	41	42	43	43	44	45	45	46	47	47	48

Figure 3-10: Forecast validation for TDP period 2023 to 2032 with IRP and Customer Services

3.8 PROVINCIAL FORECAST

The Transmission national forecast is disaggregated into the demand forecast per province, per customer load network (CLN), and transmission substation. In Figure 3-11, the provincial spatial boundaries and the load growth expected per province are shown. The growth percentages show the total load growth planned for each moderate-high scenario and the estimated percentage growth in demand and GDP per province for 2021 to 2032. Details of the local forecasts can be found in Chapter 7 where each province is addressed.

Gauteng continues to be the economic hub of South Africa and demands around 33% of the total country load. Energy-intensive developments of data centres to carry the exponential technology demands is driving demand in Gauteng. Additional to the data centres is high-end residential, electrification, and transportation sector development, which further drives demand in this province.

KwaZulu-Natal and the Western Cape are the other two load centres of the country and also have data centre demand, residential development, and light industrial developments driving major load in these provinces.

Moderate-high annual load growths are observed in both the Northern Cape and Limpopo, confirming growth expectations for mining. The increase in Limpopo is mainly due to the mining of coal resources, population growth, and the spin-off on development that these economic activities will have in the area. Limpopo also offers the greatest corridor possibilities for international trade. This indicates that these provinces will require significant transmission infrastructure reinforcement in the future.

The Free State (FS) had a turnaround with greater than expected economic growth as the recent drought ended. Agriculture delivered well in 2020, as agriculture was also the best-performing sector during COVID-19. In addition, improved mining technologies promise some improvement possibilities in the gold mining industry to add to mining growth, which is still in decline. However, the current growth is affected by the load shift from KZN to the FS, with the introduction of Sorata MTS in the FS, supplying load in parts of KZN. The province also has a vision and possible development plans to become South Africa’s industrial hub as a central point for logistical industries between South Africa’s two significant capitals and the coast.

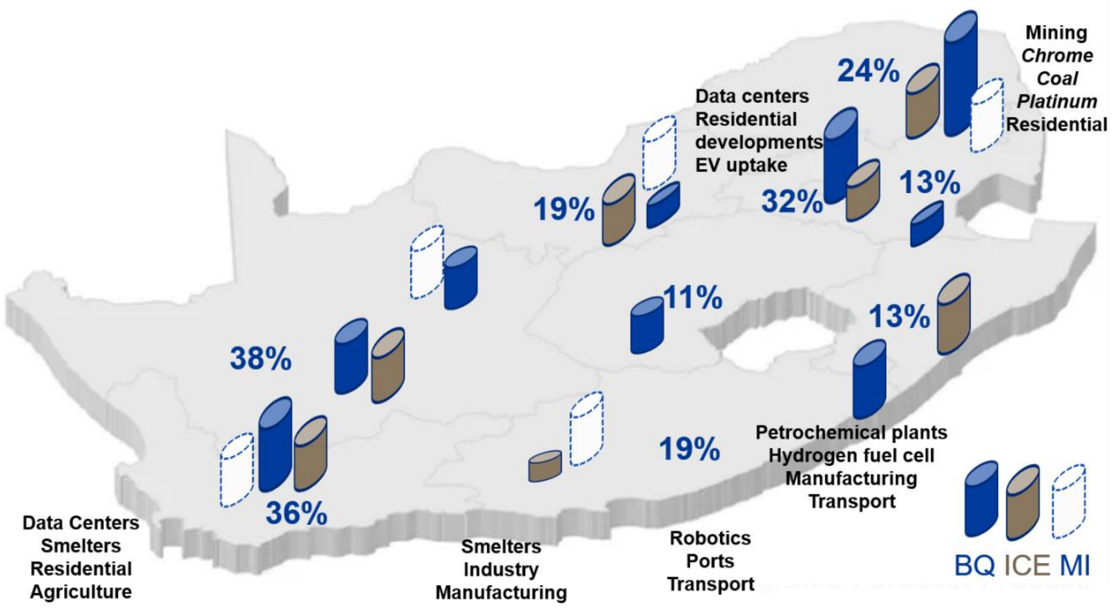


Figure 3-11: Scenario 2: transmission of moderate-high provincial growths for TDP period 2023 to 2032

Mpumalanga and North West both slowed down slightly from the previous forecast, with annual load growths of just below 2% average year on year.

As part of demand analysis, customer applications are assessed and gathered per location in budget quotations provided for additional demand and feasibility studies from customers with indicative cost estimates for the new load. Furthermore, market intelligence is gathered from the marketspace in studies, governmental investment plans, private investor information, and a range of market analyst information. The market information is closely scanned, monitored, and tracked for actual applications from Eskom. Figure 3-12 shows the applications and load interest per province.

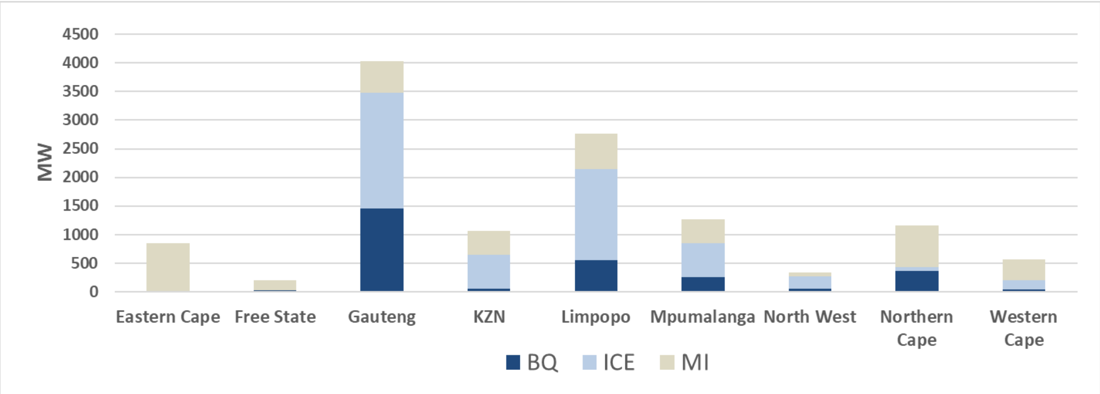


Figure 3-12: Cumulative load interest per province in MW for the TDP period 2022 to 2032

These loads will be monitored and tracked to ensure that the load is captured sufficiently in each of the provincial load forecasts. Approximately 2 800 MVA of additional load is confirmed through budget quotations issued to applying customers for the TDP period. An additional 5 300 MVA is approximated from possible and unconfirmed loads for the TDP period. Therefore, an additional growth of 8 100 MVA is anticipated from customer applications for additional loads apart from normal growth and the existing customer base. This is in line with the expected national growth figures, estimating an additional 6 000 MW of load in the next decade, when considering that not all load applications will realise, however, showing the potential load to be unlocked. Detailed load growth per province will be provided in each provincial section of this document.

4 COMPLETED PROJECTS

A summary of transmission expansion projects completed since the publication of the previous TDP in 2021 is given in Table 4-1. The project list excludes all the dedicated components of the projects resulting from the customer connection applications received.

Table 4-1: List of completed transmission expansion projects since October 2021

Province	Project name
Free State	Bloemfontein strengthening
	Harrismith strengthening

5 CUSTOMER APPLICATIONS

Table 5-1 outlines the number of indicative cost estimates (ICEs) and budget quotations processed by Transmission during the 2021/22 financial year (April 2021 to March 2022). These were as a result of applications for grid connections to the transmission network. The identities of individual applicants are not reported on in order to protect the confidentiality of the parties involved.

Table 5-1: Connection applications received and accepted in FY2021/22

Type of quotation	Budget		ICEs		Total	
Service required	**Quote**	**Accepted**	**Quote**	**Accepted**	**Quote**	**Accepted**
Generation	27	1	196	9	**223**	**10**
Load	3	1	23	5	**26**	**6**
Network service			2		**2**	
Total	**30**	**2**	**221**	**14**	**251**	**16**

6 NATIONAL OVERVIEW

The establishment of large-scale RE generation is becoming the primary driver of network development in the country, especially in the three Cape provinces, apart from the Cape corridor projects. These power corridors will connect generation pools to one another and to the country's major load centres.

The development of the transmission backbone and the associated regional power corridors was reviewed as part of the Strategic Grid Study, which considered the potential development scenarios beyond the 10-year horizon of the TDP. The objective of this strategic study was to align the transmission network with the requirements of the future generation options and those of the growing and future load centres.

The additional transformer capacity added to the TS indicates the increase in load and generation demand and in the firm capacity requirements of the customers, as well as what is required to achieve compliance with the minimum N-1 redundancy requirements in the Grid Code.

Shunt capacitors are required to support the network under contingency conditions to ensure that the required voltage levels are maintained and defer more expensive network strengthening, such as additional transmission lines. Maintaining voltages at desired levels also improves system efficiency by reducing network losses. Additional shunt reactors and line reactors are required due to the length of the 765 kV and the 400 kV transmission lines that will be constructed over this period. They are needed to enable the safe and secure operation of the system and to prevent overvoltage during light loading conditions and line switching operations.

Some projects have associated distribution projects to enable customers to benefit from them. For example, a new substation may require distribution infrastructure to connect it to the existing distribution network or connect new bulk loads. Distribution infrastructure and individual feeder bays to connect distribution infrastructure or bulk loads are not included in this report individually.

The map in Figure 6-1 shows a high-level view of the major TDP scheme projects. The relative location of the new transmission lines and associated transmission substations is indicated schematically in the figure.

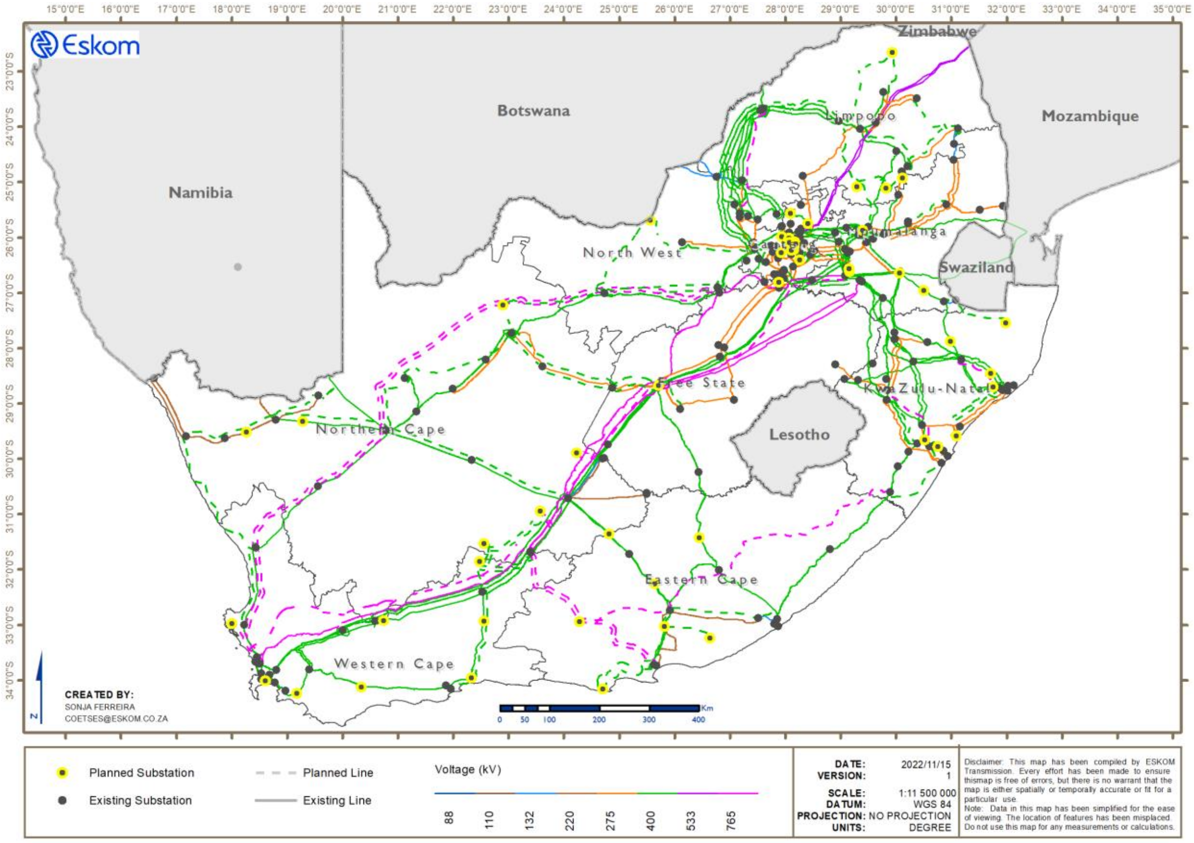


Figure 6-1: High-level overview of the major TDP scheme projects

The major new assets that have either been approved or are planned to be added to the TS over the next 10 years are summarised in Table 6-1 to Table 6-4. Note that these tables show the requirements of the transmission network to meet the generation and demand growth of the country.

Table 6-1: Planned transformers for TDP period

2023 to 2027		2028 to 2032	
Quantity	Total capacity (MVA)	Quantity	Total capacity (MVA)
60	26 970	110	78 895

Table 6-2: Planned overhead lines for TDP period

Line voltage	2023 to 2027	2028 to 2032
	Total length (km)	Total length (km)
275 kV	14	178
400 kV	2 679	5 019
765 kV	200	6 128
Grand total	**2 893**	**11 325**

Table 6-3: Planned capacitor banks for TDP period

Capacitor type	2023 to 2027		2028 to 2032	
	Quantity	Total capacity (Mvar)	Quantity	Total capacity (Mvar)
48 Mvar 88 kV	3	144	10	480
40 Mvar 132 kV	5	200	1	40
72 Mvar 132 kV	3	216	10	720
150 Mvar 275 kV	-	-	2	300
100 Mvar 400 kV	-	-	6	600
Grand total	**11**	**560**	**29**	**2 140**

Table 6-4: Planned reactors for TDP period

Reactor type	2023 to 2027		2028 to 2032	
	Quantity	Total capacity (Mvar)	Quantity	Total capacity (Mvar)
40 Mvar 220 kV	-	-	2	80
100 Mvar 400 kV	6	600	5	500
133 Mvar 765 kV	-	-	1	133
200 Mvar 765 kV	-	-	9	1 800
400 Mvar 765 kV	-	-	29	11 600
Grand total	**6**	**600**	**46**	**14 113**

7 PROVINCIAL DEVELOPMENT PLANS

7.1 EASTERN CAPE

The Eastern Cape is South Africa's second-largest province by landmass and is located on the country's south-eastern coast. The capital city of the Eastern Cape is Bhisho, and the two largest cities in the province are Port Elizabeth (PE) and East London (EL). The provincial economy is mainly driven by the automotive sector, which is the biggest manufacturing sector in the urban areas of the Eastern Cape. Nelson Mandela Bay Metropolitan Municipality (Metro) in Port Elizabeth and Buffalo City Metro in East London are the two major motor manufacturing hubs in the province.

Due to its excellent and desirable wind energy sources, the Eastern Cape has attracted a significant share of the RE projects procured to date. It is also expected that the majority of future generation from wind energy will be located in this province.

The Port Elizabeth area is supplied by means of three 400 kV transmission lines and a single 220 kV line, which also supports the manganese traction line. The infeeds into East London consist of three 400 kV lines and a single 220 kV line into the capital city, Bhisho. The current transmission network is shown in Figure 7-1.

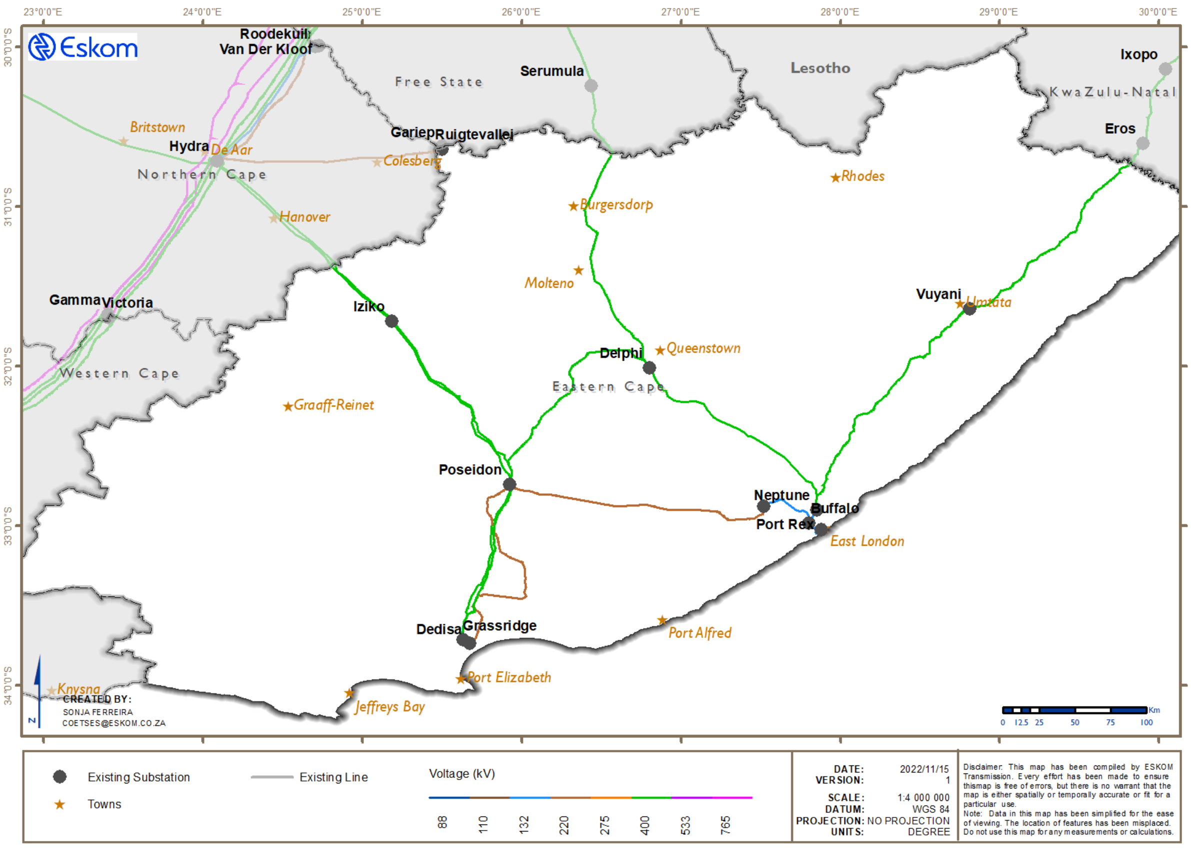


Figure 7-1: Current Eastern Cape transmission network

7.1.1 GENERATION

Historically, the Eastern Cape did not have a prodigious amount of local generation. The only sizeable generation in the province was Port Rex, with a capacity of 3 x 57 MW, operating as a peaking plant. Gariep Hydro Power Station, which is located on the provincial border of the Northern Cape and the Eastern Cape, has a generating capacity of 360 MW, with four units rated at 90 MW each. It evacuates power directly onto the Hydra 220 kV busbar via 220 kV and 132 kV lines. In recent times, the national power deficit has resulted in these peaking plant power stations generating outside the typical peak periods.

The total approved capacity in the Eastern Cape since the introduction of renewable energy independent power producers (RE IPPs) in the province amounts to 1 526 MW. The composition is shown in Table 7-1 below.

Table 7-1: Approved projects in the Eastern Cape under the REIPPPP

Programme and bid window	Wind (MW)	PV (MW)	Grand total (MW)
IPP RE 1	458	0	458
IPP RE 2	315,4	75	390,4
IPP RE 3	196,6	0	196,6
IPP RE 4	396,62	0	396,62
IPP RE 4B	32,7	0	32,7
Grand total	**1 399,32**	**75**	**1 474,32**

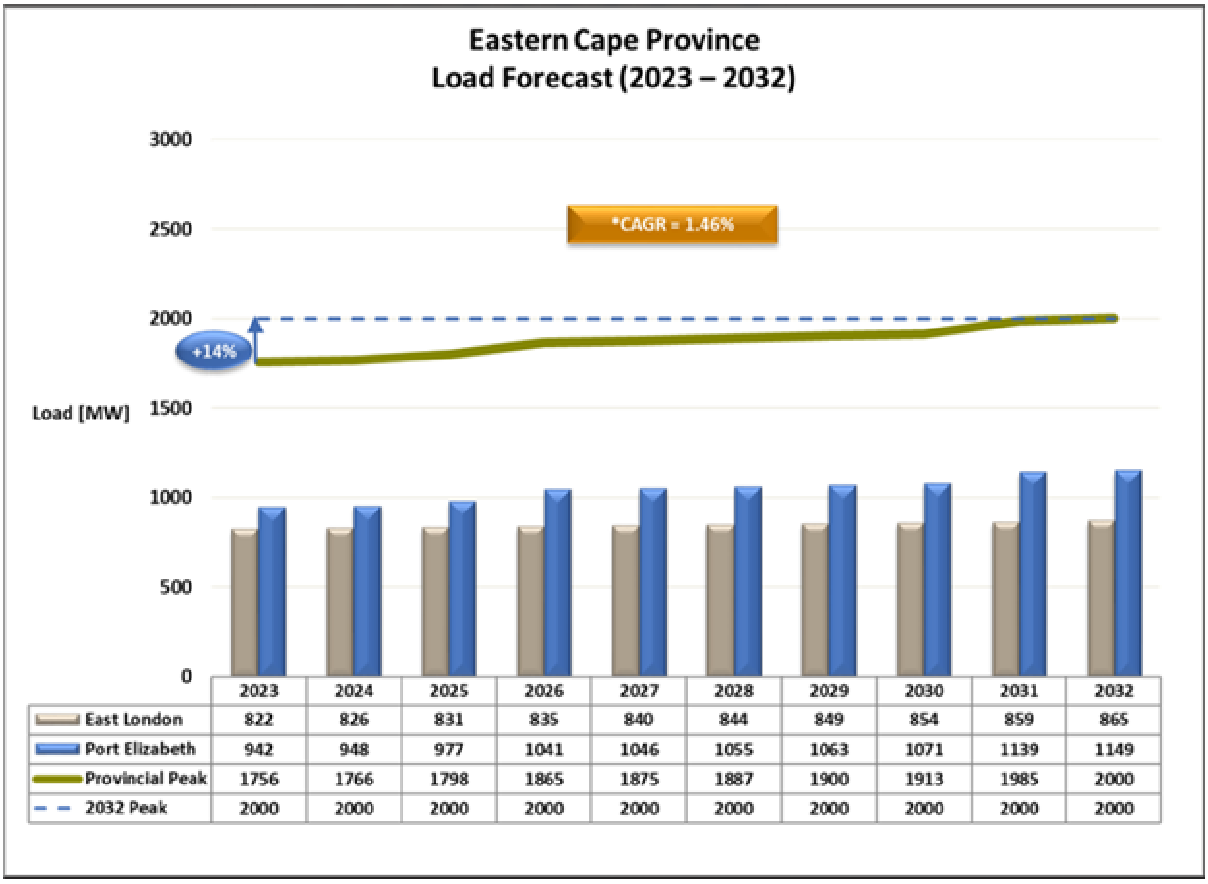
7.1.2 LOAD FORECAST

The provincial load for the Eastern Cape peaked at around 1 756 MW in 2021, and it is expected to increase to about 2 000 MW by 2032. The major economic drivers in the province are the manufacturing sector, construction, the renewable IPP sector, and supporting industries. The rate of load growth has decreased significantly compared to previous TDP cycles. The main reason for the decline in load forecast is the slow realisation of anticipated projects in the Coega Industrial Development Zone and commercial and residential developments.

There is a high potential for developments in the Nelson Mandela Bay Metro in the Port of Ngqura, popularly known as Coega. As a result, the peak demand for electricity in the Port Elizabeth area is forecasted to increase from 942 MW to about 1 149 MW in the next 10 years. The bulk of the expected load increase in the CLN is attributable to the industrial development at Coega.

The East London CLN has a mixture of rural and urban loads. Most of the rural electrification is anticipated to be in the northern parts of East London CLN, in and around the Mthatha area. The Vuyani substation and associated 400 kV supply lines are expected to unlock future electrification in the Mthatha area. The capacity of Vuyani substation also has the potential to support and unlock capacity for electrification in the area.

The load forecast for the Eastern Cape is shown in Figure 7-2.



	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
East London	822	826	831	835	840	844	849	854	859	865
Port Elizabeth	942	948	977	1041	1046	1055	1063	1071	1139	1149
Provincial Peak	1756	1766	1798	1865	1875	1887	1900	1913	1985	2000
2032 Peak	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000

Figure 7-2: Eastern Cape load forecast

7.1.3 PLANNED PROJECTS

Several projects and schemes that aim to address the long-term requirements of the province have been initiated in order to accommodate the forecasted load and generation.

7.1.3.1 Major schemes

The major TDP schemes planned in the Eastern Cape are as follows.

Greater East London strengthening Phases 3 and 4

Greater East London strengthening Phase 3 entails the establishment of 400 kV at Pembroke substation, the building of the Neptune-Pembroke 400 kV line, and the installation of the first 400/132 kV 500 MVA transformer. Greater East London strengthening Phase 4 will introduce the second 400 kV corridor into Pembroke, construction of the Poseidon-Pembroke 400 kV line, and installation of the second 500 MVA 400/132 kV transformer.

Southern Grid strengthening Phases 3 and 4

Southern Grid strengthening Phase 3 entails introducing 765 kV into the Eastern Cape by means of the first Gamma-Grassridge 765 kV line. Southern Grid strengthening Phase 4 introduces the second Gamma-Grassridge 765 kV line.

7.1.3.2 New substations

The low voltages under network contingencies at Pembroke substation and the underlying network will necessitate the introduction of 400 kV at Pembroke substation near King William's Town.

7.1.3.3 New lines

Pembroke experiences low voltages with the loss of the 220 kV line from Poseidon. A 400 kV injection from Neptune (that is, the Neptune-Pembroke 400 kV line) is required to support the 220 kV line from Poseidon. A Poseidon-Pembroke 400 kV line will further strengthen the East London CLN network and assist with the evacuation of generation in the Port Elizabeth CLN.

7.1.3.4 Reactive power compensation

Reactive power compensation projects (capacitor banks and/or static var compensators (SVCs)) are expected to improve the voltages in the Eastern Cape as more generation is transported over long distances.

7.1.3.5 Network strengthening projects

The following strengthening projects are planned for the period from 2023 to 2032.

Table 7-2: Eastern Cape – summary of projects and timelines

TDP scheme	Project name	Expected commercial operation (CO) year
Greater EL Phase 3	• Neptune-Pembroke 400 kV line	2026
	• Pembroke first 400/132 kV 500 MVA transformer	2026
	• Pembroke first 132/66 kV 160 MVA transformer	2026

TDP scheme	Project name	Expected commercial operation (CO) year
Grassridge third 500 MVA 400/132 kV transformer	• Grassridge third 500 MVA 400/132 kV transformer	2027
Dedisa third 500 MVA 400/132 kV transformer	• Dedisa third 500 MVA 400/132 kV transformer	2027
Greater EL Phase 4	• Poseidon-Pembroke 400 kV line	2028
	• Pembroke second 400/132 kV 500 MVA transformer	2028
	• Pembroke second 132/66 kV 160 MVA transformer	2028
Southern Grid strengthening Phase 3	• First Gamma-Grassridge 765 kV line	2029
Southern Grid strengthening Phase 4	• Second Gamma-Grassridge 765 kV line	2031
Poseidon 80 MVA 132/66 kV transformer	• Poseidon 80 MVA 132/66 kV transformer	2027
Poseidon 220/132 kV transformation upgrade	• Poseidon 220/132 kV transformation upgrade	2028

7.1.3.6 Projects for future independent power producers

The following transmission network strengthening projects will be required to enable the connection of the IPPs located in the province within the current TDP period based on the generation assumptions:

- Dorper 400/132 kV substation between Beta and Delphi
- Introduction of 765 kV at Grassridge substation
- Poseidon South 400/132 kV substation between Grassridge and Poseidon
- Hlaziya 400/132 kV substation
- Poseidon North 400/132 kV substation at Iziko series capacitor station
- Grahamstown 400/132 kV substation

The envisaged generation growth in the Port Elizabeth CLN in 2028 will result in undervoltages at Pembroke substation, with some circuits out of service. The construction of the Poseidon-Pembroke 400 kV line is expected to have increased generation evacuation through the Vuyani-Eros 400 kV line. The East London CLN will result in low voltage at Pembroke, Neptune, and Vuyani substations under certain network contingencies. Shunt compensation projects that entail the installation of 100 Mvar capacitor banks at 400 kV will be implemented for voltage support at the following substations:

- Pembroke
- Neptune
- Vuyani

The strengthening projects in the table below are required to facilitate future IPP integration for the period 2023 to 2032.

Table 7-3: Eastern Cape – projects required to facilitate IPP integration

TDP scheme	Project name	Expected CO year
Poseidon North 400/132 kV substation integration	• Poseidon North new 400/132 kV substation south of Iziko series capacitor station	2031
Poseidon South 400/132 kV substation integration	• Poseidon South 400/132 kV substation and loop-in between Grassridge and Poseidon	2028
Hlaziya 400/132 kV substation integration	• Hlaziya new 400/132 kV substation and 400 kV lines	2030
Dorper 400/132 kV substation integration	• Dorper new 400/132 kV substation and loop-in between Beta and Delphi	2030
East London voltage support: 100 Mvar shunt capacitor (cap) banks at Pembroke, Neptune, and Vuyani	• 100 Mvar shunt cap banks at Pembroke, Neptune, and Vuyani	2028
Southern Grid strengthening Phase 4	• Second Gamma-Grassridge 765 kV line	2031
Coega gas	• 2 x Dedisa-Coega 400 kV lines • Poseidon-Coega 400 kV line • Grassridge-Coega 400 kV line • 2 x Gamma-Grassridge 765 kV lines	2030
Grahamstown 400/132 kV substation integration	• Loop-in-and-out on future Poseidon-Pembroke 400 kV line	2029

7.1.3.7 Key Eastern Cape projects to unlock capacity for renewable energy generation

The Eastern Cape was identified as one of the provinces where additional capacity was necessary to enable access to connect renewable energy generation by the year 2027. The projects identified at existing brownfields are listed below.

- Delphi 1st 500 MVA 400/132 kV transformer
- Grassridge 4th 500 MVA 400/132 kV transformer
- Dedisa 3rd and 4th 500 MVA 400/132 kV transformers

Additional substations, namely, Poseidon, Pembroke, and Neptune, were also identified for connection of renewable energy generation; however, no network reinforcements were identified as a result of this initiative.

7.1.3.8 Projects for alternative generation scenario

Interest has been shown in the integration of generation from natural gas close to Coega Industrial Development Zone (IDZ), amounting to approximately 3 000 MW. The proposed plan includes an assessment to determine the impact on the transmission network in the Eastern Cape if all of the proposed 3 000 MW of gas located in Port Elizabeth is connected by 2031. The following additional transmission network strengthening projects will be required to enable the evacuation of the gas generation from the province:

- Establishment of a new Coega 400 kV high-voltage (HV) yard with 400 kV busbars
- Coega-Grassridge 400 kV line
- 2 x Coega-Dedisa 400 kV lines
- Coega-Poseidon 400 kV line
- Gamma-Grassridge 765 kV Lines 1 and 2 in 2029 and 2031, respectively
- Grassridge substation 132 kV fault current limiting reactors (FCLRs)

7.1.3.9 Provincial summary

The future transmission network for the province is shown in Figure 7-3 below.

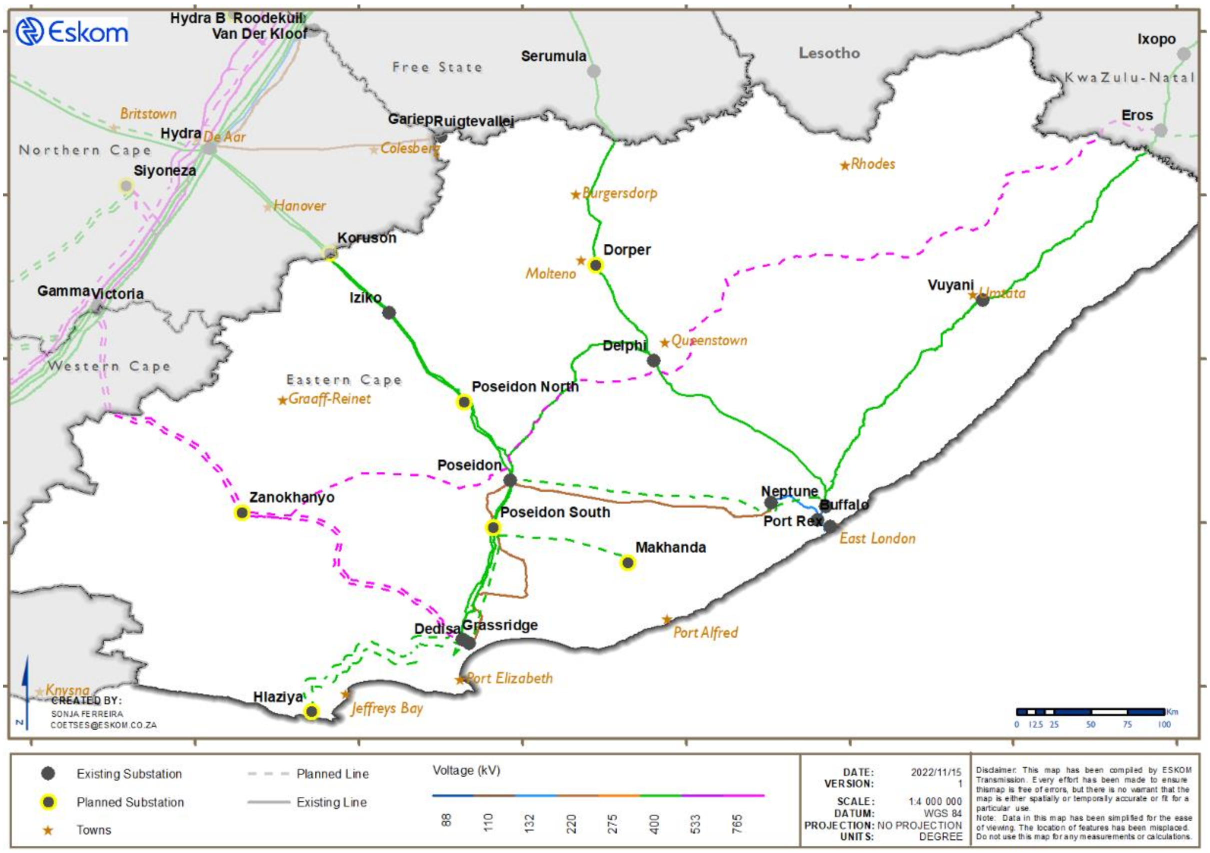


Figure 7-3: Future Eastern Cape transmission network

A summary of all new major assets planned for this province is provided in Table 7-4 to Table 7-7.

Table 7-4: Planned transformers for the Eastern Cape

Transformer type	2023 to 2027		2028 to 2032	
	Quantity	Total capacity (MVA)	Quantity	Total capacity (MVA)
Less than 100 MVA	4	124	1	90
Less than 300 MVA	1	160	1	160
500 MVA	4	2 000	12	6 000
2 000 MVA	-	-	2	4 000
Grand total	**9**	**2 284**	**16**	**10 250**

Table 7-5: Planned overhead lines for the Eastern Cape

Line voltage	2023 to 2027	2028 to 2032
	Total length (km)	Total length (km)
400 kV	41	1 061
765 kV	-	1 010
Grand total	**41**	**2 071**

Table 7-6: Planned capacitors for the Eastern Cape

Capacitor type	2023 to 2027		2028 to 2032	
	Quantity	Total capacity (Mvar)	Quantity	Total capacity (Mvar)
40 Mvar 132 kV	1	40	-	-
72 Mvar 132 kV	1	72	-	-
100 Mvar 400 kV	-	-	3	300
Grand total	**2**	**112**	**3**	**300**

Table 7-7: Planned reactors for the Eastern Cape

Reactor type	2023 to 2027		2028 to 2032	
	Quantity	Total capacity (Mvar)	Quantity	Total capacity (Mvar)
200 Mvar 400 kV	-	-	2	400
400 Mvar 765 kV	-	-	1	400
Grand total	**-**	**-**	**3**	**800**

7.2 FREE STATE

The Free State is South Africa's most centrally located province and has Bloemfontein as its capital. It has borders with most other provinces and has Lesotho as its eastern neighbour. For many decades, mining and agriculture were the bedrock of the economy in the province, but the productivity of the mining sector has been on a steady decline. This has had a negative impact on the economy and the demand for electricity in the province.

Renewable energy generation is becoming a key focus area for the province. This is due to good solar radiation. A total of 803 MW RE generation has been procured up to Bid Window 5.

The Free State comprises 275 kV, 400 kV, and 765 kV lines. These power lines extend from Mpumalanga to the Greater Cape area. It is also electrically connected to Lesotho via two Merapi-Tweespruit 132 kV lines. The existing transmission network is shown in Figure 7-4.

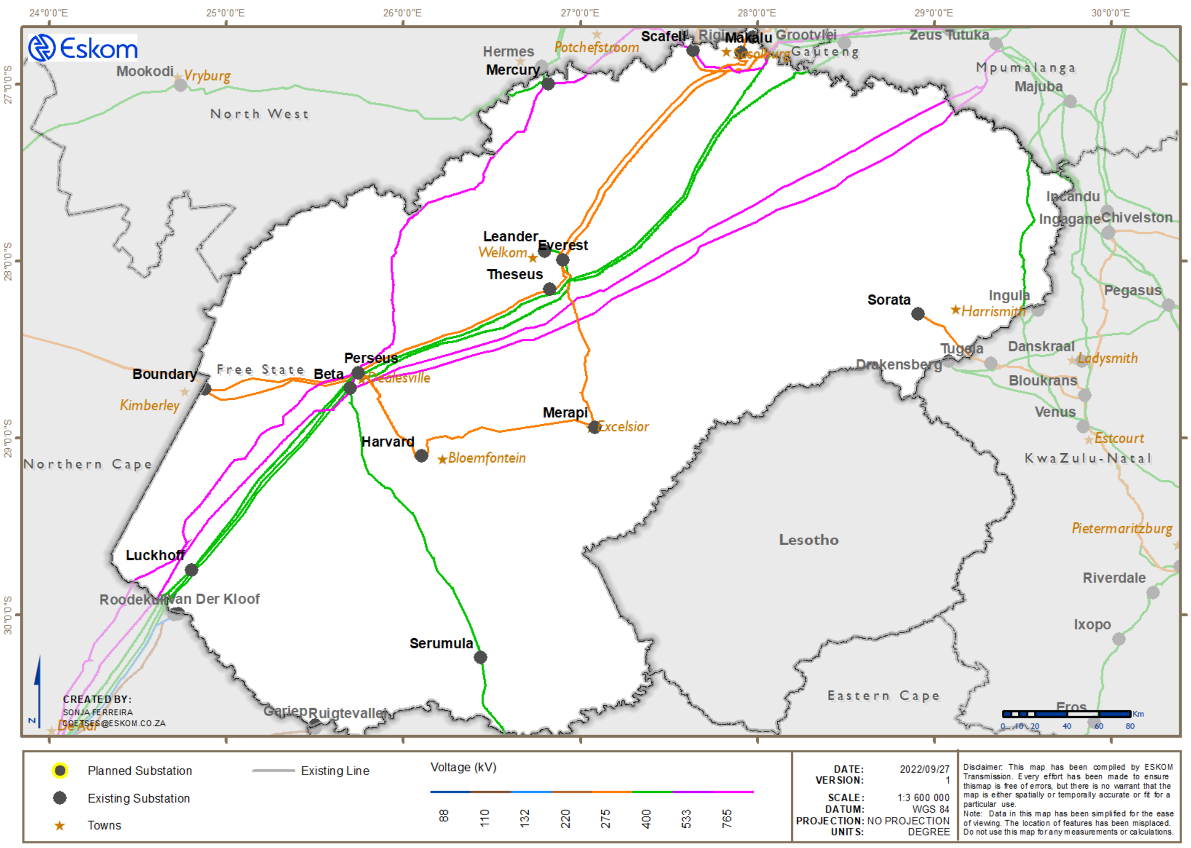


Figure 7-4: Current Free State transmission network

7.2.1 GENERATION

The power supply into the province is predominantly sourced from Lethabo Power Station and Mpumalanga via 400 kV and 275 kV transmission lines. Lethabo Power Station is a coal-fired power station located in the Vaal Triangle area of the Free State. It consists of six generating units with a total generating capacity of 3 558 MW.

7.2.1.1 Renewable energy independent power producers

A total of 803 MW RE generation has been procured in the Free State. The total generation that has been procured from REIPPPP 1 up to 4B is 203 MW, as shown in Table 7-8. A further 600 MW has been awarded under the REIPPPP 5.

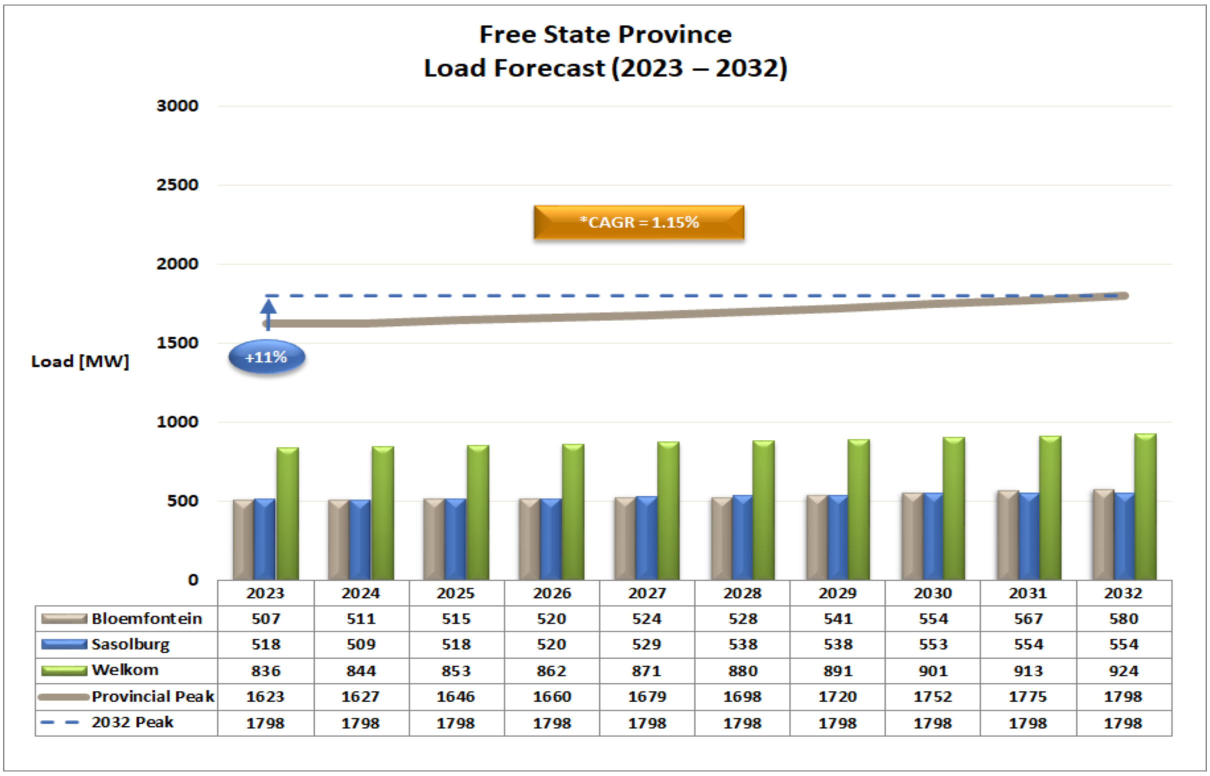
Table 7-8: Approved projects in the Free State under the REIPPPP

Programme and bid window	Small hydro (MW)	PV (MW)	Grand total (MW)
IPP RE 1	0	64	64
IPP RE 2	4,4	60	64,4
IPP RE 3	0	75	75
IPP RE 4	0	0	0
IPP RE 4B	0	0	0
Grand total	**4,4**	**199**	**203,4**

7.2.2 LOAD FORECAST

The provincial load peaked at around 1 505 MW in 2021, and it is forecasted to grow steadily at approximately 1,15% annually, from 1 623 MW in 2023 to 1 798 MW by 2032.

The Free State comprises three CLNs, namely, Sasolburg, Bloemfontein, and Welkom. The Welkom CLN consumed approximately 40,7% of the load. Sasolburg and Bloemfontein CLNs made up the remaining 59,3% of the demand in the province. The highest provincial load growth is expected in the Welkom CLN. The load forecast for the Free State is shown in Figure 7-5.



	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Bloemfontein	507	511	515	520	524	528	541	554	567	580
Sasolburg	518	509	518	520	529	538	538	553	554	554
Welkom	836	844	853	862	871	880	891	901	913	924
Provincial Peak	1623	1627	1646	1660	1679	1698	1720	1752	1775	1798
2032 Peak	1798	1798	1798	1798	1798	1798	1798	1798	1798	1798

Figure 7-5: Free State load forecast

7.2.3 PLANNED PROJECTS

7.2.3.1 Major schemes

The major projects for the Free State mainly involve overlaying the existing 275 kV networks with 400 kV networks to increase the power transfers into the respective load centres.

The major TDP schemes planned in the Free State are as follows.

Bloemfontein strengthening Phase 2

This project involves acquiring servitudes for future 400 kV lines, that is, the Beta-Harvard and Harvard-Merapi lines, and the introduction of 400 kV at Harvard and Merapi substations. The project will be executed in various stages. The implementation of each stage will depend on demand growth (generation and/or load) and strengthening requirements in the Bloemfontein CLN.

Harrismith strengthening Phase 1

This project was commissioned in 2022. It addresses network capacity constraints in the Harrismith region, which includes Tugela substation in KwaZulu-Natal and Sorata 132 kV switching station in the Free State. Sorata 132 kV switching station was extended to a 275/132 kV substation to deload Tugela substation.

Sorata substation strengthening

This project involves the construction of the second Sorata-Tugela 275 kV line (built at 400 kV and operated at 275 kV) as well as installing a second 275/132 kV transformer at Sorata substation.

Makalu substation strengthening

This project involves establishing Igesi 275/88 kV substation and looping into one of the Lethabo-Makalu 275 kV lines to create the Lethabo-Igesi and Igesi-Makalu 275 kV lines.

7.2.3.2 New substations

Igesi 275/88 kV substation will be established in the province to deload Makalu substation. It will also assist in reducing the network fault levels around Makalu substation.

7.2.3.3 New lines

A second Sorata-Tugela 275 kV line (built at 400 kV and operated at 275 kV) will be constructed as part of the Sorata substation strengthening.

7.2.3.4 Reactive power compensation

There are no reactive power compensation projects (capacitor banks and/or SVCs) planned for the Free State within the TDP period.

7.2.4 NETWORK STRENGTHENING PROJECTS

The following strengthening projects are planned for the period 2023 to 2032.

Table 7-9: Free State – summary of projects and timelines

TDP scheme	Project name	Expected CO year
Bloemfontein strengthening Phase 2A	• Construct 2 x Beta-Harvard 400 kV lines • Install 2 x 500 MVA 400/132 kV transformers at Harvard substation	2037
Harrismith strengthening Phase 1	• Install first 275/132 kV 250 MVA transformer at Sorata substation and operate Tugela-Sorata at 275 kV	Completed in 2022
Makalu strengthening	• Establish 2 x 315 MVA 275/88 kV Igesi substation • Loop-in one of Lethabo-Makalu 275 kV lines into Igesi substation	2027
Sorata substation strengthening	• Construct Sorata-Tugela 400 kV line (to be operated at 275 kV) • Install second 275/132 kV 250 MVA transformer at Sorata substation	2030

7.2.5 PROJECTS FOR FUTURE INDEPENDENT POWER PRODUCERS

The following transmission network strengthening projects will be required to enable the connection of the future IPPs located in the province within the current TDP period based on the generation assumptions.

Table 7-10: Free State – projects required to facilitate IPP integration

Project name	Required CO year
Artemis 500 MVA 400/132 kV substation	2024
Artemis 2nd 500 MVA 400/132 kV transformer	2027
Artemis 3rd 500 MVA 400/132 kV transformer	2029
Artemis 4th 500 MVA 400/132 kV transformer	2034
Theseus 3rd 500 MVA 400/132 kV transformer	2028
Mercury 3rd 500 MVA 400/132 kV transformer	2028
Scafell 275/132 kV transformer upgrade	2026

Project name	Required CO year
Perseus 2nd 2 000 MVA 765/400 kV transformer	2030
Mercury 1st 2 000 MVA 765/400 kV transformer	2029

7.2.6 PROVINCIAL SUMMARY

The future transmission network for the province is shown in Figure 7-6 below.

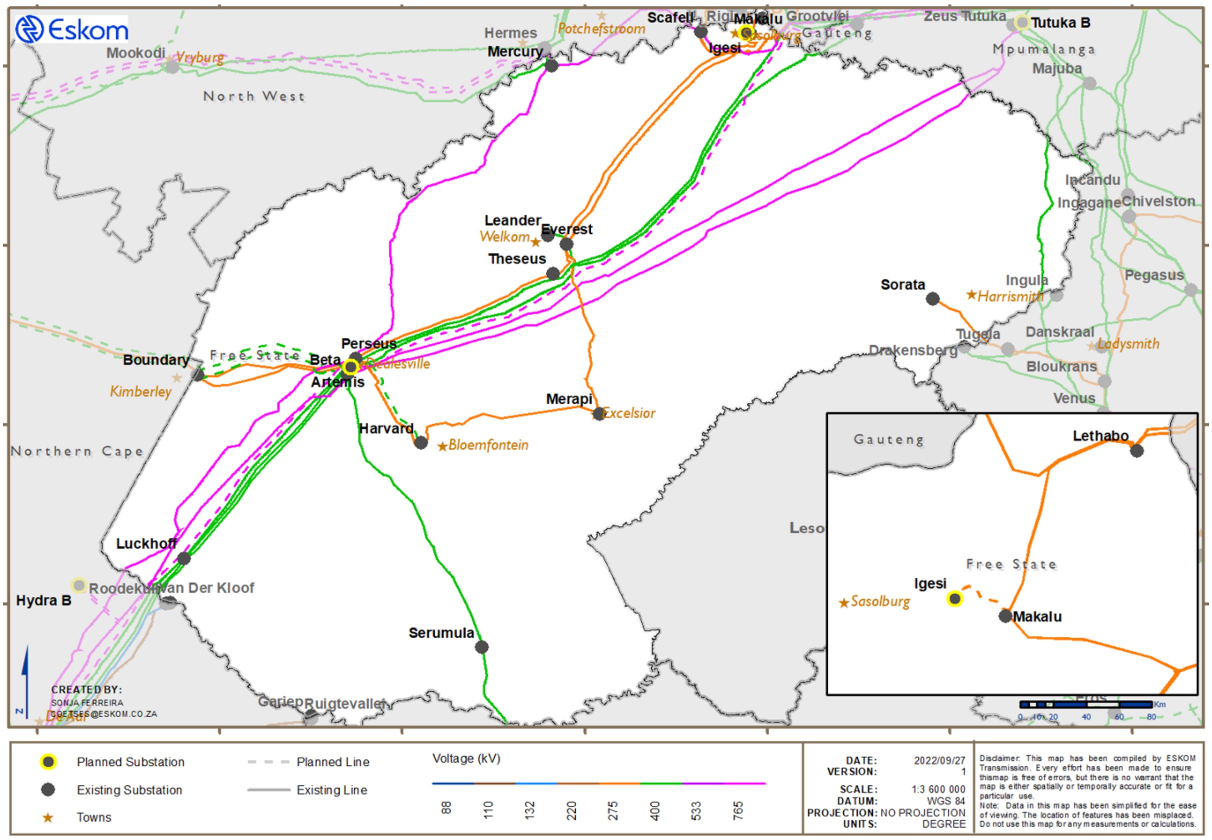


Figure 7-6: Future Free State transmission network

A summary of all new major assets planned for this province is provided in Table 7-11 to Table 7-13.

Table 7-11: Planned transformers for the Free State

Transformer type	2023 to 2027		2028 to 2032	
	Quantity	Total capacity (MVA)	Quantity	Total capacity (MVA)
Special 667 MVA	-	-	6	4 002
Less than 300 MVA	2	500	1	250
Less than 500 MVA	2	630	-	-
500 MVA	2	1 000	3	1 500
2 000 MVA	-	-	2	4 000
Grand total	**6**	**2 130**	**12**	**9 752**

Table 7-12: Planned overhead lines for the Free State

Line voltage	2023 to 2027	2028 to 2032
	Total length (km)	Total length (km)
275 kV	14	-
400 kV	-	144
765 kV	160	270
Grand total	**174**	**414**

Table 7-13: Planned reactors for the Free State

Reactor type	2023 to 2027		2028 to 2032	
	Quantity	Total capacity (MVA)	Quantity	Total capacity (MVA)
100 Mvar 400 kV	-	-	1	100
133 Mvar 765 kV	-	-	1	133
400 Mvar 765 kV	-	-	2	800
Grand total	**-**	**-**	**4**	**1 033**

7.3 GAUTENG

Gauteng is located in the north-eastern part of South Africa. Despite it being the smallest province in the country, it is the economic hub of the country, a gateway to Africa, and the most populous province in South Africa. The capital of the province is Johannesburg (Jhb). The economic mix in the province comprises the residential sector, gold mines, commercial and service customers, as well as industrial, technology, and logistics customers. Redistributors (metros and municipalities) account for about 75% of electricity consumption in the province.

The transmission infeed network into Gauteng is operated at 400 kV and 275 kV, with most of the local transmission stations in the province operated and interconnected via 275 kV lines and only a few substations run at 400 kV. The subtransmission system is run and interconnected through the 132 kV and 88 kV underlying distribution networks. The current transmission network is shown in Figure 7-7.

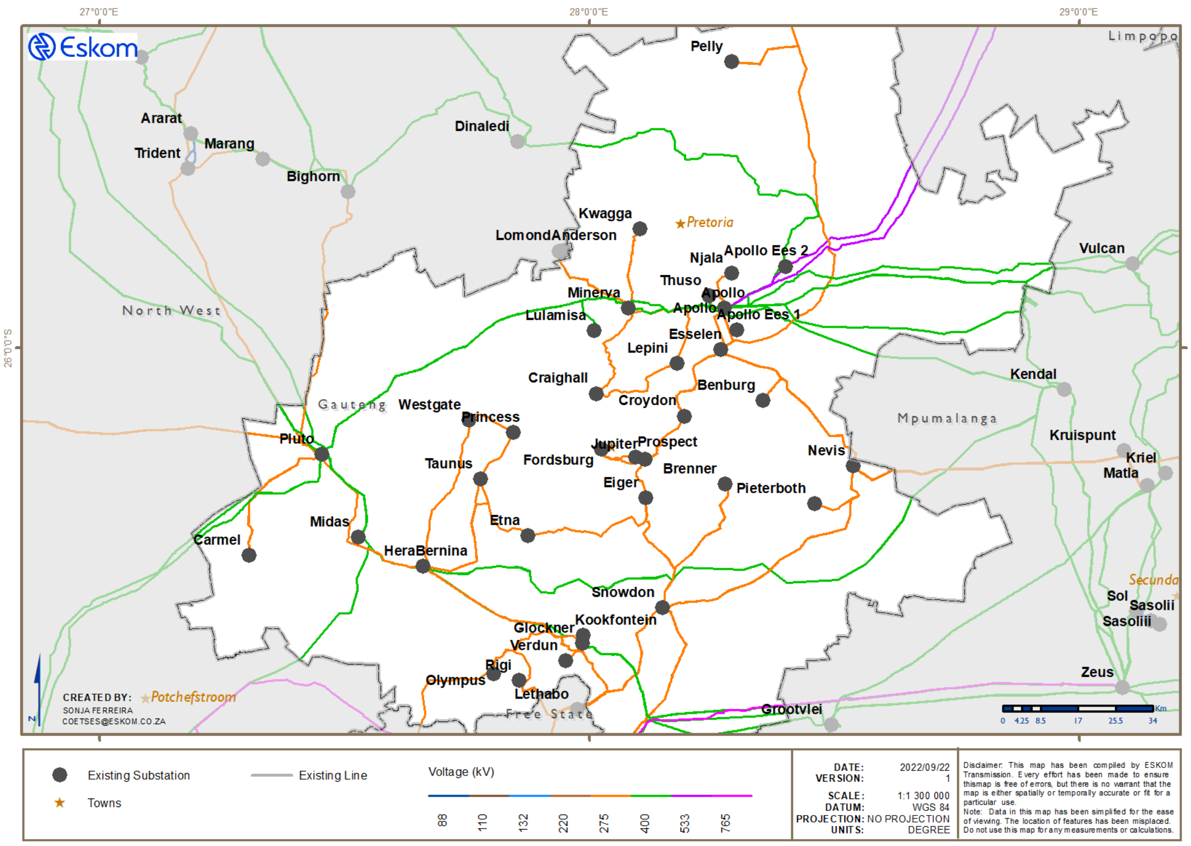


Figure 7-7: Current Gauteng transmission network

7.3.1 GENERATION

There are no Eskom power stations that lie within the defined Gauteng Grid; small municipal power stations include Kelvin and Rooiwal Power Stations. Most of the electricity consumed in Gauteng is sourced from power stations in the neighbouring grids via 400 kV and 275 kV transmission lines, as well as via the 533 kV direct current (DC) Cahora Bassa line from Mozambique. The primary sources of power are the following power stations:

- Cahora Bassa (through Apollo converter station) via 533 kV DC lines
- Duvha Power Station via 400 kV lines
- Grootvlei Power Station via 400 kV lines
- Kendal Power Station via 400 kV lines
- Kusile Power Station via 400 kV lines
- Lethabo Power Station via 275 kV lines
- Matimba Power Station via 400 kV lines
- Matla Power Station via 400 kV lines
- Medupi Power Station via 400 kV lines

Lethabo Power Station, although situated in the Free State Grid, supplies a large percentage of the reactive power requirements of Gauteng. Due to high fault levels, the Lethabo Power Station 275 kV busbar is operated split when five or more units are in service to prevent exceeding the rupturing capacity of equipment in the 275 kV yard. The major injections of reactive power in Gauteng are from Matla Power Station, Midas 400 kV via the Hera 400/275 kV transformers, and Apollo.

The REIPPPP has provided a platform for the private sector to invest in renewable energy that will be connected to the South African power grid. The total number of installed IPPs, including capacity in Gauteng, is shown in Table 7-14. These are already embedded in the municipal and Eskom distribution network. There are no significant IPPs planned for the Gauteng Grid for the foreseeable future.

Table 7-14: IPPs integrated in Gauteng

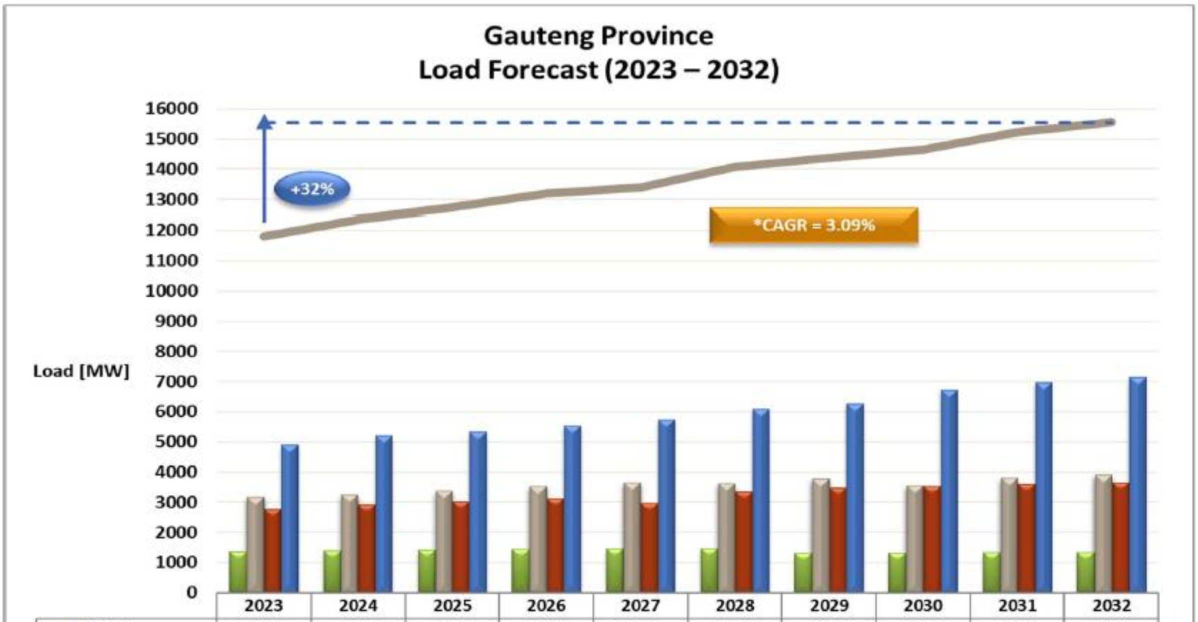
Date commissioned	Technology	POC	Capacity (MW)
April 2015	Biomass	Municipality	3
April 2015	Biomass	Municipality	2,28
December 2017	Biomass	Municipality	6
2018	Biomass	Eskom Distribution	4
2018	Biomass	Eskom Distribution	1,4
Total capacity			**16,68**

7.3.2 LOAD FORECAST

Gauteng is the economic hub of South Africa and contributes significantly to the financial, manufacturing, transport, technology, and telecommunications sectors, among others. The province currently contributes about 30% to the total transmission system peak load.

As already mentioned, the economic mix in the province comprises residential customers, gold mines, and commercial and services customers, as well as logistics, technology, and industrial customers. The provincial electricity demand peaked at about 11 507 MW in 2021 and is forecasted to grow steadily at about 3,09% annually in this TDP window, from 11 820 MW in the year 2023 to 14 744 MW by the year 2032.

The Gauteng Grid comprises four CLNs, namely, East Rand, Johannesburg, Vaal, and West Rand. The Johannesburg CLN has the highest load growth forecast, followed by the West Rand and East Rand CLNs. The highest provincial load growth is expected in the Johannesburg and West Rand CLNs due to commercial and residential developments. The Vaal CLN has the lowest growth outlook in the province. The load forecast for Gauteng is shown in Figure 7-8.



	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Vaal	1355	1388	1414	1435	1455	1470	1318	1325	1338	1343
East Rand	3158	3232	3361	3516	3648	3609	3760	3546	3795	3888
West Rand	2760	2902	3017	3100	2969	3325	3463	3522	3587	3636
Johannesburg	4883	5201	5312	5526	5717	6062	6262	6695	6958	7132
Provincial Peak	11820	12372	12741	13199	13407	14064	14382	14664	15234	15546
2032 Peak	15546	15546	15546	15546	15546	15546	15546	15546	15546	15546

Figure 7-8: Gauteng load forecast

7.3.3 PLANNED PROJECTS

Several projects and schemes that aim to address the long-term requirements of the province have been initiated to accommodate the forecasted load and generation.

7.3.3.1 Major schemes

The major TDP schemes planned in Gauteng are as follows.

Johannesburg North strengthening

The scheme is required to resolve the thermal and voltage constraints in the Johannesburg North CLN and support future loads in the CLN. Two 150 Mvar 275 kV capacitor banks were recently installed at Lepini substation and went into commercial operation at the end of 2020. This will be followed by the construction of the Apollo-Lepini 275 kV line in the next five years to increase capacity.

Vaal strengthening

The scheme entails the construction of 2 x Glockner-Etna 400 kV lines (Vaal strengthening

Phase 2) to deload the overloaded Hera substation and lines in the West Rand CLN. Phase 1 has been completed, and load can now be shifted under contingency from the Hera 400/275 kV transformers onto the Glockner 400/275 kV corridor via the Glockner-Bernina 275 kV lines. Completion of Phase 2 (the 2 x Etna-Glockner 400 kV lines) is expected in 2025. The new lines will be energised at 275 kV until the requirement for 400 kV operation at Etna and Quattro substations has been established in the future.

Simmerpan 275 kV integration

Simmerpan strengthening addresses unfirm transformation at Jupiter substation (due to load increases in the Germiston South area) and the future unfirm capacity at Croydon substation (due to growth in the Germiston North area). The scope of work (SOW) includes establishing a 275 kV transmission substation adjacent to the Simmerpan distribution substation and installing a 315 MVA 275/88 kV transformer (Phase 1B). The name of the new substation will be Sisimuka. The substation will be energised from the existing Jupiter substation initially and later swung over to the planned Jupiter B substation via one of the existing Jupiter-Simmerpan 275 kV lines (currently energised at 88 kV). Completion of the initial Phase 1B is expected in the next five years. The second 275/88 kV transformer and the second Jupiter-Sisimuka 275 kV line are only required outside the TDP period. In future, the substation will be extended further to accommodate 2 x 250 MVA 275/132 kV transformers, subject to load growth in the Croydon 132 kV network (Germiston North).

Soweto strengthening

The focus of this scheme is to ensure Grid Code compliance for Taunus and Fordsburg substations and to address the imminent thermal constraints in the Soweto distribution network. The scope of work includes establishing the new Quattro substation, which will cater for 4 x 315 MVA 275/88 kV transformers belonging to City Power and 2 x 500 MVA 275/132 kV transformers belonging to Eskom. Two 400 kV lines, energised at 275 kV, will also be built from Etna to Quattro.

Johannesburg East strengthening

This scheme addresses network constraints in the East Rand and Johannesburg South areas. Sebenza 275/88 kV substation (400/88 kV construction), which City Power has commissioned, has deloaded Prospect substation and created more transformer capacity in the East Rand area. The planned construction of two Matla-Jupiter B 400 kV lines will result in increased transfer limits in the East Rand CLN. The planned Mesong (previously North Rand) substation will be integrated through the loop-in and loop-out of the existing Apollo-Croydon 275 kV line. This solution can be developed faster than the Apollo-North Rand corridor due to environmental and land acquisition challenges.

Westgate 400 kV integration

This scheme addresses thermal constraints in the West Rand CLN, particularly Hera substation. The project entails establishing a 400 kV overlay at Westgate substation by installing a 500 MVA 400/132 kV transformer at Westgate, energised via the proposed Hera-Westgate 400 kV line (West Rand Phase 1). The first 13 km of the Hera-Westgate line will be double circuit, with the second circuit in the double-circuit section dedicated to be for the future Pluto-Westgate line (Phase 2B). The Pluto-Westgate 400 kV line and the second Westgate 400/132 kV transformer will be required within about four years of completing Phase 1, but fall outside the TDP period.

Tshwane reinforcement

The Tshwane reinforcement projects address unfirm substations due to load increases in the Tshwane economic node. A new 400/132 kV Diphororo substation will be built just outside Soshanguve and will be equipped with 2 x 500 MVA 400/132 kV transformers. This is expected in the next five years to cater for load growth in the Garankuwa and Soshanguve areas. Furthermore, a new Wildebees 400/132 kV substation will be built in the Mamelodi area to cater for the expected load growth in the Pretoria East area. Expected completion is in the next five years; the project is in the concept phase. (The schedule was revised owing to the relocation of the substation site by the City of Tshwane.)

7.3.3.2 New substations

The following new substations will be established in the Gauteng transmission network during this TDP period to address load growth and reliability:

- Diphororo 400/132 kV substation in the Pretoria North area
- Kyalami 400/132 kV substation in the Johannesburg North area
- Lesokwana 275/88 kV substation in the Ekurhuleni area
- Mesong 275/132 kV substation in the Modderfontein area
- Quattro 275/132 kV substation in the Soweto area
- Sesiu 400/88 kV substation in the Cosmo City area
- Sisimuka 275/88 kV substation in the Germiston area

- Wildebees 400/132 kV substation in Pretoria East
- Jupiter B 275 kV switching station in Germiston

7.3.3.3 New lines

- The 2 x Glockner-Etna 400 kV lines (operated at 275 kV) will deload overloaded lines in the Vaal and West Rand CLNs. They will also marginally deload the 2 x 800 MVA 400/275 kV transformers at Hera substation.
- The Apollo-Lepini 400 kV line (operated at 275 kV) will increase capacity in the Johannesburg North area.
- The 2 x Etna-Quattro 400 kV lines (operated at 275 kV) will enable the establishment of the Quattro substation to deload Taunus substation and address imminent thermal constraints in the Soweto distribution network.
- The 2 x Matla-Jupiter B 400 kV lines (operated at 275 kV) will increase transfer limits in the Johannesburg CLN.
- The Hera-Westgate 400 kV line will address thermal and voltage constraints in the West Rand CLN.

7.3.3.4 Reactive power compensation

The following reactive power compensation is planned in Gauteng, as shown in Table 7-15 below.

Table 7-15: Planned reactive power compensation in Gauteng

Substation	Voltage (kV)	Size (Mvar)
Brenner	88	2 x 48
Princess	88	1 x 48
Quattro	132	2 x 72
Taunus	132	1 x 72
Westgate	132	1 x 72
Wildebees	400	1 x 100

7.3.3.5 Summary of network strengthening projects

The following strengthening projects are planned for the period 2023 to 2032.

Table 7-16: Gauteng – summary of projects and timelines

TDP scheme	Project name	Expected CO year
Vaal strengthening Phase 2	Glockner-Etna first and second 400 kV line (operated at 275 kV)	2027
Brenner strengthening Phase 1	Brenner 2 x 88 kV 48 Mvar capacitors	2029
Tshwane Metro – Diphororo Phase 1	Diphororo 400/132 kV substation integration	2025
Tshwane Metro – Wildebees Phase 1	Wildebees 400/132 kV substation integration	2027
Tshwane Metro: Thuso third transformer	Thuso 400/132 kV substation (third 250 MVA transformer)	2030
Etna strengthening: third transformer	Etna 275/88 kV substation (third 315 MVA transformer)	2027
Soweto Phase 1: Quattro 275/88 kV	Quattro 275/88 kV substation integration	2028
Soweto Phase 2: Quattro 275/132 kV	Quattro 275/132 kV substation integration	2028
West Rand strengthening Phase 1	Westgate 400/132 kV substation integration	2029
West Rand strengthening Phase 2A: capacitors	1 x 72 Mvar cap bank at Westgate 132 kV	2029
	1 x 72 Mvar cap bank at Taunus 132 kV	
	1 x 72 Mvar cap at Quattro 132 kV	
	1 x 48 Mvar cap at Princess 88 kV	
Jhb North Phase 2	Jhb North: Apollo-Lepini first 400 kV line (operated at 275 kV)	2027
West Rand strengthening Phase 2B	Pluto-Westgate 400 kV and 2nd 400/132 kV 500 MVA transformer at Westgate	2031
Simmerpan Phase 1B	Sisimuka 275/88 kV substation integration	2031
Jhb North: Sesiu integration	Sesiu 400/88 kV substation integration	2031
Jhb East: Mesong integration	Jhb East: Mesong 275/132 kV integration	2035
Jhb East: Jupiter B integration	Jupiter B 275 kV switching station	2030
	Matla-Jupiter B 1st and 2nd 400 kV lines	
	Jupiter B 275 kV loop-ins (Prospect-Sebenza 1 and 2, Jupiter-Prospect 1, Jupiter-Fordsburg 1)	
Jhb North: Kyalami substation	Kyalami 400/132 kV substation integration	2032
Brenner Phase 2: Lesokwana substation	Lesokwana 275/88 kV substation integration	2034

7.3.3.6 Projects for future independent power producers

The possible future planned IPPs in the province do not have sufficient capacity to affect the transmission network. Therefore, no additional transmission projects are required to enable the future connection of the IPPs in Gauteng.

7.3.3.7 Projects for alternative generation scenario

No alternative generation scenario has been identified for Gauteng.

7.3.3.8 Provincial summary

The future transmission network for the province is shown in Figure 7-9 below.

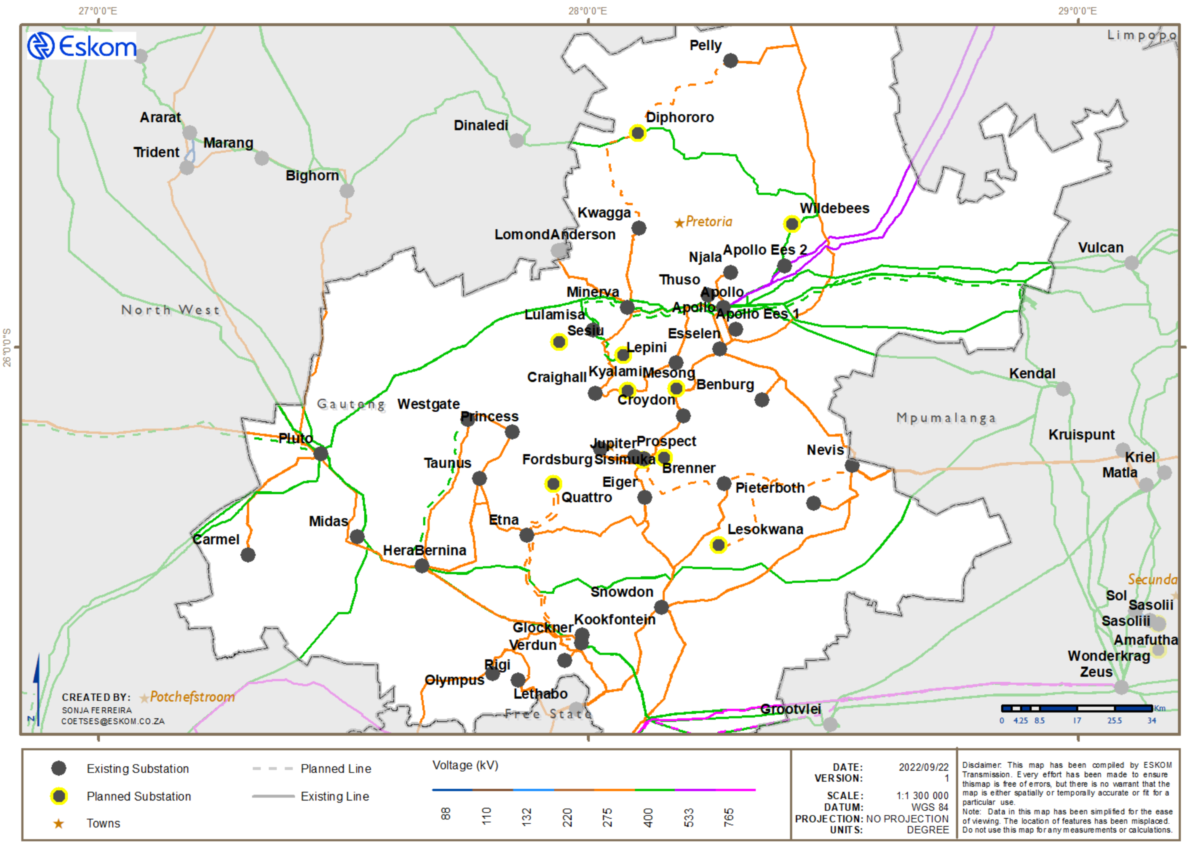


Figure 7-9: Future Gauteng transmission network

A summary of all new major assets planned for this province is provided in Table 7-17Table 7-16 to Table 7-20.

Table 7-17: Planned transformers for Gauteng

Transformer type	2022 to 2026		2027 to 2032	
	Quantity	Total capacity (MVA)	Quantity	Total capacity (MVA)
Special 90,8 MVA	3	272	-	-
Less than 100 MVA	-	-	1	1
Less than 300 MVA	-	-	3	750
Less than 500 MVA	2	630	5	1 575
500 MVA	3	1 500	15	7 500
800 MVA	1	800	1	800
Grand total	**9**	**3 202**	**25**	**10 626**

Table 7-18: Planned overhead lines for Gauteng

Line voltage	2023 to 2027	2028 to 2032
	Total length (km)	Total length (km)
275 kV	-	19
400 kV	63	135
Grand total	**63**	**154**

Table 7-19: Planned capacitor banks for Gauteng

Capacitor type	2022 to 2026		2027 to 2032	
	Quantity	Total capacity (Mvar)	Quantity	Total capacity (Mvar)
48 Mvar 88 kV	-	-	2	96
72 Mvar 132 kV	-	-	5	360
Grand total	**-**	**-**	**7**	**456**

Table 7-20: Planned reactors for Gauteng

Reactor type	2022 to 2026		2027 to 2032	
	Quantity	Total capacity (Mvar)	Quantity	Total capacity (Mvar)
48 Mvar 88 kV	-	-	3	144
40 Mvar 132 kV	-	-	-	-
72 Mvar 132 kV	-	-	4	288
100 Mvar 400 kV	-	-	-	-
Grand total	**-**	**-**	**7**	**432**

7.4 KWAZULU-NATAL

KwaZulu-Natal is situated on the eastern seaboard of South Africa along the Indian Ocean. The capital of the province is Pietermaritzburg, and its largest city is Durban. The provincial economy is mainly driven by activities concentrated around the Port of Durban and the capital, Pietermaritzburg, with significant contributions in the Richards Bay-Empangeni area, the Ladysmith-Ezakheni area, and the Newcastle-Madadeni region.

The Port of Durban and the Richards Bay Harbour play a key role in the import and export of goods in South Africa and neighbouring countries. The province has also established the Dube TradePort as an air logistics platform to promote access to global trade and tourist nodes between these two seaports. It opens up new opportunities for the production and export of high-value perishable products and manufactured goods and for shipping them directly from the King Shaka International Airport.

The Dube TradePort and the Richards Bay IDZ have been designated as special economic zones, providing incentives to attract potential investors to the province. These zones are linked to a number of agri-parks and industrial economic hubs that are being established to offer strong production linkages and clustering potential.

The main transmission supply network to KwaZulu-Natal is predominantly connected at 400 kV, with the local transmission stations mostly connected at 275 kV. The current transmission network is shown in Figure 7-10.

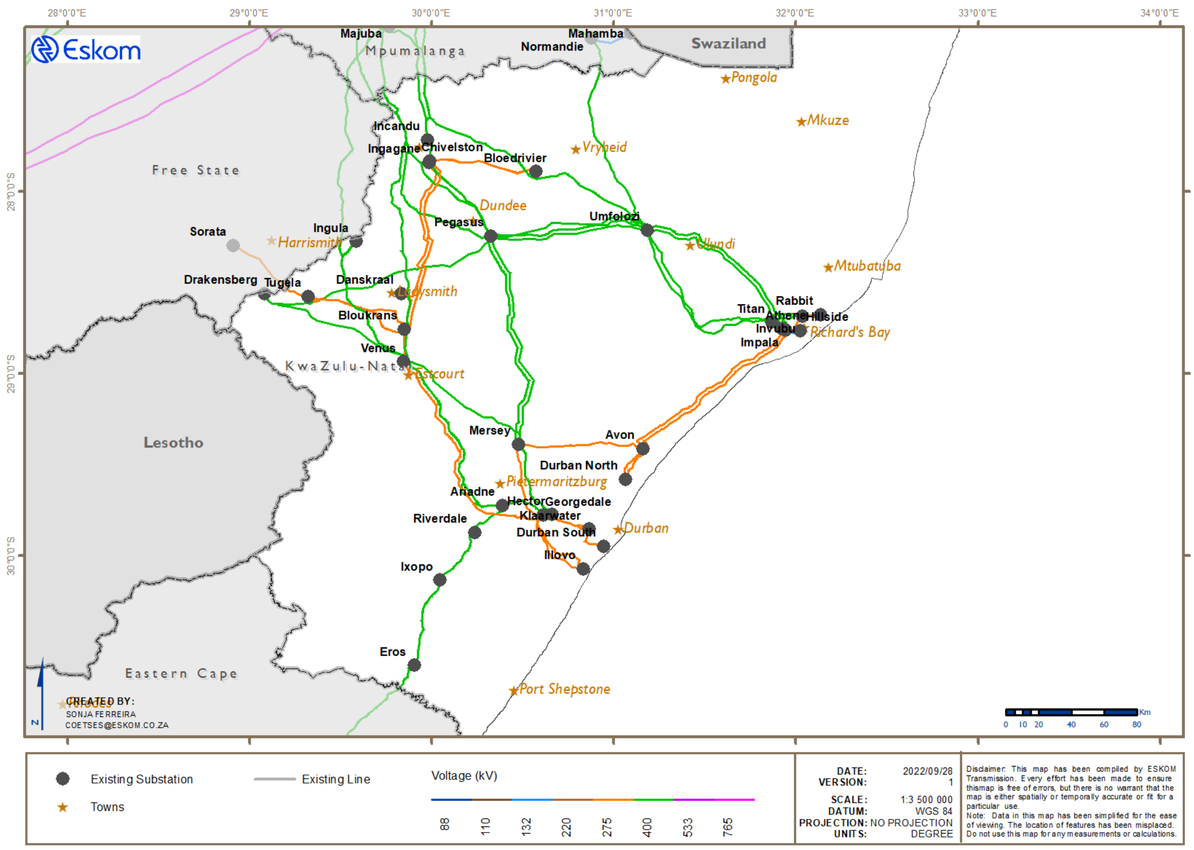


Figure 7-10: Current KwaZulu-Natal transmission network

7.4.1 GENERATION

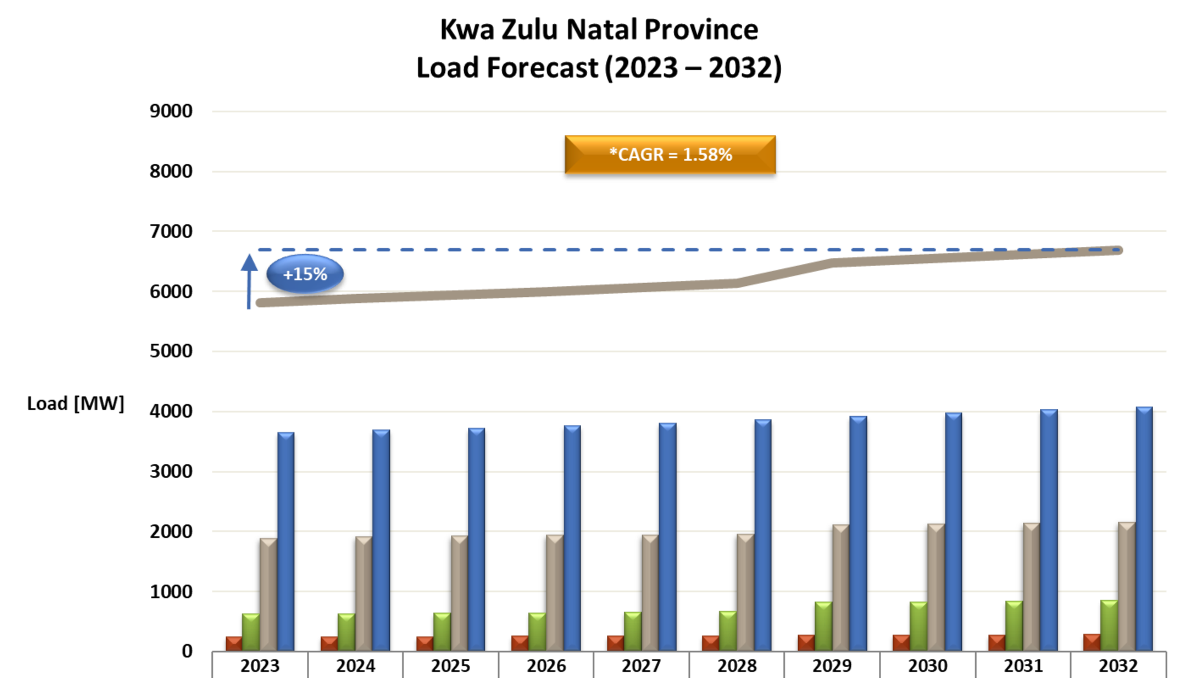
Most of the electricity consumed in KwaZulu-Natal is sourced from the power stations in Mpumalanga via 400 kV transmission lines.

There are three peaking plants in the province, consisting of a gas plant and two pumped-storage plants. These comprise the Avon OCGT and the Drakensberg and Ingula Pumped-Storage Stations. Avon OCGT has a generating capacity of 680 MW. Drakensberg and Ingula Pumped-Storage Stations have generating capacities of 1 000 MW and 1 333 MW, respectively.

7.4.2 LOAD FORECAST

The economic mix in KwaZulu-Natal comprises redistributors, commercial customers, and industrial customers. The provincial electricity demand peaked at around 5 920 MW in 2021, given the riots in July 2021 and the floods in April 2022 that negatively affected the province, leading to a decrease in load. The load is forecasted to grow steadily at about 1,9% annually, from 5 814 MW in 2023 to 6 694 MW by 2032.

The KwaZulu-Natal Grid comprises four CLNs, namely, Empangeni, Ladysmith, Newcastle, and Pinetown. The Empangeni and Pinetown CLNs are the two main load centres in the province, consuming approximately 31% and 52% of the load, respectively. Ladysmith and Newcastle CLNs make up the remaining 17% of the demand in the province. The highest provincial load growth is expected in the Pinetown and Empangeni CLNs due to industrial, commercial, and residential developments. The load forecast for KwaZulu-Natal is shown in Figure 7-11.



	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Ladysmith	236	240	243	247	251	257	262	268	274	280
Newcastle	630	633	636	647	659	670	822	830	839	848
Empangeni	1872	1906	1921	1932	1941	1953	2108	2121	2133	2152
Pinetown	3640	3681	3717	3754	3801	3860	3909	3969	4019	4070
Provincial Peak	5814	5890	5942	5999	6063	6141	6470	6548	6617	6694
2032 Peak	6694	6694	6694	6694	6694	6694	6694	6694	6694	6694

Figure 7-11: KwaZulu-Natal load forecast

7.4.3 PLANNED PROJECTS

Several projects and schemes that aim to address the long-term requirements of the province have been initiated to accommodate the forecasted load and generation.

7.4.3.1 Major schemes

The major TDP schemes planned in KwaZulu-Natal are as follows.

KZN 765 kV strengthening: Empangeni integration

This project entails the construction of the Mbewu-Umfolozi 765 kV line and the establishment of Mbewu 765/400 kV substation near Empangeni. Initially, the planned Mbewu-Umfolozi 765 kV line will be operated at 400 kV, and only the 400 kV yard will be established at Mbewu substation. Mbewu substation will be integrated into the 400 kV network by looping in the Athene-Umfolozi and Invubu-Umfolozi 400 kV lines and the new Invubu-Mbewu 400 kV line. The introduction of 765 kV will depend on demand growth (generation and/or load) in the province.

KZN strengthening: Iphiva 400/132 kV substation

This project involves establishing Iphiva 400/132 kV substation near Mkuze to address supply constraints around Pongola, Makhatini Flats, and iSimangaliso (Greater St Lucia) Wetland Park. The planned Iphiva substation will be supplied by two 400 kV lines, namely, the Normandie-Iphiva and Duma-Iphiva 400 kV lines. The two 400 kV lines will be executed in various stages. The implementation of each stage will depend on demand growth (generation and/or load) and network strengthening requirements.

eThekwini electricity network strengthening

This scheme involves establishing Inyaninga 2 x 500 MVA 400/132 kV substation near King Shaka International Airport and Shongweni 2 x 500 MVA 400/132 kV substation near Ntshongweni.

Inyaninga substation will be supplied by two Inyaninga-Mbewu 400 kV lines. It will deload the Mersey-Avon 275 kV system and supply the Dube TradePort Development.

Shongweni substation will be supplied by two Hector-Shongweni 400 kV lines. It will deload the Hector-Klaarwater and Georgedale-Klaarwater 275 kV system and supply the projected demand growth around Hillcrest and Ntshongweni.

KZN 765 kV strengthening: Pinetown integration

This project entails the construction of the Isundu-Venus 765 kV line and the establishment of Isundu 765/400 kV substation near Pietermaritzburg. Initially, the planned Isundu-Venus

765 kV line will be operated at 400 kV, and only the 400 kV yard will be established at Isundu substation. Isundu substation will be integrated into the 400 kV network by looping in the Ariadne-Hector 400 kV Line 1. The introduction of 765 kV will depend on demand growth (generation and/or load) in the province.

KZN 765 kV strengthening: Isundu-Mbewu 400 kV Lines 1 and 2

This project entails the construction of Isundu-Mbewu 400 kV Lines 1 and 2 to interconnect Isundu and Mbewu substations. The two lines will provide redundancy to Isundu and Mbewu substations during network contingencies. Isundu-Mbewu 400 kV Line 1 will also be the main 400 kV supply to Inyaninga 400/132 kV substation, although Inyaninga substation would initially be supplied from Mbewu substation.

7.4.3.2 New substations

The following new substations will be established in KwaZulu-Natal during this TDP period to address load growth and reliability:

- Mbewu 400 kV switching station near Empangeni town
- Iphiva 400/132 kV substation near Mkuze town
- Inyaninga 400/132 kV substation near King Shaka Airport in Durban
- Shongweni 400/132 kV substation near Ntshongweni
- Isundu 400 kV switching station near Pietermaritzburg

7.4.3.3 New lines

The following new transmission lines will be constructed in KwaZulu-Natal during this TDP period to address demand growth and reliability:

- The Ariadne-Venus second 400 kV line involves dismantling an existing Georgedale-Venus 275 kV line and constructing a second Ariadne-Venus 400 kV line. Construction of the line is under way.
- The Ariadne-Eros second 400 kV line involves constructing a 400/132 kV multi-circuit line between Ariadne substation and Eros substation. The 400 kV circuit will extend from Ariadne substation to Eros substation, but the 132 kV circuit will go from Ariadne and terminate in Port Shepstone. Construction of the line is under way.
- Mbewu-Umfolozi 765 kV line (operated at 400 kV)
- Invubu-Mbewu 400 kV line

- Iphiva-Normandie 400 kV line
- Inyaninga-Mbewu 2 x 400 kV lines
- Hector-Shongweni 2 x 400 kV lines
- Isundu-Venus 765 kV line (operated at 400 kV)

7.4.3.4 Reactive power compensation

In KwaZulu-Natal, there are plans to refurbish the Athene and Impala static var compensators (SVCs).

7.4.3.5 Network strengthening projects

The following strengthening projects are planned for the period between 2022 and 2031.

Table 7-21: KwaZulu-Natal – summary of projects and timelines

TDP scheme	Scope of work	Expected CO year
Ariadne-Venus 400 kV Line 2	• Construct Ariadne-Venus 400 kV Line 2 by recycling Georgedale-Venus 275 kV Line 2	2024
South Coast strengthening	• Construct Ariadne-Eros 400 kV Line 2	2024
Transnet Freight Rail upgrade	• Madlanzini 1 x 160 MVA 400/88 kV substation	2033
	• Loop-in Camden-Normandie 400 kV Line 1	
	• Nzalo 1 x 160 MVA 400/88 kV substation	
	• Loop-in Normandie-Umfolozi 400 kV Line 1	
	• Duma 1 x 160 MVA 400/88 kV substation	
	• Loop-in Pegasus-Athene 1 400 kV Line 1	
KZN 765 kV strengthening – Empangeni integration	• Mbewu 400 kV switching station	2028
	• Loop-in Athene-Umfolozi 400 kV Line 1 and Invubu-Umfolozi 400 kV Line 1 into Mbewu substation	
	• Construct Umfolozi-Mbewu 765 kV line (extension of Majuba-Umfolozi 765 kV Line 1); operate at 400 kV	
	• Construct Invubu-Mbewu 400 kV Line 2	
Northern KZN strengthening – Phase 1	• Establish 1 x 500 MVA 400/132 kV Iphiva substation	2029

TDP scheme	Scope of work	Expected CO year
	• Construct Normandie-Iphiva 400 kV Line 1	
eThekwini electricity network strengthening	• Establish 2 x 500 MVA 400/132 kV Inyaninga substation	2034
	• Construct Inyaninga-Mbewu 400 kV Lines 1 and 2	
	• Establish 2 x 500 MVA 400/132 kV Shongweni substation	2036
	• Construct Hector-Shongweni 400 kV Lines 1 and 2	
KZN 765 kV strengthening – Pinetown integration	• Isundu 400 kV switching station	2032
	• Loop-in Ariadne-Venus 400 kV Line 1 into Isundu substation	
	• Construct Isundu-Venus 765 kV line; operate at 400 kV	
KZN 765 kV strengthening – Isundu-Mbewu 400 kV interconnector	• Construct Isundu-Mbewu 400 kV Lines 1 and 2	2032

7.4.3.6 Projects for future independent power producers

A 400 kV substation will be required in Richards Bay to integrate the proposed large-scale gas-to-power plants. The high-level scope of work to integrate a large-scale gas-to-power plant into the transmission grid is as follows:

- Establishment of a 400 kV substation at the gas plant facility
- Construction of 4 x 400 kV lines from the gas plant to loop into the Athene-Invubu and Athene-Umfolozi 400 kV lines

7.4.3.7 Projects for alternative generation scenario

No alternative generation scenario has been identified for KwaZulu-Natal.

7.4.3.8 Provincial summary

The future transmission network for the province is shown in Figure 7-12 below.

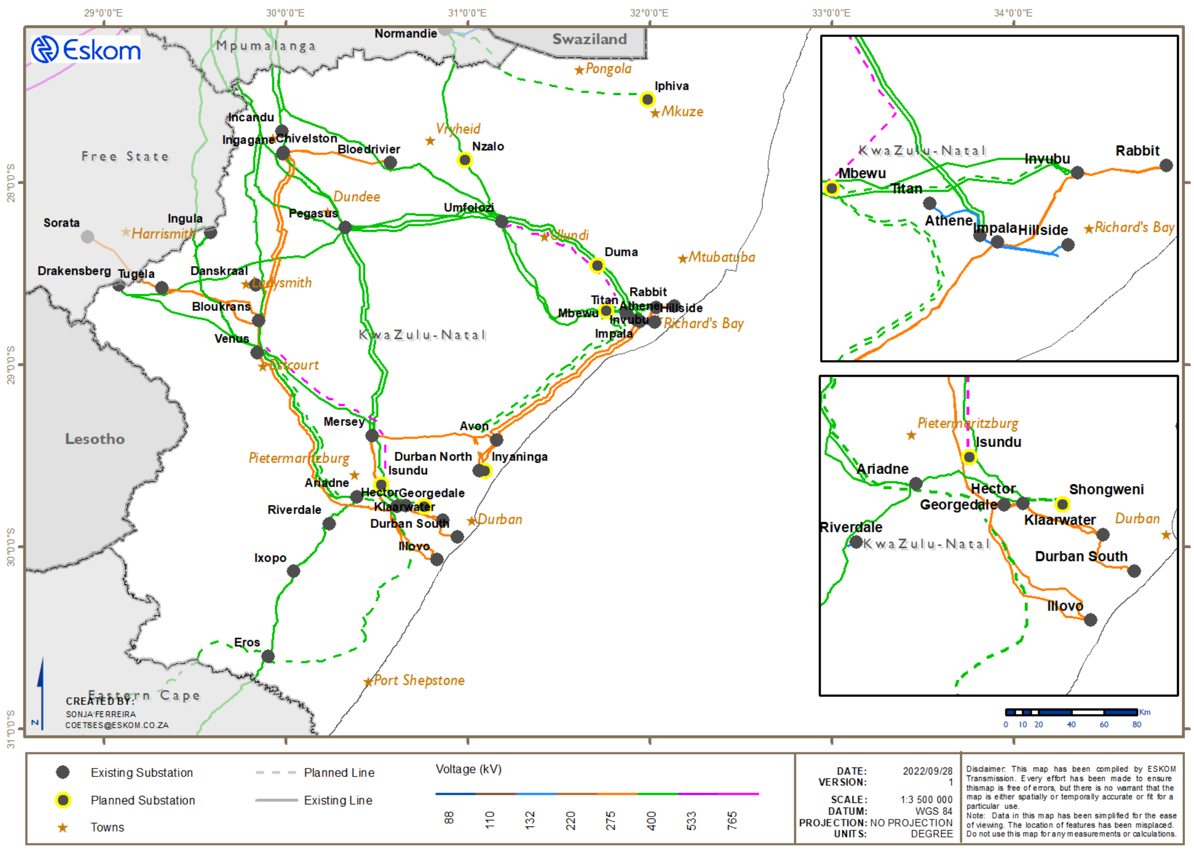


Figure 7-12: Future KwaZulu-Natal transmission network

A summary of all new major assets planned for this province is provided in **Table 7-22** and **Table 7-23**.

Table 7-22: Planned transformers for KwaZulu-Natal

Transformer type	2023 to 2027		2028 to 2032	
	Quantity	Total capacity (MVA)	Quantity	Total capacity (MVA)
Less than 100 MVA	-	-	1	10
Less than 300 MVA	9	1 980	-	-
500 MVA	-	-	1	500
800 MVA	-	-	2	1 600
Grand total	**9**	**1 980**	**4**	**2 110**

Table 7-23: Planned overhead lines for KwaZulu-Natal

Line voltage	2023 to 2027	2028 to 2032
	Total length (km)	Total length (km)
400 kV	580	316
765 kV	-	188
Grand total	**580**	**504**

7.5 LIMPOPO

Limpopo is situated in the northernmost part of South Africa and is named after the mighty Limpopo River that runs through it. Limpopo is the fifth-largest province in South Africa and shares international borders with Botswana, Mozambique, and Zimbabwe. The capital city of the province is Polokwane.

The provincial economy is mainly driven by mining, the exportation of primary products, and the importation of manufactured goods. Limpopo is the "bread and fruit basket" of South Africa, producing up to 60% of all fruit, vegetables, maize meal, wheat, and cotton. Major international mining operations contribute 20% to Limpopo's economy, making mining one of the primary drivers of economic activity in the province. Limpopo's diverse mining activities include diamonds, iron ore, coal, copper, platinum, and chrome.

The transmission network of the province comprises 400 kV and 275 kV and is interconnected via the 132 kV underlying distribution network. The current transmission network is shown in Figure 7-13.

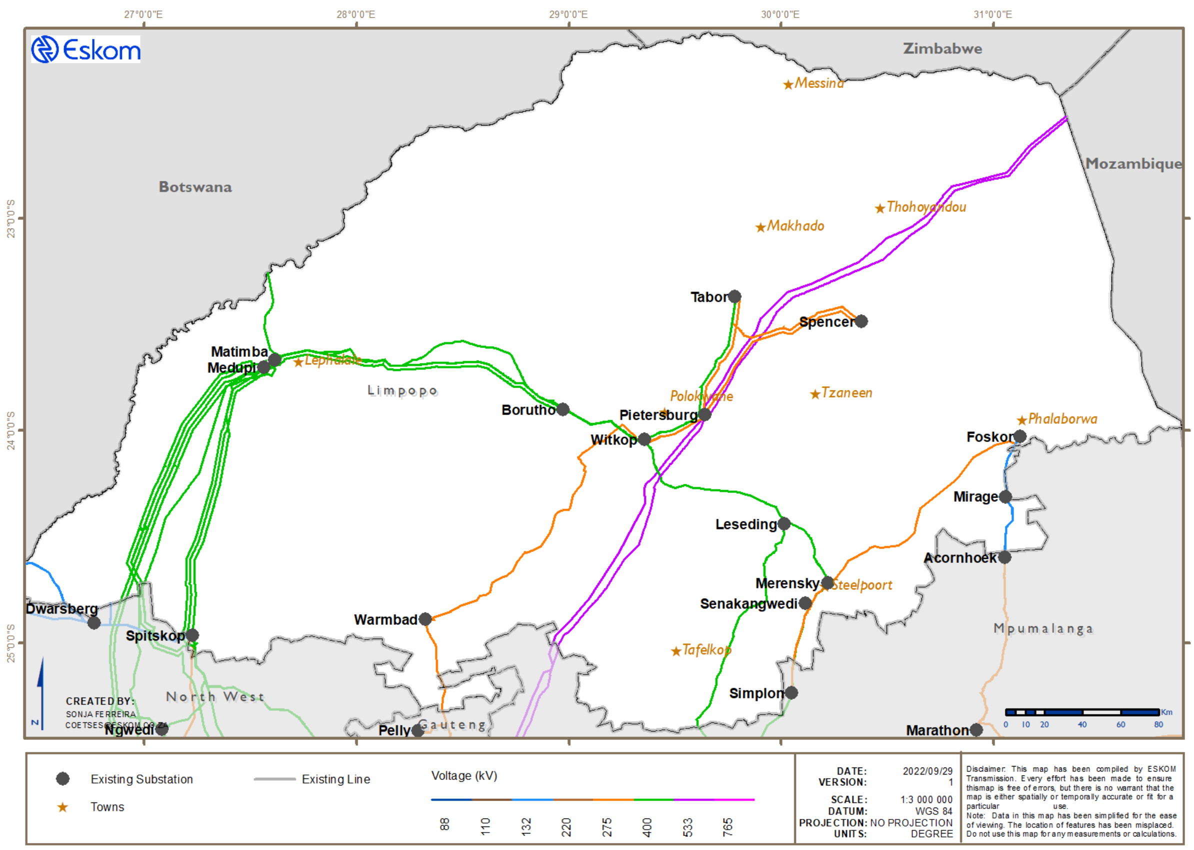


Figure 7-13: Current Limpopo transmission network

7.5.1 Generation

The baseload generation in Limpopo is located in the coal mining town of Lephalale, which has rich coal reserves. Two coal-fired power stations are located in this area, namely, Medupi and Matimba Power Stations. With the completion of Medupi in 2021, these two power stations can provide almost 8,5 GW of generation to the South African grid; however, since 8 August 2021, Medupi Unit 4 has been out of service due to an explosion.

Matimba Power Station, named after the Tsonga word for “power”, is one of the world’s largest direct dry-cooled power stations, with 6 x 665 MW turbo-generator units. Matimba was commissioned in 1989 and is designed to generate 3 990 MW of power. The adjacent Grootegeluk Colliery has sufficient coal reserves to guarantee Matimba a minimum lifespan of 35 years, extending it to a possible 50 years at 2 100 tons of coal per hour.

Medupi Power Station, named after the Sepedi word meaning “gentle rain”, will be one of the largest coal-fired plants and the largest dry-cooled power station in the world. It will be

25% larger than Matimba Power Station in terms of operation, design, and dimensions. The power station has a generating capacity of 4 356 MW (6 x 726 MW units).

The REIPPPP has provided a platform for the private sector to invest in RE connected to the South African power grid. The total approved capacity in Limpopo since the inception of the programme amounts to 118 MW. The composition is shown in Table 7-24.

Table 7-24: Approved projects in Limpopo under the REIPPPP

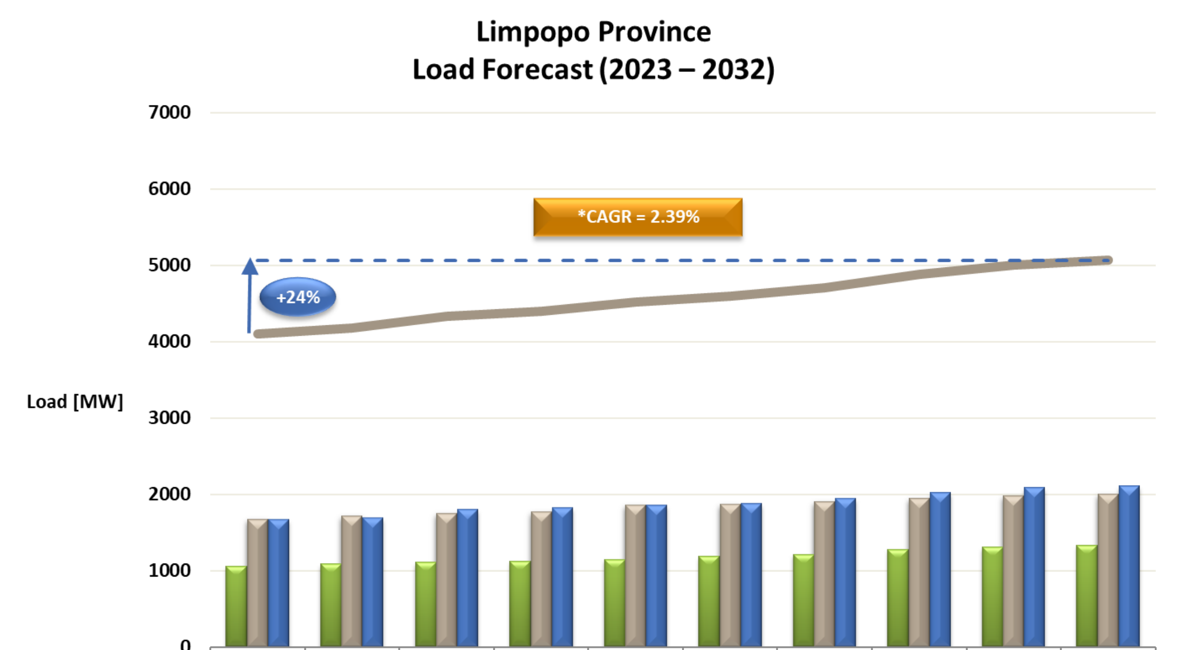
Programme and bid window	Name of project	Type	Capacity (MW)	Transmission substation
IPP RE 1	Tabor PV plant	PV	28	Tabor 132 kV
	Witkop PV plant	PV	30	Witkop 132 kV
IPP RE 3	Matimba PV plant	PV	60	Matimba 132 kV

7.5.2 LOAD FORECAST

The 2021 peak load for the province was 3 106 MW. There was an increase of 207 MW compared to the peak demand of 2 899 MW that was experienced for the year 2019.

The province consists of three CLNs: Lephalale, Polokwane, and Phalaborwa. The Lephalale CLN is expected to have a steady growth rate of 2,39%. This can be attributed to heavy and light industry and commercial and residential developments as spin-offs. Mining activities are also expected in the areas of Lephalale and Phalaborwa CLN, as well as increased mining activities and possible smelting operations near Leseding substation over the next 10 years.

The load forecast for Limpopo is shown in Figure 7-14.



	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Polokwane	1065	1090	1109	1131	1153	1190	1216	1280	1311	1339
Lephalale	1670	1708	1742	1764	1854	1872	1904	1946	1978	1995
Phalaborwa	1665	1692	1806	1828	1852	1877	1939	2020	2086	2109
Provincial Peak	4099	4183	4334	4395	4523	4600	4710	4886	5004	5069
2032 Peak	5069	5069	5069	5069	5069	5069	5069	5069	5069	5069

Figure 7-14: Limpopo load forecast

7.5.3 PLANNED PROJECTS

Several projects and schemes that aim to address the long-term requirements of the province have been initiated to accommodate the forecasted load and generation.

7.5.3.1 Major schemes

The major schemes for the province consist of the establishment of a 765 kV network (operated at 400 kV), integration of the Medupi Power Station, and extension of the 400 kV and 275 kV networks, which entails installation of additional transformers at existing and new substations.

The major TDP schemes planned in Limpopo are as follows.

Medupi Transmission integration (400 kV and 765 kV)

The project is part of the original scope for Medupi Power Station integration into the grid. It entails constructing the 400 kV and 765 kV lines from the vicinity of Medupi Power Station to bulk power evacuation points in Polokwane CLN and North West.

Waterberg generation 400 kV stability enhancement

The following projects are required due to future planned generation projects around the Waterberg area. These projects were raised to ensure that the power stations in the area would remain transiently stable.

- 400 kV line from Medupi to Witkop (~200 km)
- 400 kV line from Borutho to Silimela (~100 km)

Nzhelele 400 kV integration

The integration of 400 kV into Nzhelele is required to deload Tabor and Spencer substations and to enable load growth in the northern parts of Limpopo. The 400 kV supply to enable this project will be sourced from Tabor and Borutho substations through two 400 kV lines.

Limpopo East corridor strengthening

These projects will resolve transformation constraints and supply future load growth around Spencer and Foskor substations for the next 20 years. In addition, this scheme will introduce 400 kV corridors between Spencer, Foskor, and Merensky substations, resulting in higher transfer limits and savings in losses on the Limpopo transmission network.

Silimela substation

A new transmission substation will be introduced next to the existing Wolwekraal distribution substation to resolve network constraints in the Mapoch and Kwaggafontein areas. In addition, the substation will supply the long-term future load growth expected in the south-western part of the Phalaborwa CLN and deload Simplon substation. This project is currently in execution.

Sekhukhune substation

Sekhukhune substation will be constructed near Uchoba distribution substation to create additional transmission network capacity for forecasted future load growth in the Steelpoort area.

7.5.3.2 New substations

The following new substations will be established in Limpopo to address current and future load growth in the network:

- Nzhelele 400/132 kV substation
- Silimela 400/132 kV substation
- Sekhukhune 400/275/132 kV substation

Some of the new substations have been renamed as indicated in Table 7-25.

Table 7-25: Limpopo substation name changes

Previous name	New name
Marble Hall	Silimela
Mogwase	Ngwedi
Tubatse	Manogeng
Pholo/Maphutha/Senakangwedi B	Sekhukhune
Dwaalboom	Dwarsberg
Rockdale B	Emkhiweni

7.5.3.3 New lines

The following new lines will be established in the network as part of the Medupi integration requirements in order to ensure transient stability of the generation in the area, to connect new substations, and to alleviate network constraints:

- Medupi-Witkop 400 kV line
- Medupi-Borutho 400 kV line
- Borutho-Silimela 400 kV line
- Borutho-Nzhelele 400 kV line
- Manogeng-Sekhukhune 400 kV line
- Sekhukhune-Senakangwedi 275 kV line
- Manogeng-Silimela 400 kV line
- Witkop-Sekhukhune 400 kV line
- Tabor-Nzhelele 400 kV line

- Foskor-Merensky second 275 kV line (built at 400 kV specification)
- Foskor-Spencer 400 kV line

7.5.3.4 Reactive power compensation

The following capacitor banks will be installed for voltage support in Limpopo:

- 2 x 36 Mvar 132 kV capacitor banks at Tabor substation
- 2 x 36 Mvar 132 kV capacitors at Spencer substation

7.5.3.5 Network strengthening projects

The following strengthening projects are planned for the period between 2023 and 2032.

Table 7-26: Limpopo – summary of projects and timelines

TDP scheme	Project name	Expected CO year
Medupi Transmission integration	• Medupi-Borutho 400 kV line	2022
	• Medupi-Ngwedi first 765 kV line (energised at 400 kV)	2024
Waterberg generation 400 kV stability enhancement	• Medupi-Witkop first 400 kV line	2024
	• Borutho-Silimela first 400 kV line	2029
Highveld North-West and Lowveld North reinforcement Phase 2	• Silimela 400/132 kV substation	2024
	• Manogeng 400 kV switching station	
	• Loop-in Duvha-Leseding 400 kV line into Manogeng switching station	
	• Manogeng-Silimela 400 kV line	
Highveld North-West and Lowveld North reinforcement Phase 1	• Emkhiweni-Silimela 400 kV line	2029
Sekhukhune integration Phase 1	• Sekhukhune 400/275/132 kV substation (1 x 800 MVA 400/275 kV transformer and 2 x 500 MVA 400/132 kV transformers)	2032
	• Loop-in Arnot-Merensky 400 kV into Sekhukhune substation	
	• Manogeng-Sekhukhune first 400 kV line	
	• Sekhukhune-Senakangwedi first 275 kV line	
Sekhukhune integration Phase 2	• Witkop-Sekhukhune first 400 kV line	2032
Nzhelele 400 kV integration	• Nzhelele 400/132 kV substation (2 x 500 MVA 400/132 kV transformers)	2032

TDP scheme	Project name	Expected CO year
	• Tabor-Nzhelele 400 kV line	
	• Borutho-Nzhelele first 400 kV line	
Foskor and Acornhoek 275/132 kV transformation upgrades	• Foskor-Merensky second 400 kV line	2029
Limpopo East corridor strengthening	• Establishment of 400 kV busbars at Spencer substation and Foskor substation	2029
	• Foskor first 400 MVA 400/275 kV transformer	
	• Spencer first 500 MVA 400/132 kV transformer	
	• Foskor-Spencer first 400 kV line (110 km)	
	• Merensky-Foskor second 275 kV line changeover to 400 kV line	
Polokwane reactive power compensation	• Spencer 2 x 36 Mvar capacitor banks	2027
	• Tabor 2 x 36 Mvar capacitor banks	2026
Warmbad transformation upgrade	• Warmbad first 250 MVA 275/132 kV transformer	2027
Leseding transformation upgrade	• Leseding third 500 MVA 400/132 kV transformer	2029
Acornhoek transformation upgrade	• Acornhoek third 125 MVA 400/132 kV transformer	2027
Borutho transformation upgrade	• Borutho third 500 MVA 400/132 kV transformer	2028

7.5.3.6 Projects for future independent power producers

There is sufficient transmission network capacity to integrate future planned IPPs in the province. Therefore, no additional transmission projects are required to enable the future connection of the IPPs in Limpopo at this stage.

7.5.3.7 Projects for alternative generation scenario

No alternative generation scenario has been identified for Limpopo.

7.5.3.8 Provincial summary

The future transmission network for the province is shown in Figure 7-15 below.

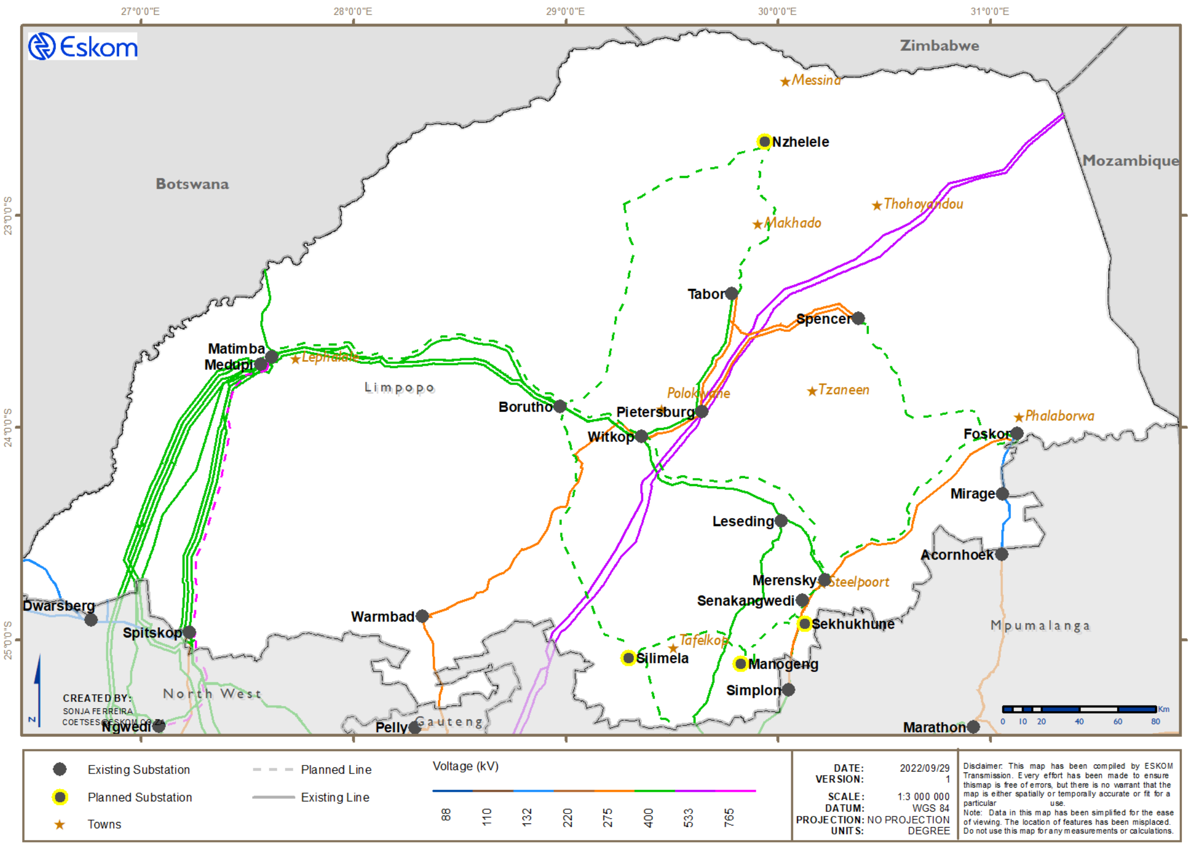


Figure 7-15: Future Limpopo transmission network

A summary of all new major assets planned for this province is provided in Table 7-27 to Table 7-30.

Table 7-27: Planned transformers for Limpopo

Transformer type	2023 to 2027		2028 to 2032	
	Quantity	Total capacity (MVA)	Quantity	Total capacity (MVA)
Less than 100 MVA	4	490	-	-
Less than 300 MVA	3	625	-	-
Less than 500 MVA	-	-	2	715
500 MVA	-	-	5	2 500
800 MVA	-	-	1	800
Grand total	**7**	**1 115**	**8**	**4 015**

Table 7-28: Planned overhead lines for Limpopo

Line voltage	2023 to 2027	2028 to 2032
	Total length (km)	Total length (km)
275 kV	-	150
400 kV	276	845
Grand total	**276**	**995**

Table 7-29: Planned capacitor banks for Limpopo

Capacitor type	2023 to 2027		2028 to 2032	
	Quantity	Total capacity (Mvar)	Quantity	Total capacity (Mvar)
40 Mvar 132 kV	4	160	-	-
48 Mvar 88 kV	-	-	2	96
Grand total	**4**	**160**	**2**	**96**

Table 7-30: Planned reactors for Limpopo

Reactor type	2023 to 2027		2028 to 2032	
	Quantity	Total capacity (Mvar)	Quantity	Total capacity (Mvar)
100 Mvar 400 kV	-	-	2	200
Grand total	**-**	**-**	**2**	**200**

7.6 MPUMALANGA

Mpumalanga is a province located in the north-eastern part of South Africa that shares international borders with Mozambique and Swaziland. The capital of Mpumalanga is Nelspruit, the major city in the Mbombela Local Municipality. The provincial economy is largely driven by farming, mining, heavy industry, and tourism – thanks to attractions such as the Kruger National Park, Sudwala Caves, and Blyde River Canyon.

The transmission grid in Mpumalanga is comprised mainly of 275 kV and 400 kV overhead lines. The supply to the Cape corridor is via the Alpha and Zeus 400/765 kV substations located in Mpumalanga. International customers, namely, Mozambique and Swaziland, also connect to the Eskom network at 132 kV, 275 kV, and 400 kV. Figure 7-16 represents the current transmission network in Mpumalanga.

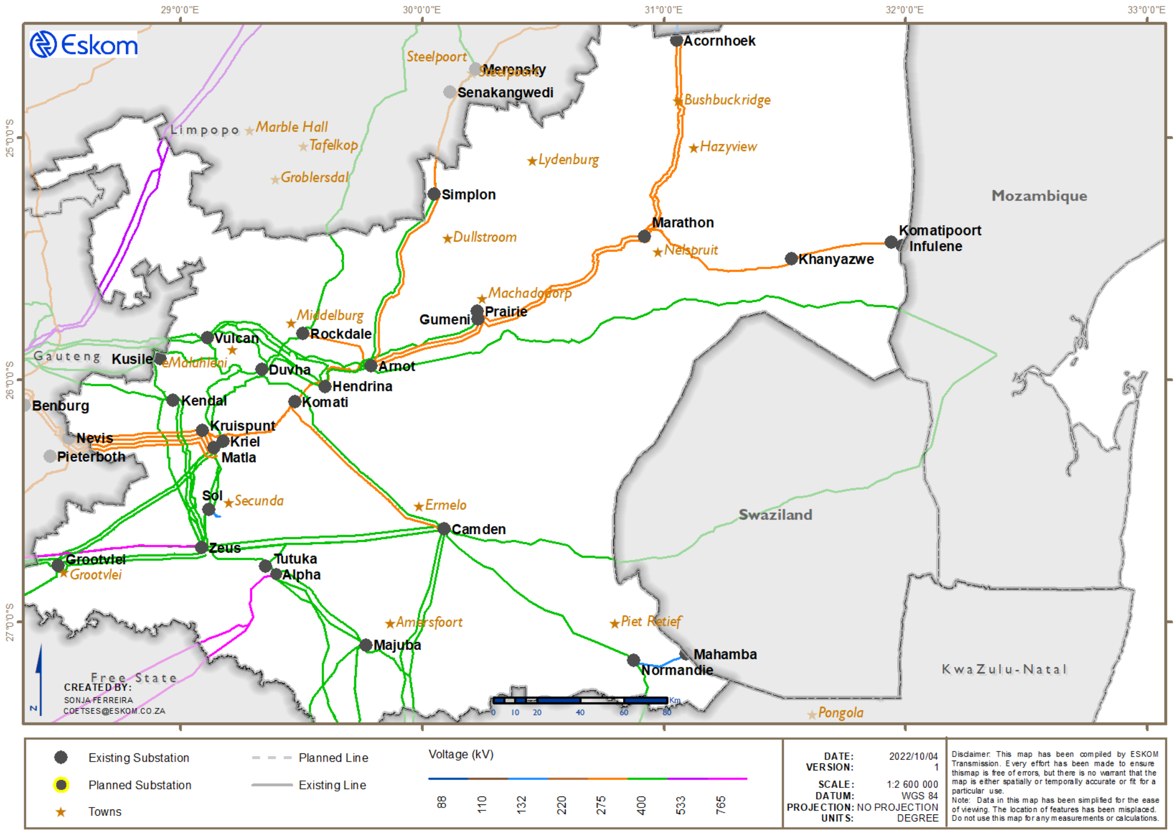


Figure 7-16: Current Mpumalanga transmission network

7.6.1 GENERATION

Mpumalanga is considered the generation hub of South Africa's electricity network due to the concentration of power stations in this region and their proximity to the large load centres. Currently, 12 of 14 Eskom coal-fired power stations, namely, Arnot, Camden, Duvha, Grootvlei, Hendrina, Kendal, Komati, Kriel, Matla, Majuba, and Tutuka, also including one of the two Eskom power stations currently under construction, namely, Kusile Power Station, are located in Mpumalanga.

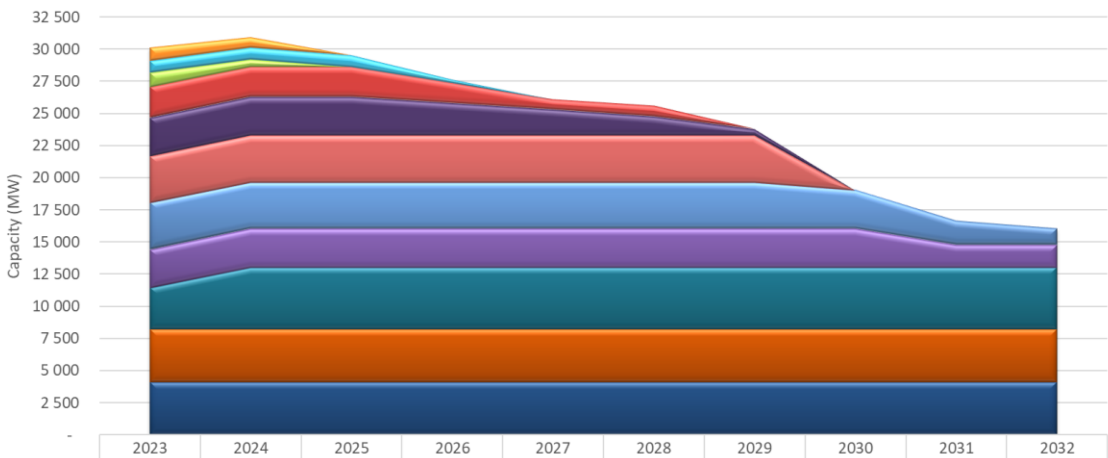
The total capacity of Kusile Power Station on completion is expected to be 5 076 MW. Table 7-31 details the programme for the Kusile units becoming commercially available.

Table 7-31: Kusile Power Station schedule

Generator unit	Planned CO date
Unit 1	2018
Unit 2	2019
Unit 3	2021
Unit 4	2023
Unit 5	2024
Unit 6	2024

The only remaining transmission project for the integration of Kusile Power Station is the Kusile-Lulamisa 400 kV line. This project was delayed due to servitude acquisition challenges and is required before Unit 5 is commissioned.

Hendrina, Grootvlei, and Komati Power Stations are close to reaching the end of their economic life. Figure 7-17 shows the existing nominal generation capacity of the coal-fired power stations in Mpumalanga and the expected drop in capacity over the TDP period. The capacity is expected to decrease from approximately 30 GW to 16 GW.



	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Hendrina	1 020	820	-	-	-	-	-	-	-	-
Grootvlei	900	900	900	300	-	-	-	-	-	-
Camden	1 161	570	-	-	-	-	-	-	-	-
Arnot	2 352	2 352	2 352	1 568	784	784	-	-	-	-
Kriel	3 000	3 000	3 000	2 500	2 000	1 500	500	-	-	-
Tutuka	3 654	3 654	3 654	3 654	3 654	3 654	3 654	-	-	-
Matla	3 600	3 600	3 600	3 600	3 600	3 600	3 600	3 000	1 800	1 200
Duvha	3 000	3 000	3 000	3 000	3 000	3 000	3 000	3 000	1 800	1 800
Kusile	3 200	4 800	4 800	4 800	4 800	4 800	4 800	4 800	4 800	4 800
Majuba	4 110	4 110	4 110	4 110	4 110	4 110	4 110	4 110	4 110	4 110
Kendal	4 116	4 116	4 116	4 116	4 116	4 116	4 116	4 116	4 116	4 116

Figure 7-17: Coal-fired Generation forecast for Mpumalanga

As the grid connection capacity in high-yield areas in the country for RE diminishes, there has been interest in connecting RE plants in Mpumalanga. Figure 7-18 shows the expected RE and battery energy storage system (BESS) integration forecasted for Mpumalanga according to the 2022 TDP Generation Assumptions Paper.

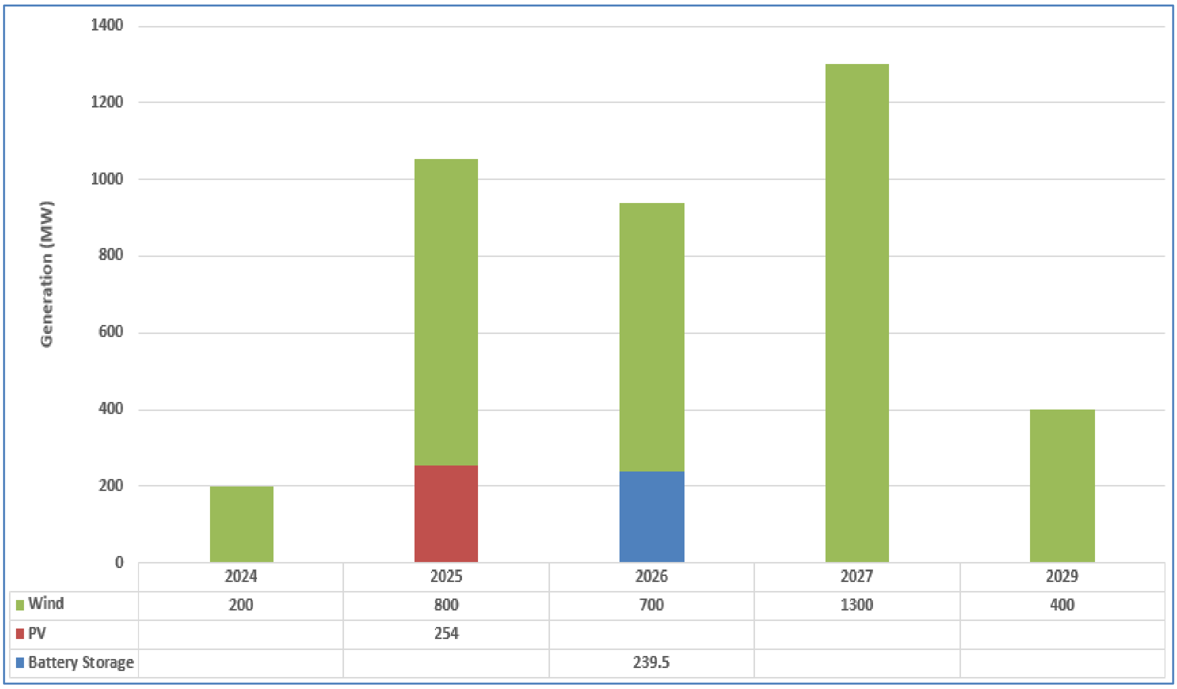


Figure 7-18: Renewable energy generation forecast for the North East Grid

Since the publishing of the assumptions paper, there have been further developments in RE integration throughout the province, especially in close proximity to the coal-fired power stations. The following transmission projects have been identified for integration of renewable energy in Mpumalanga and are in pre-concept phases; the scope of these projects could change once development is under way.

1. Majuba 2 x 315 MVA 400/88 kV transformer upgrades
2. Majuba 2 x 500 MVA 400/132 kV transformers
3. Prairie 500 MVA 275/132 kV Transformer 3
4. Alpha 2 x 500 MVA 400/132 kV transformers
5. Camden B 4 x 500 MVA 400/132 kV substation integration
6. Gumeni 2^{nd} 500 MVA 400/132 kV transformer
7. Hendrina 500 MVA 400/132 kV Transformer 3

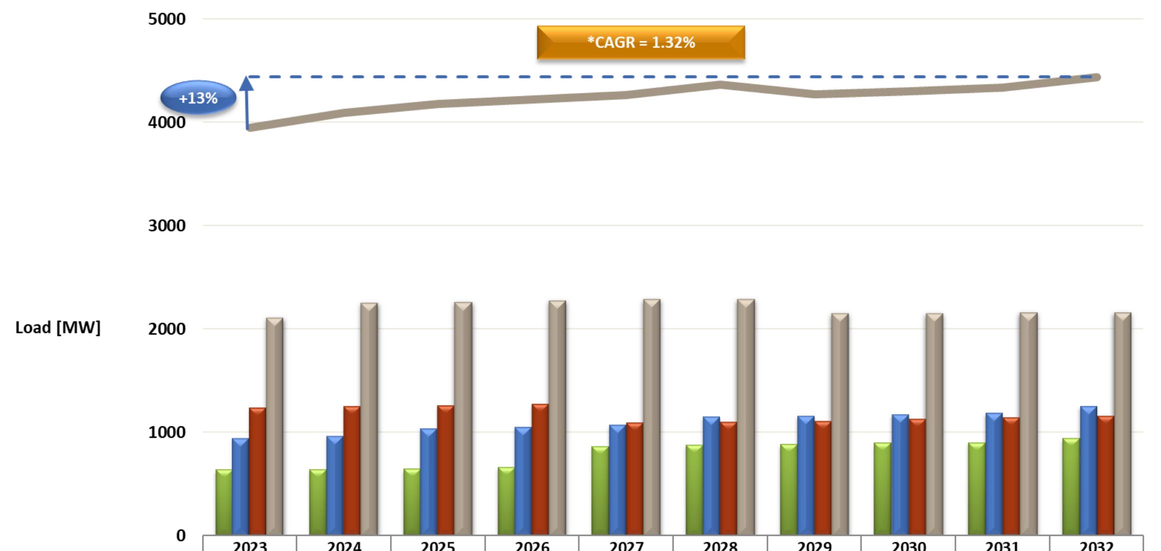
7.6.2 LOAD FORECAST

Load growth is expected in the province due to development in the commercial, electrification, and industrial sectors. The future load mix is not expected to differ from the existing one, mainly comprised of redistributors and mining, commercial, and industrial customers. The cumulative average growth rate in the TDP period is estimated at 1,32% per annum, from 3 945 MW (at provincial peak) in the year 2023 to 4 439 MW in the year 2032.

Mpumalanga consists of four CLNs, and each CLN is made up of a number of substations, as follows:

- **Highveld South CLN** – Sol, Camden, Alpha, Tutuka, Normandie, Majuba, Grootvlei, and Zeus
- **Lowveld CLN** – Marathon, Prairie, Simplon, Khanyazwe, Komatipoort, and Gumeni
- **Middelburg CLN** – Rockdale, Hendrina, Duvha, Komati, and Arnot
- **Witbank CLN** – Vulcan, Matla, Kendal, Kriel, Kruispunt, and Kusile

The load forecast for Mpumalanga is shown in Figure 7-19.



	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Middelburg	638	641	644	663	863	877	883	896	901	941
Lowveld	944	970	1042	1052	1076	1154	1164	1174	1186	1253
Witbank	1237	1254	1264	1274	1096	1104	1112	1129	1145	1162
Highveld South	2114	2254	2265	2276	2287	2293	2150	2153	2158	2157
Provincial Peak	3945	4095	4181	4221	4268	4362	4269	4302	4334	4439
2032 Peak	4439	4439	4439	4439	4439	4439	4439	4439	4439	4439

Figure 7-19: Mpumalanga load forecast

7.6.3 PLANNED PROJECTS

Several projects and schemes that aim to address the long-term requirements of the province have been initiated in order to accommodate the forecasted load and generation.

7.6.3.1 Major schemes

The major TDP schemes planned in Mpumalanga are as follows.

Emkhiweni 400/132 kV integration

This scheme entails establishing the new Emkhiweni 400/132 kV substation, which is required to address both Vulcan and Rockdale unfirm transformations. The project is also integral to the line deviation projects planned by Eskom Distribution, related to undermining and burning grounds. The project will comprise 2 x 500 MVA transformers and turn-ins from the existing Arnot-Kendal 400 kV line. This project recently entered the execution phase and is also dependent on Eskom Distribution integration plans. The second phase of this scheme includes the Emkhiweni-Silimela 400 kV line, as the Silimela integration project in Limpopo is at an advanced stage and is expected to be completed before the Emkhiweni integration.

Wonderkrag 400/132 kV integration

This scheme entails establishing the new Wonderkrag 400/132 kV substation, which is required to address the unfirm transformation and fault level exceedance at Sol substation. The substation will comprise 4 x 500 MVA transformers as well as a fifth standby transformer. This project is currently in the execution phase, but is facing land acquisition challenges. Due to this delay, an interim solution is being investigated as part of the Wonderkrag integration. A switching station named Amafutha is now being expedited to meet certain customer commitments.

Marathon 400/132 kV integration

This project is required to address the low voltages under the loss of any 275 kV line in that corridor. The scope of work for this phase is the following:

- Marathon 400/132 kV substation (first 500 MVA 400/132 kV transformer)
- Marathon-Gumeni 400 kV line

The project has been delayed for longer than expected, as the servitude challenges include an expropriation process.

Madlanzini 400/88 kV integration

This project forms part of the Transnet Freight Rail scheme, and the scope of work for the project is the following:

- Madlanzini 1 x 160 MVA 400/88 kV substation
- Loop-in Camden-Normandie 400 kV Line 1

Camden B 400/132 kV integration

This new project is in the concept phase and is required due to RE IPP interest in the vicinity of Camden Power Station. The scope of work for this project is the following:

- Camden B 4 x 500 MVA 400/132 kV substation
- Loop-in Camden-Incandu 400 kV line

7.6.3.2 New substations

Additional 400/132 kV substations will be established due to load growth in order to remain Grid Code compliant and to create additional capacity.

- Emkhiweni 400/132 kV substation will address both Vulcan and Rockdale unfirm transformations and improve safe working conditions over burning grounds. It will also address the N-1 line firmness to the future Silimela substation.
- Wonderkrag 400/132 kV substation will address the unfirm transformation and high fault levels at Sol substation.
- Madlanzini 400/88 kV substation is one of three traction substations required for the Transnet Freight Rail project and, hence, is customer dependent. The other two stations will be located in KZN.
- Camden B 400/132 kV substation is required for the integration of RE IPP projects and is in the concept phase.

7.6.3.3 New lines

- Emkhiweni-Silimela 400 kV line
- Emkhiweni 400 kV turn-ins
- Kusile-Lulamisa 400 kV line
- Gumeni-Marathon 400 kV line
- Madlanzini 400 kV turn-ins
- Camden B 400 kV turn-ins
- Camden-Sol Lines 1 and 2 turn-ins to Zeus

7.6.3.4 Reactive power compensation

No reactive power compensation projects (capacitor banks and/or SVCs) are planned for Mpumalanga for this TDP period. Eskom Distribution planned to add some compensation in the Lowveld network to improve voltages under contingency. However, these projects have since been deferred due to funding challenges, and the network will be prone to low voltages under contingency.

7.6.3.5 Network strengthening projects

The following strengthening projects are planned for the period between 2023 and 2032.

Table 7-32: Mpumalanga – summary of strengthening projects and timelines

Scheme name	Project/SOW	Expected CO date
Kusile integration Phase 2: Lulamisa	Kusile-Lulamisa 1st 400 kV line	2023
Emkhiweni 400 kV integration	Emkhiweni 2 x 500 MVA 400/132 kV substation	2026
	Turn-in of Kendal-Arnot 400 kV line into Emkhiweni 400/132 kV substation	
	Emkhiweni-Silimela 400 kV line	
Sol underrated equipment upgrade and FCLRs	Upgrade underrated equipment at Sol substation, and install FCLRs	2024
Wonderkrag 400 kV integration	New Wonderkrag 5 x 500 MVA 400/132 kV substation	2027
	Turn-in of Kriel-Zeus 400 kV line into Wonderkrag substation	
	Turn-in of Kriel-Tutuka 400 kV line into Wonderkrag substation	
Amafutha 132 kV switching station	Establish Amafutha switching station	2025
	2 x Sol-Amafutha 132 kV lines	
Mpumalanga underrated equipment upgrade (MURE)	Upgrade underrated equipment at Vulcan 400 kV, Rockdale 132 kV, Hendrina 400 kV, Kruispunt 132 kV, Komati 275 kV, Zeus 400 kV, Arnot 400 kV and 275 kV, Tutuka 400 kV, Alpha 400 kV, Majuba 400 kV, and Matla 275 kV; install Matla FCLRs	2026
Khanyazwe 2nd transformer	Install 1 x 500 MVA 275/132 kV transformer	2026
Marathon 400 kV integration	Gumeni-Marathon 400 kV line	2031
	Marathon 1 x 500 MVA 400/132 kV substation	
Transnet Freight Rail upgrade	Madlanzini 1 x 160 MVA 400/88 kV substation	2026 to 2029
	Loop-in Camden-Normandie 400 kV line 1	

7.6.3.6 Projects for future independent power producers

The table below outlines the RE integration projects currently in the concept phase in Mpumalanga.

Table 7-33: Summary of expected RE generation integration projects for Mpumalanga

Scheme name	Project/SOW	Expected CO date
Hendrina 500 MVA 400/132 kV Transformer 3	Install 1 x 500 MVA 400/132 kV transformer	2026
Majuba 400/88 kV transformer upgrades	Replace 2 x 160 MVA transformers with 315 MVA transformers	2026
Gumeni 2nd 400/132 kV transformer	Install the 2nd 500 MVA 400/132 kV transformer	2027
Prairie 500 MVA 275/132 kV Transformer 3	Install 1 x 500 MVA 275/132 kV transformer	2027
Majuba 400/132 kV extension	Install 2 x 500 MVA 400/132 transformers	2028
Alpha 400/132 kV extension	Install 2 x 500 MVA 400/132 kV transformers	2028
Camden B 400/132 kV integration	Establish Camden B 4 x 500 MVA 400/132 kV substation	2030
	Camden-Incandu loop-ins	
Camden-Sol Lines 1 and 2 loop into Zeus	Camden-Sol Lines 1 and 2 loop into Zeus	2024

7.6.3.7 Projects for alternative generation scenario

No alternative generation scenario has been identified for Mpumalanga.

7.6.3.8 Provincial summary

The future transmission network for the province is shown in Figure 7-20 below.

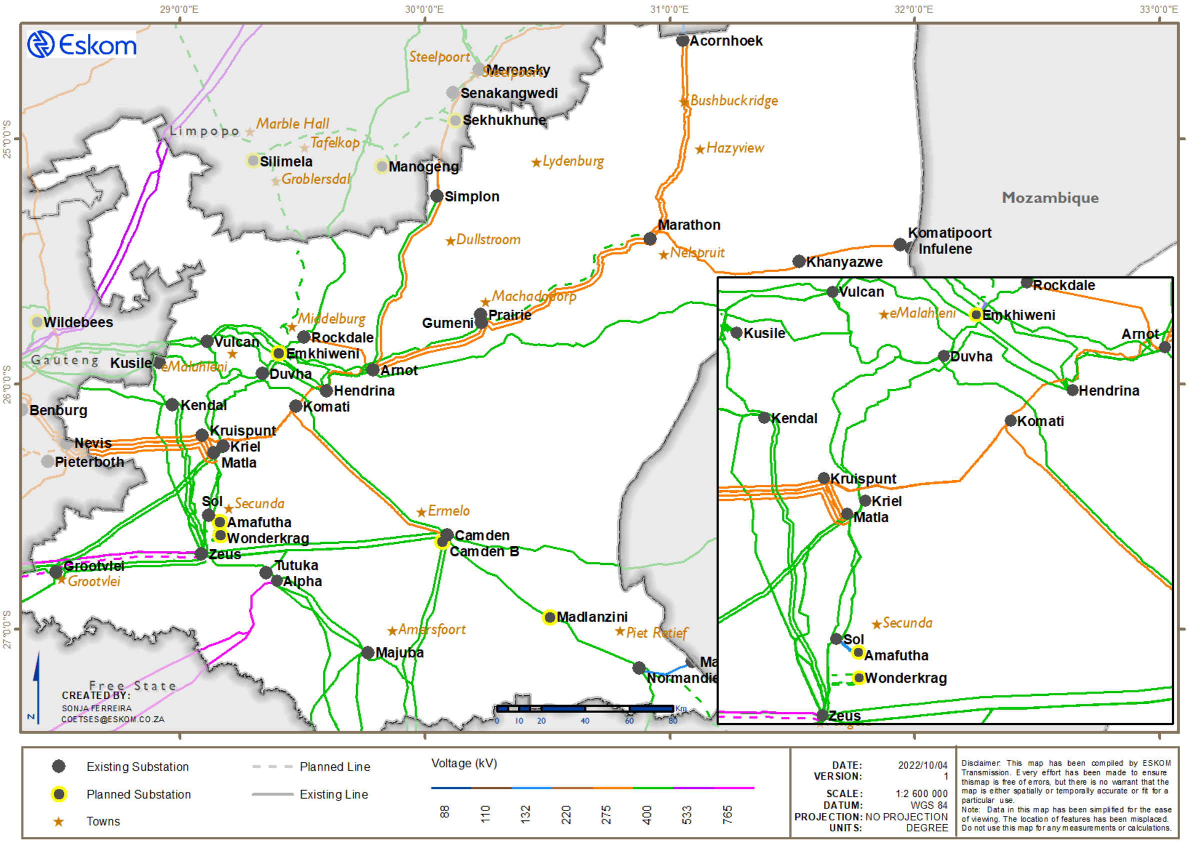


Figure 7-20: Future Mpumalanga transmission network

A summary of all new major assets planned for this province is provided in Table 7-34 to Table 7-37.

Table 7-34: Planned transformers for Mpumalanga

Transformer type	2023 to 2027		2028 to 2032	
	Quantity	Total capacity (MVA)	Quantity	Total capacity (MVA)
Less than 100 MVA	2	120	-	-
Less than 300 MVA	1	250	3	570
Less than 500 MVA	1	300	1	315
500 MVA	9	4 500	9	4 500
800 MVA	-	-	-	-
2 000 MVA	-	-	1	2 000
Grand total	**13**	**5 170**	**14**	**7 385**

Table 7-35: Planned overhead lines for Mpumalanga

Line voltage	2023 to 2027	2028 to 2032
	Total length (km)	Total length (km)
400 kV	136	593
Grand total	**136**	**593**

Table 7-36: Planned capacitor banks for Mpumalanga

Reactor type	2023 to 2027		2028 to 2032	
	Quantity	Total capacity (Mvar)	Quantity	Total capacity (Mvar)
72 Mvar 132 kV	-	-	2	144
Grand total	**-**	**-**	**2**	**144**

Table 7-37: Planned reactors for Mpumalanga

Reactor type	2023 to 2027		2028 to 2032	
	Quantity	Total capacity (Mvar)	Quantity	Total capacity (Mvar)
400 Mvar 765 kV	-	-	1	400
Grand total	**-**	**-**	**1**	**400**

7.7 NORTHERN CAPE

The Northern Cape is situated in the western part of South Africa. It is bordered by Botswana, Namibia, and North West to the north, by the Free State and the Eastern Cape to the east, by the Western Cape to the south, and by the Atlantic Ocean to the west. The provincial economy is primarily driven by mining and agriculture.

It consists of vast tracts of land with excellent solar radiation and wind resources, which makes it an attractive location for solar and wind energy production. To date, 3 878 MW of renewable energy plants have been integrated into the Northern Cape. Lately, there has also been considerable interest in green hydrogen production in the province.

The Northern Cape comprises 220 kV, 275 kV, 400 kV, and 765 kV lines. These power lines extend from Mpumalanga to the Eastern and Western Cape. It is also electrically connected to Namibia via Aries-Kokerboom 400 kV Line 1 and Aggeneis-Harib 220 kV Lines 1 and 2. The existing transmission network is shown in Figure 7-21.

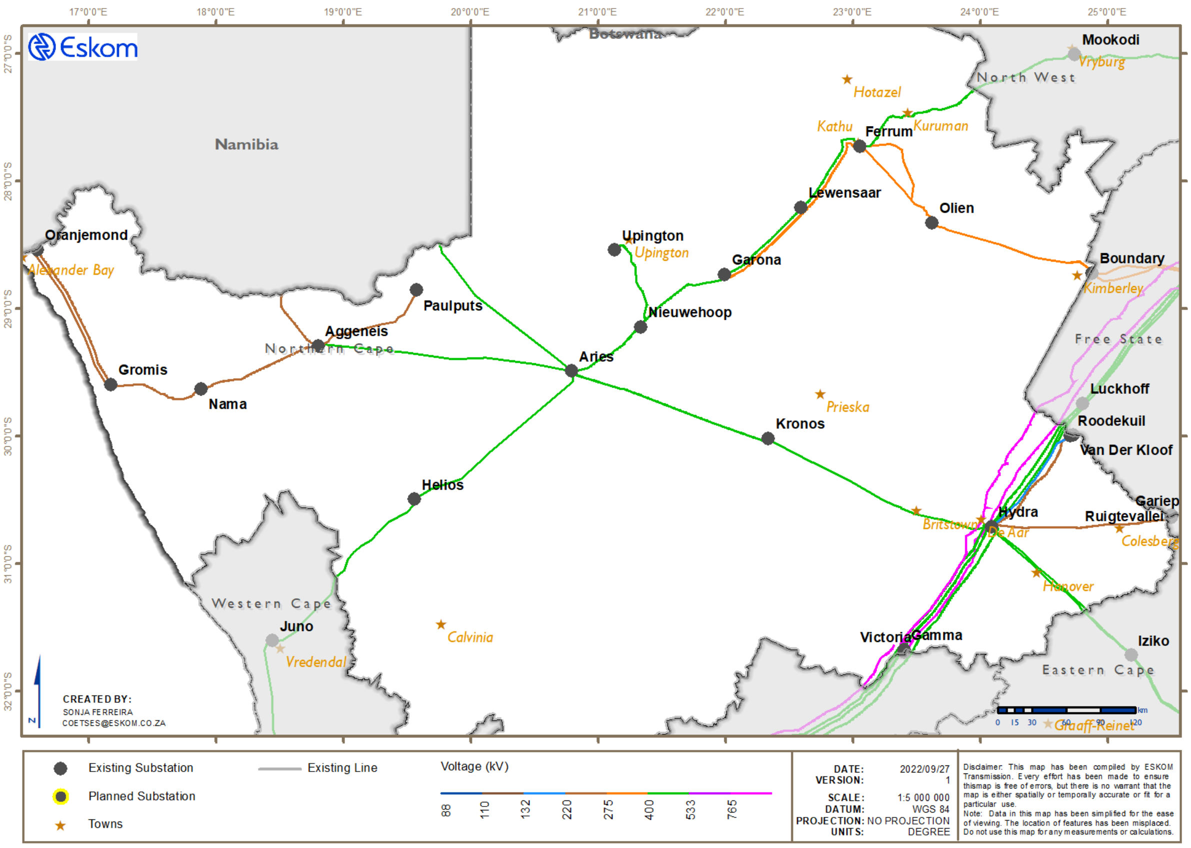


Figure 7-21: Current Northern Cape transmission network

7.7.1 Generation

Van der Kloof Hydro Power Station is the only conventional power station in the Northern Cape. It consists of two 120 MW generators, with a total generating output of 240 MW. It is integrated into the transmission grid via the Hydra-Roodekuil 220 kV and Hydra-Roodekuil 132 kV lines.

7.7.1.1 Renewable energy independent power producers

The REIPPPP has resulted in over 4 212 MW of RE generation being procured in the Northern Cape. The total generation that has been procured from REIPPPP 1 up to 4B is 3 290 MW, as shown in Table 7-38.

Table 7-38: Summary of commissioned projects in the Northern Cape under the REIPPPP

Programme	CSP (MW)	Wind (MW)	PV (MW)	Small hydro (MW)	Grand total (MW)
IPP RE 1	150		465		615
IPP RE 2	50		405	10	465
IPP RE 3	200	590	300		1 090
IPP RE 3.5	200				200
IPP RE 4			415		415
RE IPP 4B		375	130		505
Grand total	**600**	**965**	**1 715**	**10**	**3 290**

A further 922 MW has been awarded under the RMIPPPP and REIPPPP 5, as indicated in Table 7-39

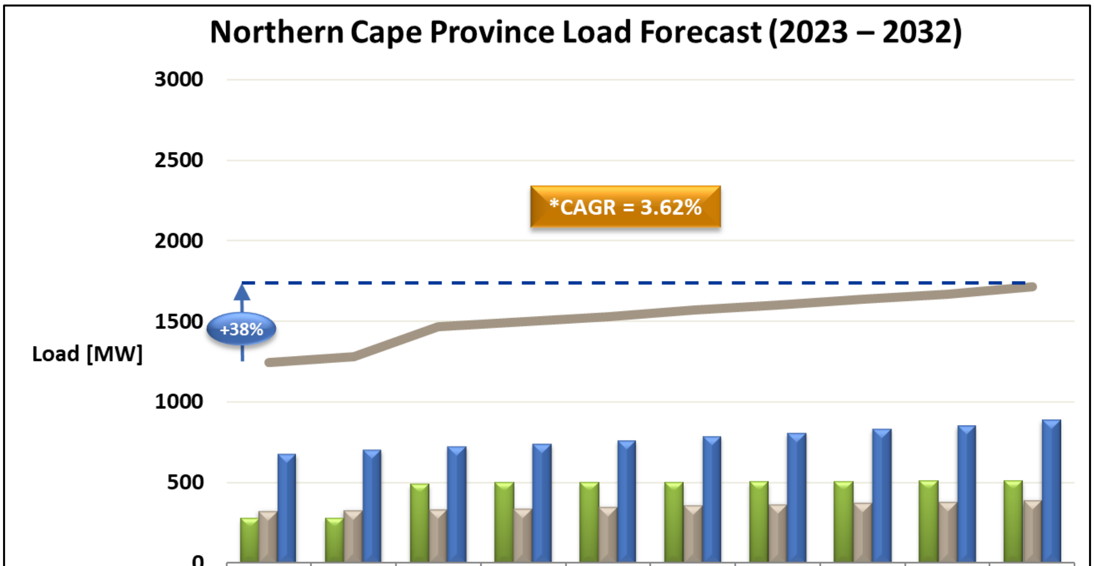
Table 7-39: Summary of approved projects in the Northern Cape under the RMIPPPP and REIPPPP 5

Programme	Wind (MW)	PV (MW)	Grand total (MW)
RMIPPPP	-	648	648
IPP RE 5	124	150	274
Grand total	**124**	**798**	**922**

7.7.2 LOAD FORECAST

The provincial load peaked at around 1 178 MW over the last year, and it is expected to increase to about 1 715 MW by 2032.

The Northern Cape comprises three CLNs, namely, Karoo, Kimberley, and Namaqualand. The provincial peak is expected to increase by 38% from 1 245 MW in 2023 to 1 715 MW in 2032. This equates to a compound annual growth rate (CAGR) of 3,62%. The steep load increase is due to mining and associated industrial activities. The load forecast for the province is shown in **Figure 7-22**.



	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Namaqualand	278	280	489	498	500	501	504	507	509	511
Karoo	322	328	333	339	348	357	366	375	380	388
Kimberley	679	704	723	742	762	789	810	832	854	889
Provincial Peak	1245	1279	1467	1500	1531	1569	1603	1637	1667	1715

Figure 7-22: Northern Cape load forecast

7.7.3 PLANNED PROJECTS

Several network extension and strengthening projects that aim to address the long-term requirements of the province have been initiated to accommodate new generation and the forecasted load.

7.7.3.1 Major TDP schemes

The major TDP schemes planned in the Northern Cape are as follows.

Gromis-Oranjemond corridor strengthening

This strengthening involves extending the 400 kV network to overlay the existing radial 220 kV networks. This will improve network reliability and increase capacity to connect new loads and generators. The first phase, which involved constructing the Gromis-Oranjemond 400 kV line, was commissioned in 2018, and it is currently operated at 220 kV. The Gromis-Juno 400 kV line and Gromis 400/220 kV transformer are under construction.

Aries-Gromis corridor strengthening

This project involves the construction of the second Aries-Aggeneis 400 kV line and the first

Aggeneis-Gromis 400 kV line. The latter will overlay the existing 220 kV line between Aggeneis and Gromis substations. The project will improve network reliability and increase capacity to connect new loads and generators.

Kimberley strengthening Phase 3

This strengthening involves the construction of Ferrum-Mookodi-Hermes 400 kV lines as well as Umtu 400/132 kV substation. It will provide additional capacity to evacuate power out of the Northern Cape and also to cater for the latent mining loads in the area. The construction of Umtu 400/132 kV substation will be triggered mainly by demand growth in the area. However, the associated 400 kV lines will still play a critical role in evacuating power out of the province.

Kimberley strengthening Phase 4

This strengthening involves the construction of the Beta-Boundary-Ferrum 400 kV line as well as the introduction of 400/132 kV transformation at Boundary substation. It will deload the existing 275 kV network, create capacity to connect additional generation, and assist in evacuating power out of the Northern Cape.

Upington strengthening

This strengthening involves the construction of the Aries-Upington and the Ferrum-Upington 400 kV lines as well as increasing 400/132 kV transformation at Upington substation. This will increase capacity at Upington substation to connect additional generators and improve the reliability of the substation.

Paulputs strengthening

The first phase of the project will involve the construction of the Aggeneis-Paulputs 400 kV line and the introduction of 400/132 kV transformation at Paulputs substation. Secondly, the Aries-Kokerboom 400 kV line will be looped in and looped out of Paulputs substation to increase network capacity and to improve the security of supply at Paulputs substation.

Aries-Hydra corridor strengthening

This project involves the construction of the second Aries-Kronos-Hydra 400 kV line. It is key to unlock capacity and to enable the evacuation of RE generation from Namakwa and ZF Mgcawu District Municipalities.

Additional reactive compensation will be installed at Aries substation, that is, an Aries 400 kV dynamic device to assist with dynamic reactive power and voltage control to strengthen the Kimberley and Namaqualand CLNs.

Cape corridor Phase 4

This involves the construction of a second 765 kV line from Zeus substation in Mpumalanga to Sterrekus substation in the Western Cape. It will be constructed in sections, namely, Zeus-Mercury, Mercury-Perseus, Perseus-Gamma, and Gamma-Sterrekus. It will provide additional capacity to evacuate power from the Greater Cape to the northern parts of the country.

Cape corridor Phases 5 and 6

This project involves the construction of two 765 kV lines from Mercury substation in North West to Sterrekus substation in the Western Cape. There will be three intermediate 765/400 kV substations along the power line, namely, Umtu and Aries substations in the Northern Cape and Juno substation in the Western Cape. It will provide additional capacity to evacuate excess power from the Northern Cape and Western Cape.

7.7.3.2 Network strengthening projects

The following major strengthening projects are planned for the period 2023 to 2032.

Table 7-40: Northern Cape – summary of projects and timelines

TDP scheme	Project name	Expected CO year
Gromis-Oranjemond corridor strengthening	Gromis-Oranjemond 400 kV line	Commissioned
	Gromis-Juno 400 kV line	2024
	Gromis 400/220 kV transformer	2024
Aries-Gromis corridor strengthening	Aries-Aggeneis 400 kV Line 2	2029
	Aggeneis-Gromis 400 kV Line 1	2029
Kimberley strengthening Phase 3	Ferrum-Mookodi 400 kV line	2028
	Hermes-Mookodi 400 kV line	2028
	Umtu 765/400 kV transformer	2032
Kimberley strengthening Phase 4	Beta-Boundary 400 kV Line 1	2029
	Boundary 400/132 kV transformer	2029
	Boundary-Ferrum 400 kV Line 1	2031
Upington strengthening	Aries-Upington 400 kV Line 1	2026
	Ferrum-Upington 400 kV Line 1	2027
	Upington 400/132 kV Transformer 2	2026
Paulputs strengthening	Aggeneis-Paulputs 400 kV Line 1	2027
	Paulputs 400/132 kV transformer	2027
	LILO: Aries-Kokerboom 400 kV line	2030
Aries-Kronos-Hydra corridor strengthening	Aries dynamic reactive compensator	2027
	Aries-Kronos 400 kV Line 2	2028
	Hydra-Kronos 400 kV Line 2	2028
Cape corridor Phase 4	Mercury-Zeus 765 kV Line 2	2029
	Mercury-Perseus 765 kV Line 2	2029
	Gamma-Perseus 765 kV Line 2	2031
	Gamma-Sterrekus 765 kV Line 2	2031

7.7.3.3 Projects to facilitate RE integration

The following transmission network strengthening projects will be required to enable the connection of the future RE IPPs located in the province, according to the generation assumptions.

Table 7-41: Northern Cape – projects required to facilitate RE integration

Customer load network	Project name
Namaqualand	Aggeneis substation 500 MVA 400/132 kV Transformer 1
	Aries substation 400/132 kV 500 MVA Transformer 1
	Groeipunt substation 500 MVA 400/132 kV Transformer 1
	Gromis substation 500 MVA 400/132 kV Transformer 1
	Helios substation 500 MVA 400/132 kV Transformer 2

Customer load network	Project name
	Korana substation 500 MVA 400/132 kV Transformer 1
	Nama substation 400/132 kV Transformer 1
	Paulputs substation 400/132 kV 500 MVA Transformer 2
Karoo	Gamma substation 500 MVA 400/132 kV Transformer 1
	Gamma substation 500 MVA 400/132 kV Transformer 2
	Gamma substation 2 000 MVA 765/400 kV Transformer 1
	Hydra 2 000 MVA 765/400 kV Transformer 2
	Hydra substation 2 x 400/132 kV transformer upgrades
	Hydra B substation 500 MVA 400/132 kV Transformer 1
	Hydra B substation 500 MVA 400/132 kV Transformer 2
	Kronos substation 500 MVA 400/132 kV Transformer 3
	Loxton substation 500 MVA 400/132 kV Transformer 1
	Loxton substation 500 MVA 400/132 kV Transformer 2
	Siyoneza substation 500 MVA 400/132 kV Transformer 1
	Siyoneza substation 500 MVA 400/132 kV Transformer 2
Kimberley	Boundary substation 500 MVA 400/132 kV Transformer 1
	Garona substation 500 MVA 400/132 kV Transformer 1
	Upington substation 500 MVA 400/132 kV Transformer 3
	Umtu substation 1st 400/132 kV Transformer 1
Cape corridor Phase 5A	Aries-Upington 765 kV Line 1 (operate at 400 kV)
	Upington-Umtu 765 kV Line 1 (operate at 400 kV)
	Umtu-Mookodi 765 kV Line 1 (operate at 400 kV)
	Mookodi-Mercury 765 kV Line 1 (operate at 400 kV)
Cape corridor Phase 5B	Aries 765/400 kV extension (2 000 MVA Transformer 1)
	Bypass Upington, operate Aries-Umtu 765 kV Line 1
	Bypass Mookodi, operate Umtu-Mercury 765 kV Line 1
Cape corridor Phase 6	Aries 2 000 MVA 765/400 kV Transformer 2
	Aries-Umtu 765 kV Line 2
	Umtu-Mercury 765 kV Line 2
	Install series compensation on the Umtu-Mercury 765 kV Lines 1 and 2
	Mercury 2 000 MVA 765/400 kV Transformer 1

7.7.4 PROVINCIAL SUMMARY

The future transmission network for the province is shown in **Figure 7-23** below.

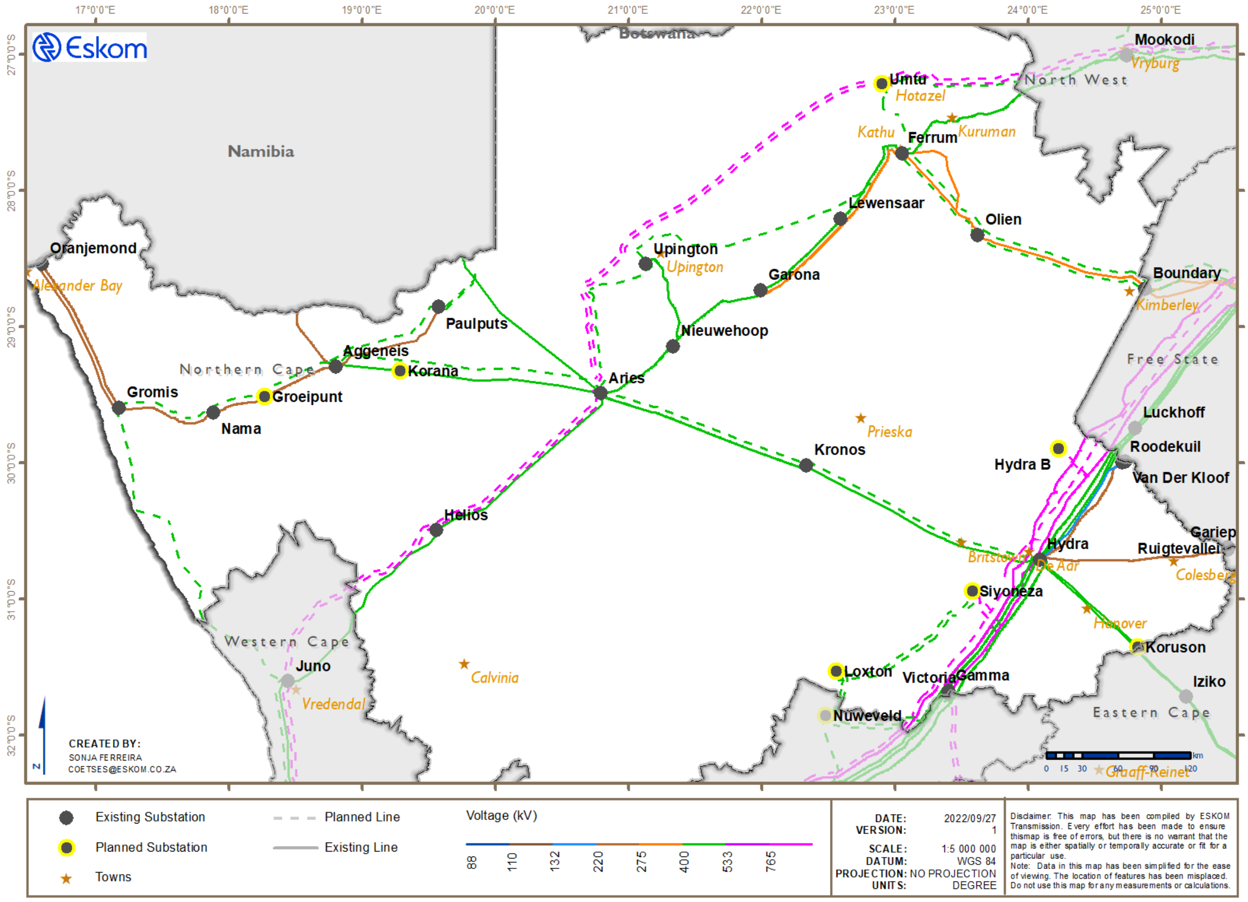


Figure 7-23: Future Northern Cape transmission network

A summary of all new major assets planned for this province is provided in Table 7-42 to Table 7-45

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Table 7-42: Planned transformers for the Northern Cape

Transformer type	2023 to 2027		2028 to 2032	
	Quantity	Total capacity (MVA)	Quantity	Total capacity (MVA)
Less than 100 MVA	-	-	1	20
Less than 300 MVA	-	-	-	-
Less than 500 MVA	1	500	-	-
500 MVA	2	815	18	9 000
800 MVA	-	-	-	-
2 000 MVA	-	-	1	2 000
Grand total	**3**	**1 315**	**20**	**11 020**

Table 7-43: Planned overhead lines for the Northern Cape

Line voltage	2023 to 2027	2028 to 2032
	Total length (km)	Total length (km)
400 kV	1 242	1 313
765 kV	-	440
Grand total	**1 242**	**1 753**

Table 7-44: Planned capacitor banks for the Northern Cape

Capacitor type	2023 to 2027		2028 to 2032	
	Quantity	Total capacity (Mvar)	Quantity	Total capacity (Mvar)
40 Mvar 132 kV	-	-	1	40
Grand total	**-**	**-**	**1**	**40**

Table 7-45: Planned reactors for the Northern Cape

Reactor type	2023 to 2027		2028 to 2032	
	Quantity	Total capacity (Mvar)	Quantity	Total capacity (Mvar)
40 Mvar 220 kV	-	-	2	80
100 Mvar 400 kV	3	300	1	100
400 Mvar 765 kV	-	-	4	1 600
Grand total	**3**	**300**	**7**	**1 780**

7.8 NORTH WEST

North West, also known as the “Platinum Province”, is a neighbour to Botswana and shares borders with the Free State, the Northern Cape, Limpopo, and Gauteng. Its capital is Mahikeng.

The province is enriched with various mineral resources, such as gold, uranium, platinum, diamonds, dimension stone, fertile and vast agriculture soil, a strong manufacturing sector, and plentiful opportunities in RE and agro-processing. North West is a key ferrochrome producer and is home to large platinum mines and refineries.

In addition, both tourism activities and investment opportunities thrive in the province, which boasts, among others, internationally renowned tourism hubs. These include the Big Five Pilanesberg National Park (located in the crater of an extinct volcano), the Madikwe Game Reserve, the Sun City Entertainment and Golf Complex, the Taung Skull Heritage Site, and the ever-popular Hartbeespoort Dam.

The northern and western parts of the province have many sheep farms and cattle and game ranches. The eastern and southern parts are crop-growing regions that produce maize, sunflowers, tobacco, cotton, and citrus fruits.

The transmission network consists of a highly interconnected 400 kV network, with an underlying 275 kV network. The current North West transmission network is shown in Figure 7-24.

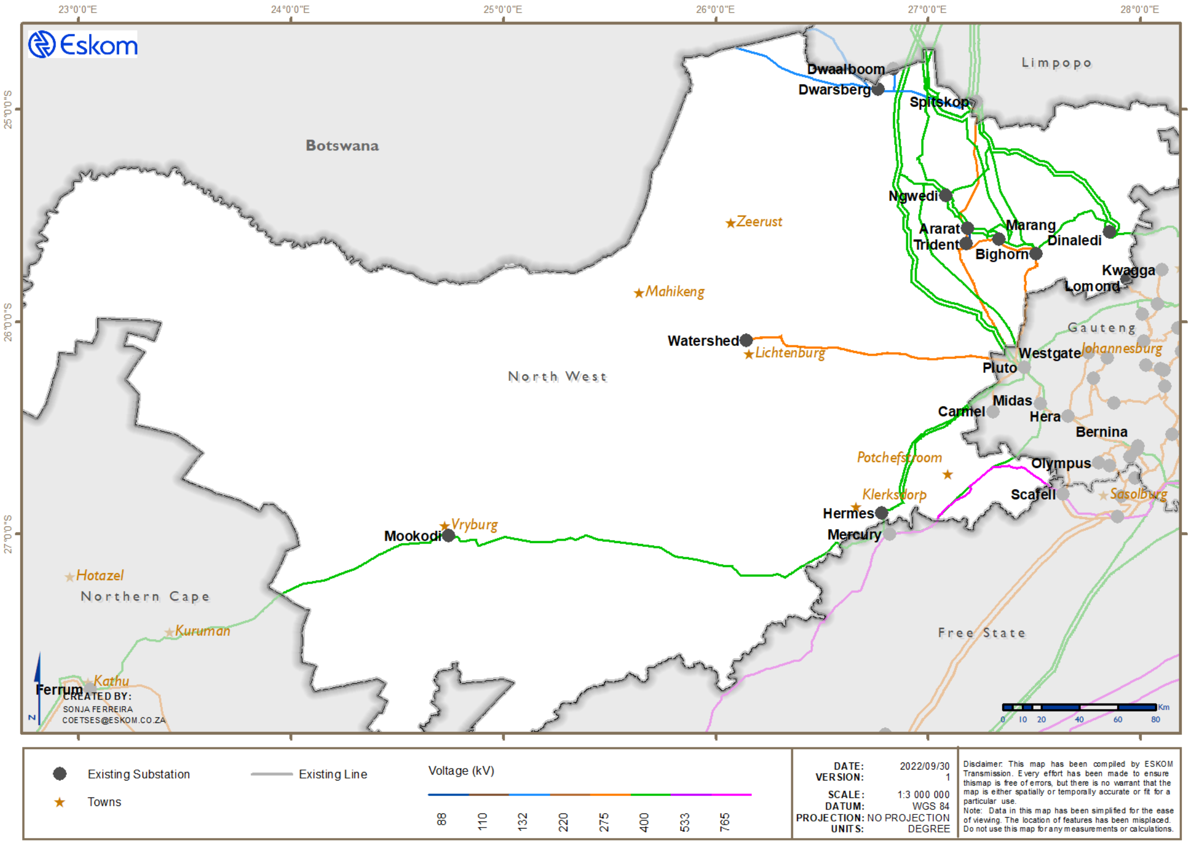


Figure 7-24: Current North West transmission network

7.8.1 GENERATION

There are no power stations located in North West. All the power consumed in this province is sourced from power stations in Limpopo and Mpumalanga. With the complete integration of the Medupi Power Station, most of the power of the province will be supplied from Limpopo.

The REIPPPP has provided a platform for the private sector to invest in RE connected to the South African power grid. Thus far, in North West, around 275 MW of RE plants have been committed for integration into the power grid from Rounds 1 to 4B, and 100% of these plants are PV. The approved projects in the REIPPPP are summarised in Table 7-46 below.

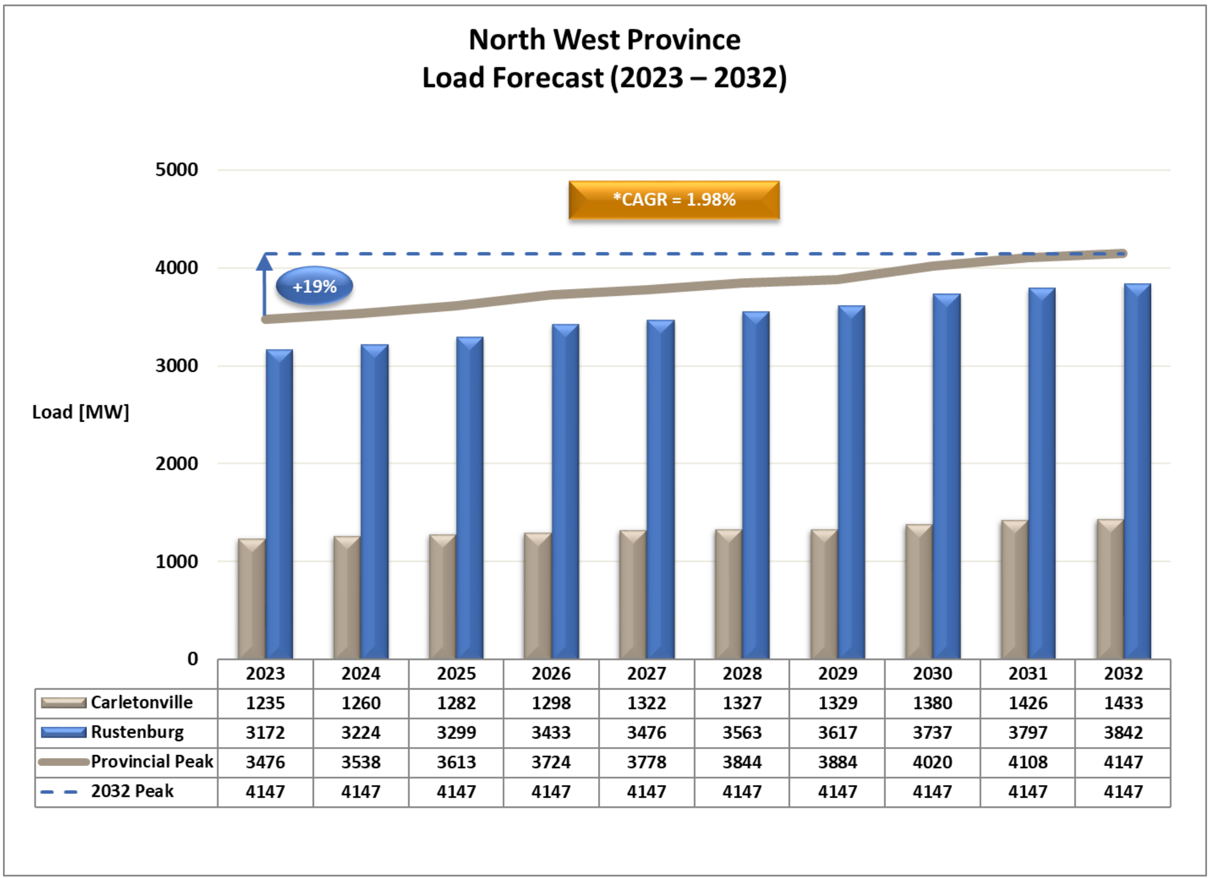
Table 7-46: Approved projects in North West under the REIPPPP

Programme and bid window	PV (MW)	Grand total (MW)
IPP RE 1	7	7
RE IPP 4B	268	268
Grand total	**275**	**275**

7.8.2 LOAD FORECAST

The mainstay of the economy of North West is mining, which generates more than half of the GDP of the province. There is an abundance of livestock farming, as well as game ranches and crop-growing regions that yield a variety of produce. The provincial economy is also driven by the entertainment and casino complex at Sun City and the Lost City.

This province comprises two CLNs, namely, Rustenburg and Carletonville, with Rustenburg accounting for the majority of the load in the province. The electricity demand peaked at around 3 279 MW in 2021, with the load in the province projected to increase to about 4 147 MW by the year 2032. The load forecast is shown in Figure 7-25.



	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Carletonville	1235	1260	1282	1298	1322	1327	1329	1380	1426	1433
Rustenburg	3172	3224	3299	3433	3476	3563	3617	3737	3797	3842
Provincial Peak	3476	3538	3613	3724	3778	3844	3884	4020	4108	4147
2032 Peak	4147	4147	4147	4147	4147	4147	4147	4147	4147	4147

Figure 7-25: North West load forecast

7.8.3 PLANNED PROJECTS

Several projects and schemes that aim to address the long-term requirements of the province have been initiated to accommodate the forecasted load and generation.

7.8.3.1 Major schemes

The major TDP schemes planned in North West are as follows.

Rustenburg strengthening Phase 1

The scheme refers to the extension of Bighorn substation with the installation of 2 x 500 MVA 400/132 kV transformers. Major customers will be supplied at 132 kV, deloading the existing 275/88 kV transformers. This project will be aligned with the load forecast and is customer dependent.

Rustenburg strengthening Phase 2

Rustenburg strengthening Phase 2 refers to the extension of Marang substation, which will also introduce a 132 kV voltage level at the substation. The distribution network will be upgraded from 88 kV to 132 kV in conjunction with introducing a 132 kV line at Marang substation. Due to the slump in the platinum sector in Rustenburg, this project has been deferred to outside the TDP period.

Rustenburg strengthening Phase 3

The scheme is expected to address low voltages in the Rustenburg CLN under contingencies by installing shunt capacitors at Marang, Bighorn, and Dinaledi substations. This will also improve the voltage profile and provide reactive power support in the Rustenburg CLN.

Watershed strengthening

This scheme addresses substation transformation capacity and undervoltages on the 275 kV Watershed busbar under contingency conditions. In addition, the switching voltage step-change problems associated with the existing 88 kV shunt capacitors will be addressed. A new 250 MVA 275/132 kV transformer was installed in September 2021; the installation of 1 x 30 Mvar 88 kV and 2 x 30 Mvar 132 kV shunt capacitor banks is in the execution phase and is currently expected to reach commercial operation by 2024. New 2 x 500 MVA 275/132 kV transformers are proposed to facilitate the integration of RE generation in the area, mainly solar power, in the next five years or so; one 500 MVA unit will replace the 250 MVA unit.

To address long-term load requirements, without local PV generation or BESS, some load will be shifted from Watershed substation to Mookodi substation. A new Mahikeng substation, designed at 400/132 kV, is planned approximately 60 km west of Watershed substation and will be integrated into the transmission system via a Pluto-Mahikeng 180 km 400 kV line and the Mookodi-Mahikeng 160 km 400 kV line. Mahikeng substation will address both the load and generation integration requirements around Mahikeng.

7.8.3.2 New substations

To address load growth and solar generation integration around Mahikeng, Mahikeng 400/132 kV substation will be established in North West. It will also provide a possible strategic connection corridor to the Southern African Development Community (SADC) region through Botswana as the first point of entry.

7.8.3.3 New lines

- The Medupi-Ngwedi first 765 kV line (energised at 400 kV) near Mogwase is under construction and will provide the required level of reliability to fully evacuate the power from the Waterberg generation pool to North West.
- Pluto-Mahikeng 400 kV line and Mookodi-Mahikeng 400 kV line

7.8.3.4 Reactive power compensation

Additional shunt capacitors are planned at the following locations:

- Watershed 88 kV 1 x 30 Mvar and 132 kV 2 x 30 Mvar
- Bighorn 132 kV 2 x 72 Mvar and 88 kV 3 x 48 Mvar
- Marang 88 kV 5 x 48 Mvar
- Dinaledi 132 kV 3 x 72 Mvar

7.8.3.5 Network strengthening projects

The following strengthening projects are planned for the period 2023 to 2032.

Table 7-47: North West – summary of projects and timelines

TDP scheme	Project name	Expected CO year
Watershed strengthening	• Watershed substation 132 kV reactive power compensation (2 x 30 Mvar capacitors)	2024
	• Watershed substation 88 kV reactive power compensation (1 x 30 Mvar capacitor)	
Watershed (backbone) strengthening Phase 3	• Pluto-Mahikeng 400 kV line	2032
	• Mahikeng first 315 MVA 400/88 kV transformer	
	• Mookodi-Mahikeng 400 kV line	2036
	• Mahikeng second 315 MVA 400/88 kV transformer	
Kimberley strengthening Phase 3	• Hermes-Mookodi first 400 kV line	2028
Rustenburg strengthening Phase 1	• Bighorn 2 x 500 MVA 400/132 kV transformer	2034

TDP scheme	Project name	Expected CO year
Rustenburg strengthening Phase 2	• Marang extension 2 x 500 MVA 400/132 kV substation	2034
Rustenburg strengthening Phase 3	• Bighorn reactive compensation (2 x 72 Mvar 132 kV and 3 x 48 Mvar 88 kV shunt capacitors) • Marang reactive compensation (5 x 48 Mvar 88 kV shunt capacitors) • Dinaledi reactive compensation (3 x 72 Mvar 132 kV shunt capacitors)	2028
Medupi integration	• Medupi-Ngwedi first 765 kV line (energised at 400 kV)	2024
Trident-Ararat 2 x 88 kV lines capacity uprate	• Trident-Ararat 2 x 88 kV lines capacity uprate	2027

7.8.3.6 Projects for future independent power producers

The following transmission network strengthening projects will be required to enable the connection of the IPPs located in the province within the current TDP period based on the generation assumptions.

Table 7-48: North West – projects required to facilitate IPP integration

Project name	Required CO year	Expected CO year
Mookodi 1 x 500 MVA 400/132 kV transformer	2025	2026
Mookodi reactive power compensation	2023	2026
Watershed substation upgrade: 2 x 500 MVA 275/132 kV transformers	2027	2028
Carmel substation upgrade: 1 x 500 MVA 275/132 kV transformer	2027	2028

7.8.3.7 Projects for alternative generation scenario

No alternative generation scenario has been identified for North West.

7.8.3.8 Provincial summary

The future transmission network for the province is shown in Figure 7-26 below. It is expected that the complete integration of Medupi Power Station will further enhance the major power corridors into Rustenburg and extend into the Carletonville supply zones.

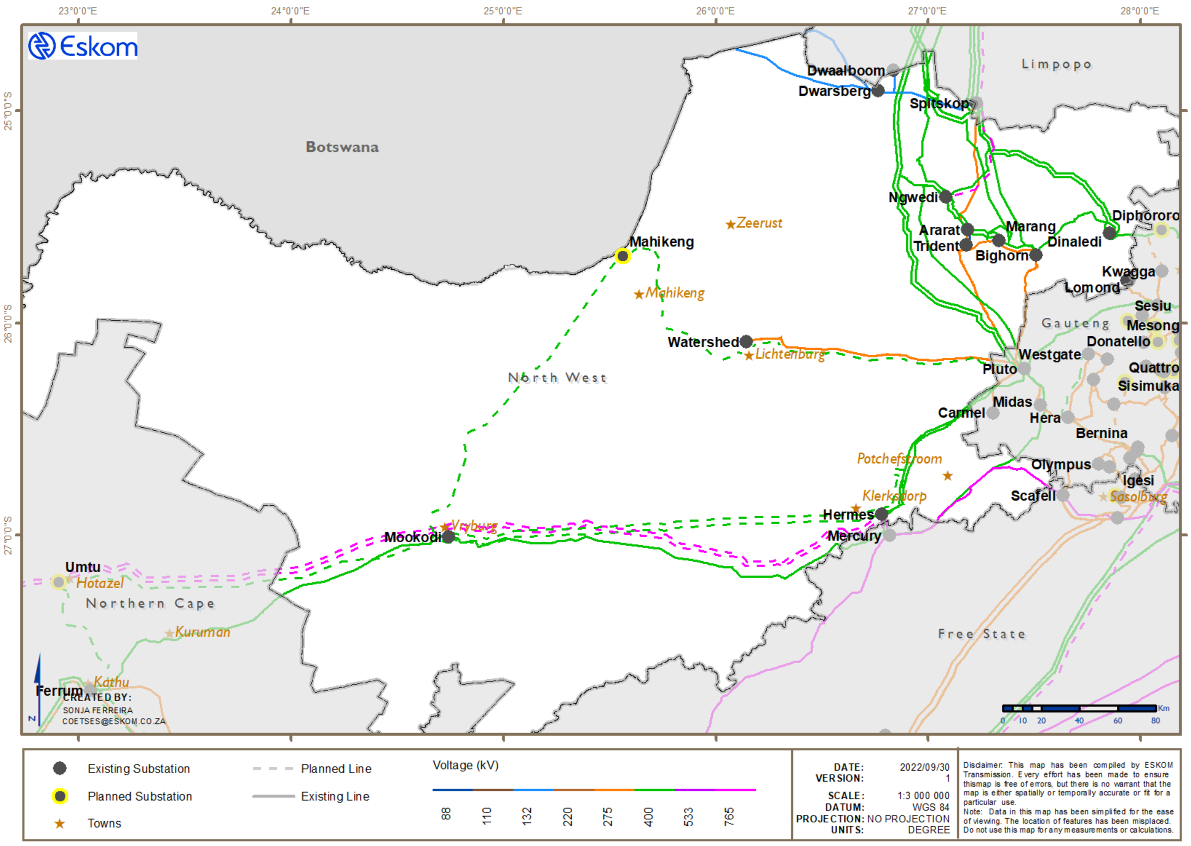


Figure 7-26: Future North West transmission network

A summary of all new major assets planned for this province is provided in Table 7-49 to Table 7-52.

Table 7-49: Planned transformers for North West

Transformer type	2023 to 2026		2027 to 2032	
	Quantity	Total capacity (MVA)	Quantity	Total capacity (MVA)
Less than 300 MVA	2	360	-	-
Less than 500 MVA	-	-	3	945
500 MVA	1	500	2	1 000
800 MVA	-	-	1	800
Grand total	**3**	**860**	**6**	**2 745**

Table 7-50: Planned overhead lines for North West

Line voltage	2023 to 2026	2027 to 2032
	Total length (km)	Total length (km)
400 kV	140	240
765 kV	-	-
Grand total	**140**	**240**

Table 7-51: Planned capacitor banks for North West

Capacitor type	2023 to 2026		2027 to 2032	
	Quantity	Total capacity (Mvar)	Quantity	Total capacity (Mvar)
48 Mvar 88 kV	3	144	6	288
72 Mvar 132 kV	2	144	-	-
150 Mvar 275 kV	-	-	2	300
Grand total	**5**	**288**	**8**	**588**

Table 7-52: Planned reactors for North West

Reactor type	2023 to 2026		2027 to 2032	
	Quantity	Total capacity (Mvar)	Quantity	Total capacity (Mvar)
100 Mvar 400 kV	3	300	1	100
Grand total	**3**	**300**	**1**	**100**

7.9 WESTERN CAPE

The Western Cape is situated in the south-western part of South Africa and has Cape Town as its capital. The provincial economy is mainly driven by tourism, financial services, business services, real estate, agriculture, and the manufacturing sector. Cape Town is the economic hub of the province, with a robust clothing and textile industry that provides significant employment opportunities in the province. The provincial load peaked at around 3 400 MW in 2022, and it is expected to increase to about 5 000 MW by 2032.

Cape Town

The Western Cape region of South Africa is also noted for its abundance of wind resources, making it one of South Africa's ideal locations for wind energy projects, a number of which are already in operation. To date, 1 108 MW of RE generation plants have been integrated into the Western Cape. There has also been considerable interest in gas generation.

The Western Cape transmission network consists mostly of 400 kV lines. It stretches over 550 km from Gamma substation (near Victoria West) to Philippi substation (near Mitchells Plain). It is also interconnected to the Northern Cape along the West Coast. The current transmission network is shown in Figure 7-27.

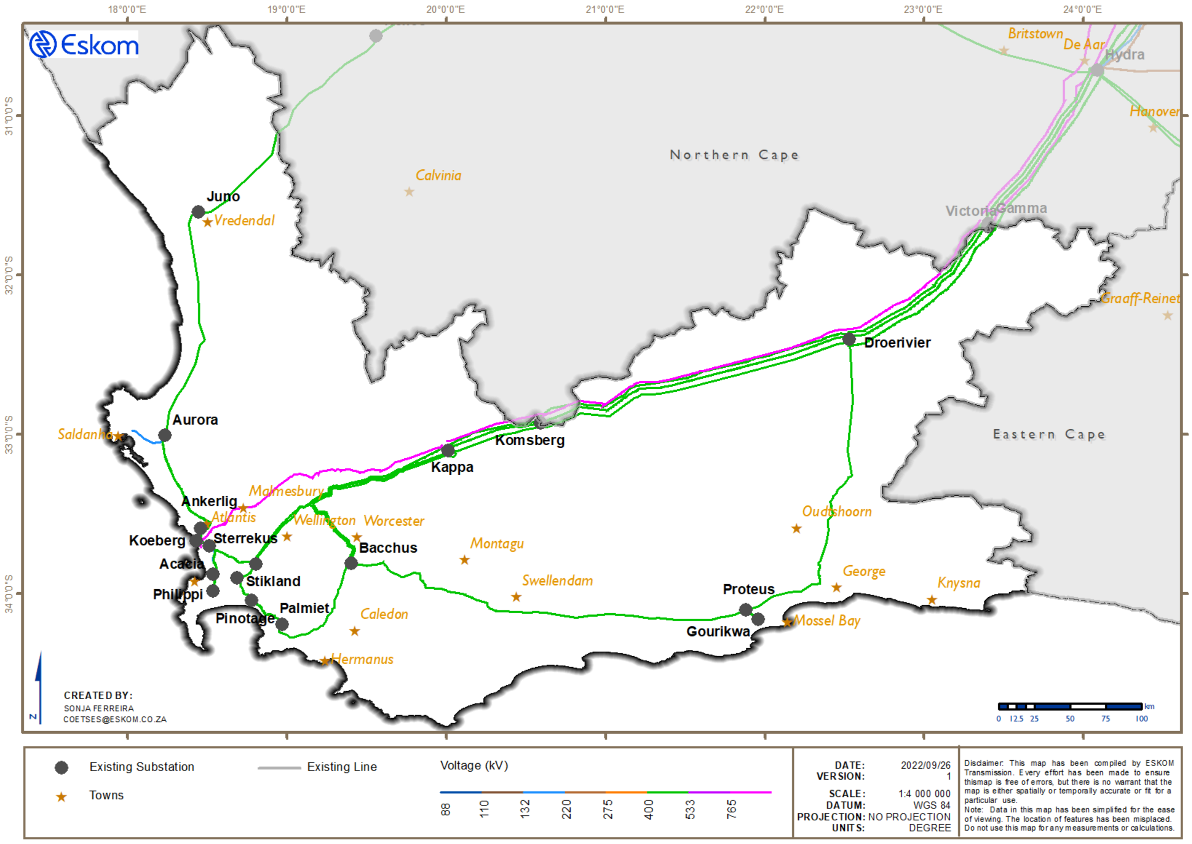


Figure 7-27: Current Western Cape transmission network

7.9.1 GENERATION

Koeberg Power Station is the only baseload power station situated locally in the Western Cape. There are also four Eskom peaking plants in the Western Cape, consisting of pumped-storage and gas turbine generation, which help to meet the demand in the Western Cape and the national grid during generation shortages. These comprise the Palmiet Pumped-Storage Scheme, the Ankerlig and Gourikwa OCGT stations, and the Acacia Gas Turbine Station. In addition, there are three City of Cape Town (CoCT)-owned peaking plants in Cape Town, which help to manage CoCT demand. These are the Steenbras Pumped-Storage Station and the Athlone and Roggebaai Gas Turbine Stations. The Western Cape has also benefited from RE generation due to its climate and proximity to the coastline.

Koeberg Power Station

Koeberg Power Station is situated at Duynefontein, 27 km north of Cape Town, on the Atlantic coast. Koeberg ensures a reliable supply of electricity to the Western Cape. It has operated safely and efficiently for 30 years and has a further active life of about 20 years. Koeberg

Power Station has a generating capacity of 1 860 MW (sent-out). The two units are rated at 970 MW each.

Koeberg Power Station

Acacia Power Station

Acacia Power Station forms part of the peaking group of power stations and consists of 3 x 57 MW gas turbine engines at an installed capacity of 171 MW. Acacia predominantly operates in synchronous condenser operation (SCO) mode to regulate the voltages in the area. In addition, it provides an off-site emergency supply to Koeberg Power Station in accordance with the National Nuclear Regulator licencing requirement.

Ankerlig and Gourikwa Power Stations

The OCGTs were built to meet the rapidly increasing demand for peaking power on the Eskom grid. The gas turbine engines are similar to those used in the aviation industry and use liquid fuel (diesel). Some of the units have been fitted with dual-fuel burners in anticipation of conversion to CCGT. In addition to their generating capabilities, some of the units at these two power stations are also used to regulate network voltages when running in SCO.

Ankerlig Power Station is located in Atlantis in the Western Cape and has an installed capacity of 1 350 MW (9 x 150 MW). Gourikwa Power Station is located in Mossel Bay and has an installed capacity of 750 MW (5 x 150 MW).

Palmiet Pumped-Storage Scheme

Palmiet Pumped-Storage Scheme is a joint venture between Eskom and the Department of Water Affairs and Forestry. It is situated in the ecologically sensitive Kogelberg Nature Reserve in the Western Cape, near Grabouw.

The power station delivers 400 MW (2 x 200 MW) of peak power into the Eskom national grid and carries out a frequency and voltage regulating role. It is also part of an inter-catchment water transfer project supplying water to Cape Town.

Water flows from an upper reservoir to the machines located in an underground power station for generating purposes. The water is collected in a lower reservoir and pumped back to the upper reservoir during off-peak periods.

Steenbras Pumped-Storage Scheme

Steenbras Dam is an earth-fill type of dam located on the Steenbras River in the Hottentots-Holland Mountains, high above Gordons Bay, near Cape Town. In 1979, Steenbras Dam became part of the first pumped-storage scheme in the country to supplement Cape Town's electricity supply during periods of peak demand.

Steenbras Pumped-Storage Scheme is a CoCT generating facility. It consists of 4 x 45 MW units and is integrated into the CoCT network.

Athlone and Roggebaai Power Stations

Athlone and Roggebaai power stations are two gas turbine stations, which are owned and operated by the CoCT. They are used to generate electricity over much shorter periods, as they use much more expensive fuel (aviation Jet-A1).

Athlone Power Station is located at the site of the demolished Athlone Coal-Fired Power Station along the N2 highway near Pinelands and has an installed capacity of 36 MW. Roggebaai Power Station is situated at the V&A Waterfront and has an installed capacity of 42 MW.

Both power stations are used for reducing the peak load of the CoCT, but can also be used to supply local loads during emergencies.

Sere Wind Farm

Sere Wind Farm is an Eskom wind generating facility that was completed in January 2015 and has a capacity of 100 MW. It is located north-west of Vredendal in Skaapvlei, approximately 300 km north of Cape Town.

Sere Wind Farm

Independent power producers

The REIPPPP and the RMIPPPP have resulted in 2 241 MW of IPP generation being procured in the Western Cape, with 1 008 MW in commercial operation, as shown in Table 7-53.

Table 7-53: Commissioned and approved IPP projects in the Western Cape

Bid window	Name of project	Type	Capacity (MW)	Transmission substation	Commercial operation
1	Dassiesklip Wind Energy Facility	Wind	26	Bacchus	May 2014
	Hopefield Wind Farm	Wind	65	Aurora	Feb. 2014
	SlimSun Swartland Solar Park	PV	5	Aurora	Aug. 2015
	Touwsrivier Project	PV	36	Bacchus	Dec. 2014
2	Gouda Wind Facility	Wind	135	Muldersvlei	Aug. 2015
	West Coast 1	Wind	90	Aurora	June 2015
	Aurora-Rietvlei Solar Power	PV	9	Aurora	Dec. 2014
	Vredendal Solar Park	PV	9	Juno	July 2014
3	Electra Capital (Pty) Ltd	PV	75	Aurora	Sept. 2015
4B	Perdekraal East	Wind	107	Kappa	Oct. 2020
	Excelsior Wind	Wind	32	Bacchus	Aug. 2020
4	Karusa Wind Farm	Wind	140	Komsberg	July 2022
	Roggeveld	Wind	140	Komsberg	May 2022
4B	Soetwater Wind Farm	Wind	139	Komsberg	July 2022
RMIPP	Karpowership SA Saldanha	Gas	320	Aurora	-
	Oya Energy Hybrid Facility	Hybrid	128	Kappa	-
5	Beaufort West Wind Facility	Wind	140	Galenia	-
	Trakas Wind Facility	Wind	140	Galenia	-
	Grootfontein PV 1, 2, and 3	PV	3 x 75	Kappa	-
	Brandvalley Wind Farm	Wind	140	Komsberg	-
	Rietkloof Wind Farm	Wind	140	Komsberg	-

7.9.2 LOAD FORECAST

The Western Cape comprises three CLNs, namely, Peninsula, Outeniqua, and West Coast. The Peninsula CLN is the main load centre in the province, consuming approximately 67% of the load. Outeniqua and West Coast CLNs make up the remaining 33% of the demand in the province.

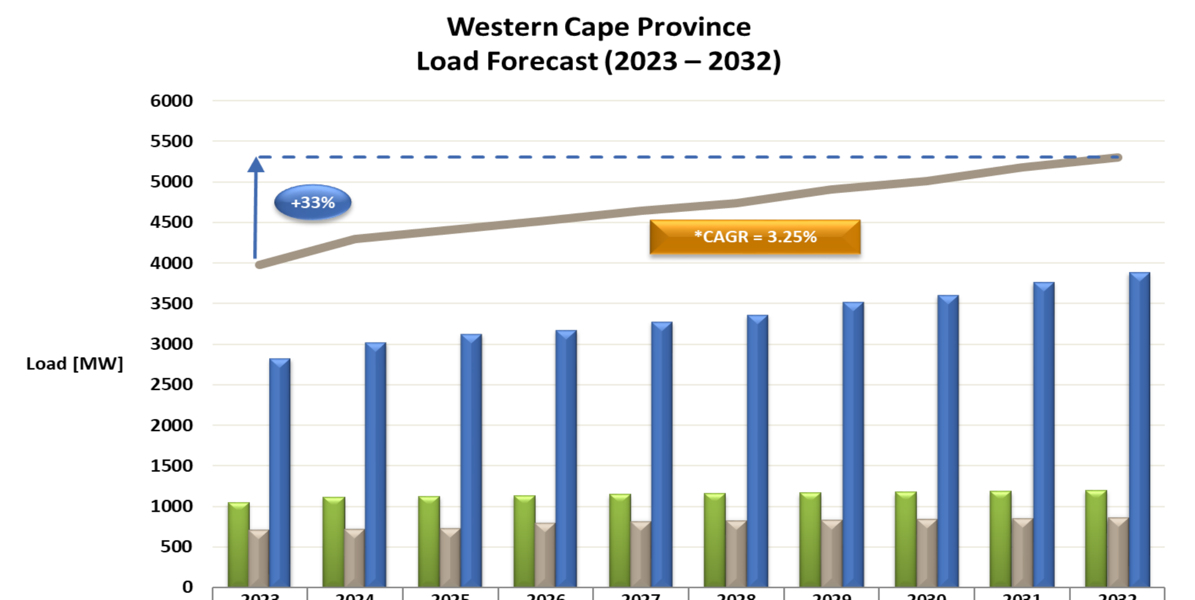
The past strong residential, commercial, and light industrial load growth in the Peninsula CLN is expected to continue for a number of years. Some areas of interest are the area around Philippi and Mitchells Plain, where higher-density residential properties are being developed on existing residential stands. The growth of streaming-based entertainment and digitisation has also prompted a growing demand for data centres in the Peninsula CLN. The July 2020 explosion incident at the Astron Energy refinery, which is supplied from Acacia substation, resulted in a temporary shutdown of the plant.

Load growth in the West Coast area is expected due to the Saldanha Bay Industrial Development Zone (IDZ). The 120 ha area, which was designated as an IDZ in October 2013, is well situated to service the marine oil and gas markets on the African continent. The Western Cape Department of Economic Development is also investigating the feasibility of establishing a floating liquefied natural gas terminal for the importation of gas. In November 2019, Saldanha Steel, which is supplied from Aurora substation, announced that it would be halting production and reducing operations to a state of care and maintenance for a possible restart in June 2022.

Saldanha Steel

Demand in the Outeniqua CLN is due to natural load growth and residential developments. In October 2020, PetroSA forecasted that its Mossel Bay plant would run out of gas by December 2020 and, subsequently, applied for a reduction in its notified maximum demand (NMD) at Proteus substation.

The load forecast for the three CLNs and the Western Cape is shown in Figure 7-28. The load is forecasted to grow from 3 670 MW in 2023 to 5 030 MW in 2032. This translates to 33% over the next 10 years, with a compound annual growth rate (CAGR) of 3,25%.



	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
West Coast	1050	1117	1127	1137	1147	1158	1168	1179	1189	1199
Outeniqua	713	723	737	799	814	826	838	850	858	867
Peninsula	2830	3027	3126	3171	3274	3361	3521	3611	3770	3885
Provincial Peak	3979	4300	4414	4524	4642	4742	4911	5015	5180	5304
2032 Peak	5304	5304	5304	5304	5304	5304	5304	5304	5304	5304

Figure 7-28: Load forecast for the Western Cape

7.9.3 Planned projects

Several projects have been initiated to resolve the existing and future network constraints, supply the forecasted load, and integrate the additional generation. These projects take the condition of existing assets, potential costs of the proposed solutions, and environmental impacts and challenges into consideration.

7.9.3.1 Major schemes

Cape corridor Phase 4: second Zeus-Sterrekus 765 kV line

The Cape Corridor comprises high-voltage transmission lines originating from Zeus substation (near Bethal) and Alpha substation (near Standerton) in Mpumalanga to Hydra substation (near De Aar) in the Northern Cape. It then extends into the Western Cape and terminates at Muldersvlei substation (near Klapmuts) and Sterrekus substation (near Melkbosstrand).

The Cape corridor has been strengthened, with the first 765 kV line comprising the following sections that were constructed and energised over a period of more than 10 years:

- Zeus-Mercury and Mercury-Perseus in December 2012
- Hydra-Perseus in July 2013
- Perseus-Gamma and Hydra-Gamma in February 2014
- Gamma-Kappa in April 2015
- Kappa-Sterrekus in December 2016

The Aries-Nieuwehoop-Ferrum 400 kV line in the Northern Cape has provided a further improvement in overall power transfer capacity of the Cape corridor.

Additional improvements will be brought about by the following strengthening projects in the Northern Cape:

- Juno-Gromis 400 kV line
- Aries SVC

This will result in Cape corridor adequacy until ~2026. Beyond 2026, the preferred strengthening to provide additional transfer capacity is constructing a second 765 kV line.

7.9.3.2 Substations

Local strengthening is planned across the province, mainly comprising additional transformers at existing substations and seven new 400/132 kV substations:

- Asteria substation (2 x 500 MVA) near Bot River (Botrivier)
- Erica substation (2 x 500 MVA) near Philippi
- Agulhas substation (2 x 500 MVA) near Swellendam
- Narina substation (2 x 500 MVA) in the George area
- Bokkom substation (2 x 500 MVA) near Langebaanweg
- Koring substation (1 x 500 MVA) near Merweville
- Galenia substation (1 x 500 MVA), 60 km south of Beaufort West

7.9.3.3 Lines

The Ankerlig-Sterrekus double-circuit 400 kV line, which was commissioned recently, will provide for some level of the required network reliability to evacuate the total power in the Koeberg and Ankerlig generation pool, especially under planned transmission line maintenance in the area. The existing second Koeberg-Acacia 400 kV line, which is currently operated at 132 kV, must also be energised at 400 kV in order to meet the required level of network reliability. This line is expected to be commissioned at 400 kV when the Koeberg emergency off-site supply is relocated from Acacia Power Station to Ankerlig Power Station.

A project for an additional 400 kV line between Droërivier substation and Gourikwa Power Station has been initiated to cater for gas generation projects that may emanate in the Mossel Bay area as well as for potential renewable generation projects towards Beaufort West.

The above projects will also allow for an increase in power output at the existing generating facilities such as Koeberg, Ankerlig, and Gourikwa Power Stations.

7.9.3.4 Major projects for future IPPs

There are three designated renewable energy development zones (REDZs) in the Western Cape, namely, Overberg (REDZ1), Komsberg (REDZ2), and Beaufort West (REDZ11). These were identified as areas with strategic importance for RE generation and were gazetted as such in February 2018 and February 2021.

The Western Cape is, therefore, a prime location for wind generation as well as for some PV generation. As a result of this, ~6 800 MW of additional RE generation is forecasted in the Western Cape by 2032. This is in addition to what has already been commissioned or given preferred bidder status.

With the integration of large-scale renewable generation over the next 10 years, the Western Cape will become a net exporter of power, with as much as 11 GW of excess generation during peak load. The actual amount is dependent on the utilisation of the OCGTs at Ankerlig and Gourikwa Powers Stations and the availability of both units at Koeberg Power Station.

Additional infrastructure will, therefore, be required to evacuate the excess power from the Western Cape and to deliver it to the load centres in the central and eastern parts of the country. For the most part, the line routes lie within the recently gazetted electricity grid infrastructure (EGI) corridors.

The required strengthening can be summarised as follows:

- 2 x Mercury-Sterrekus 765 kV lines (via Umtu, Aries, and Juno substations), with series compensation between Umtu and Mercury substations
- 765/400 kV transformation at Juno, Aries, and Umtu substations

- 765/400 kV transformation may also have to be introduced at Mercury and Gamma substations, and additional 765/400 kV 2 000 MVA transformers may be required at Zeus, Perseus, Hydra, Kappa, and Sterrekus substations.

7.9.3.5 Provincial summary

The Western Cape transmission development plan for the period 2023 to 2032 is summarised in Table 7-54.

Table 7-54 : Western Cape – summary of projects and timelines

TDP scheme	Project name	Expected CO year
Establish Koeberg off-site supply at Ankerlig Power Station	• Establish Koeberg off-site supply at Ankerlig Power Station • Loop-in-and-out of Koeberg-Dassenberg 132 kV line	2024
Koeberg 400 kV busbar reconfiguration and transformers upgrade	• Koeberg 400/132 kV GIS substation • Install 2 x 250 MVA 400/132 kV transformers • Reroute existing Koeberg 400 kV and 132 kV lines to the new substation	2031
Philippi substation extension	• Establish 400 kV busbar • Install 3rd 400/132 kV 500 MVA transformer as a hot standby	2028
Transnet Freight Rail iron ore (Orex) traction line upgrade	• Install 60 MVA 400/50 kV transformer at Juno substation	2024
Galenia substation	• Galenia 400/132 kV substation (1st 500 MVA transformer) • Loop-in-and-out of Droërivier-Proteus 400 kV line	2024
Komsberg 2nd 400/132 kV transformer	• Install 2nd 400/132 kV 500 MVA transformer at Komsberg substation	2024
Koring substation	• Koring 400/132 kV substation (1st 500 MVA transformer) • Loop-in-and-out of Droërivier-Komsberg 1 400 kV line • Bypass Komsberg 1 series capacitor bank	2024
Juno substation transformation upgrade	• Replace the 2 x 40 MVA 132/66 kV units with 2 x 80 MVA units • Install an additional 20 MVA 66/22 kV unit with the existing 10 MVA unit	2026

TDP scheme	Project name	Expected CO year
2nd Koeberg-Acacia 400 kV line	• 2nd Koeberg-Acacia 400 kV line	2026
Erica substation	• Erica substation (1st and 2nd 400/132 kV 500 MVA transformers) • Philippi-Erica 400 kV line	2028
	• Loop-in-and-out Pinotage-Stikland 400 kV line	2029
Agulhas substation	• Agulhas substation (1st and 2nd 400/132 kV 500 MVA transformers) • Loop-in-and-out Bacchus-Proteus 400 kV line • Bypass Bacchus series capacitor bank	2028
Saldanha Bay network strengthening (Phase 1)	• At Aurora substation, replace one of the three existing 400/132 kV 250 MVA transformers with a 500 MVA unit as part of refurbishment	2028
	• Strategically acquire a substation site in the Saldanha Bay area • Construct 2 x 400 kV lines (operated at 132 kV) from Aurora substation to Blouwater substation	2028
Saldanha Bay network strengthening (Phase 2)	• Bokkom substation (1st and 2nd 400/132 kV 500 MVA transformers) • Loop-in-and-out of Ankerlig-Aurora 1 400 kV line	Deferred
Asteria substation	• Asteria substation (1st and 2nd 400/132 kV 500 MVA transformers) • Loop-in-and-out of Palmiet-Bacchus 400 kV line	2026
Narina substation	• Narina substation (1st and 2nd 400/132 kV 500 MVA transformers) • Loop-in-and-out of Droërivier-Proteus 400 kV line • Bypass Proteus series capacitor bank	2032
Cape corridor Phase 4: 2nd Zeus-Sterrekus 765 kV line	• Zeus-Perseus 1st 765 kV line • Series compensation at Zeus and Perseus • Perseus-Gamma 2nd 765 kV line	2031
	• Gamma-Kappa 2nd 765 kV line	2029

TDP scheme	Project name	Expected CO year
	• Kappa-Sterrekus 2nd 765 kV line • Loop-in-and-out Koeberg-Stikland 400 kV line into Sterrekus • Sterrekus substation 2nd 765/400 kV 2 000 MVA transformer	2031
Droërivier-Narina-Gourikwa 400 kV line	• Droërivier-Narina-Gourikwa 400 kV line	2029
Stikland 3rd 400/132 kV transformer	• Install 3rd 400/132 kV transformer and FCLRs	Pre-CRA
Pinotage 3rd 400/132 kV transformer	• Install 3rd 400/132 kV transformer and FCLRs	Pre-CRA
Acacia 1st and 2nd 66/33 kV transformers	• Replace the 2 x 80 MVA 132/33 kV transformers with 2 x 10 MVA 66/33 kV units	2025
Droërivier 3rd 400/132 kV transformer	• Install 400/132 kV 500 MVA transformer • Establish new 132 kV busbar	2027
Kappa 2nd 400/132 kV transformer	• Install 2nd 400/132 kV 500 MVA transformer	2027
Komsberg 3rd 400/132 kV transformer	• Install 3rd 400/132 kV 500 MVA transformer	2027
Koring 2nd 400/132 kV transformer	• Install 2nd 400/132 kV 500 MVA transformer	2027
Galenia 2nd 400/132 kV transformer	• Install 2nd 400/132 kV 500 MVA transformer	2027
Juno 3rd 400/132 kV transformer	• Install 400/132 kV 500 MVA transformer	2027
Juno substation 400/132 kV transformation upgrade	• Replace the 2 x 125 MVA 400/132 kV transformers with 2 x 500 MVA units	-
2nd Aurora-Juno 400 kV line	• 2nd Aurora-Juno 400 kV line	2031

TDP scheme	Project name	Expected CO year
Cape corridor Phase 5	• Establish Umtu (Hotazel) 765/400 kV substation • Umtu 765/400 kV (1^{st} 2 000 MVA transformer) • Aries extension 765/400 kV (1^{st} 2 000 MVA transformer) • Juno extension 765/400 kV (1^{st} 2 000 MVA transformer) • Mercury-Umtu 1^{st} 765 kV line • Umtu-Aries 1^{st} 765 kV line • Aries-Juno 1^{st} 765 kV line • Juno-Sterrekus 1^{st} 765 kV line	2032
Cape corridor Phase 6	• Umtu substation 2^{nd} 765/400 kV 2 000 MVA transformer • Aries substation 2^{nd} 765/400 kV 2 000 MVA transformer • Juno substation 2^{nd} 765/400 kV 2 000 MVA transformer • Sterrekus substation 3^{rd} 765/400 kV 2 000 MVA transformer • Mercury-Umtu 2^{nd} 765 kV line • Umtu-Aries 2^{nd} 765 kV line • Aries-Juno 2^{nd} 765 kV line • Juno-Sterrekus 2^{nd} 765 kV line • Install 50% series compensation on Mercury-Umtu 765 kV lines	Deferred

The future Western Cape transmission network is shown in Figure 7-29.

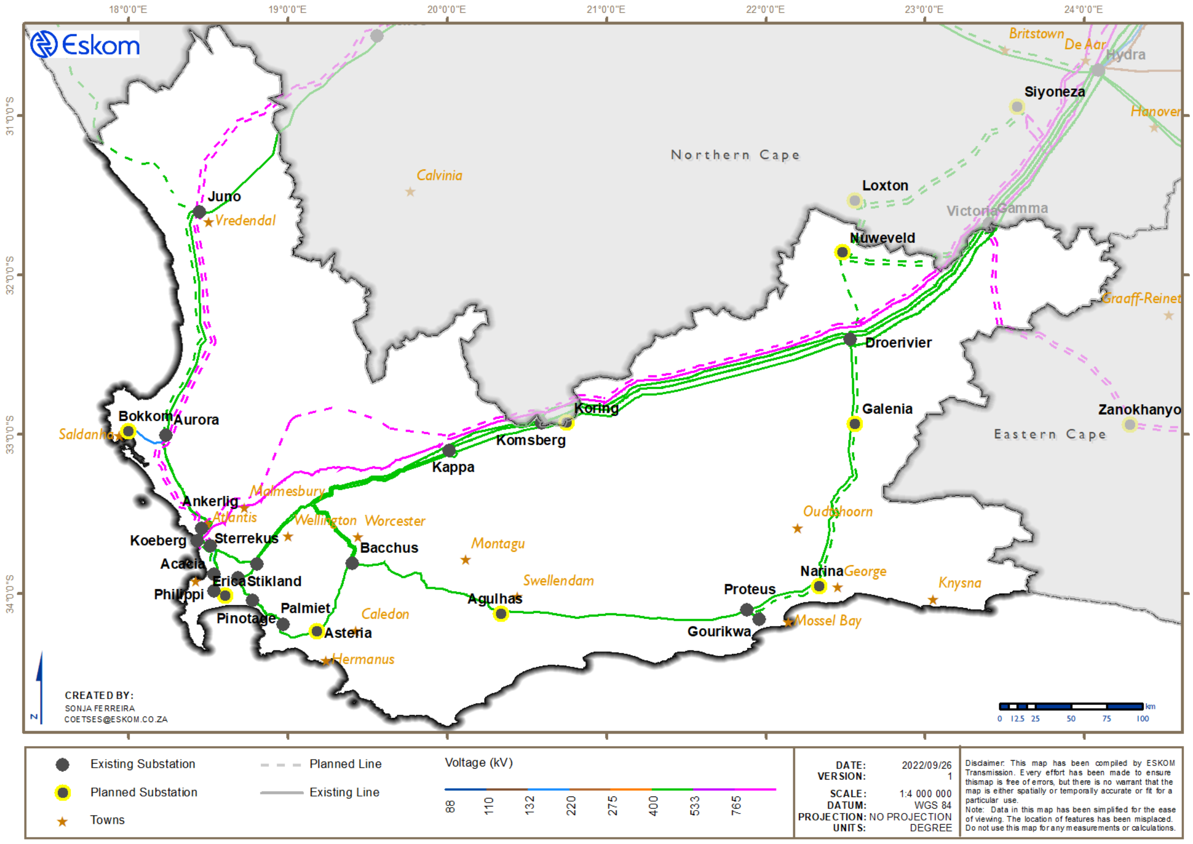


Figure 7-29: Future Western Cape transmission network

A summary of all new major assets planned for this province is provided in Table 7-55 to Table 7-58.

Table 7-55: Planned transformers for the Western Cape

Transformer type	2023 to 2027		2028 to 2032	
	Quantity	Total capacity (MVA)	Quantity	Total capacity (MVA)
Less than 100 MVA	6	360	1	20
Less than 300 MVA	1	250	-	-
Less than 500 MVA	1	315	-	-
500 MVA	8	4 000	11	5 500
2 000 MVA	-	-	2	4 000
Grand total	**16**	**4 925**	**14**	**9 520**

Table 7-56: Planned overhead lines for the Western Cape

Line voltage	2023 to 2027	2028 to 2032
	Total length (km)	Total length (km)
400 kV	39	464
765 kV	40	510
Grand total	**79**	**974**

Table 7-57: Planned capacitor banks for the Western Cape

Capacitor type	2023 to 2027		2028 to 2032	
	Quantity	Total capacity (Mvar)	Quantity	Total capacity (Mvar)
72 Mvar 132 kV	-	-	3	216
100 Mvar 400 kV	-	-	1	100
Grand total	**-**	**-**	**4**	**316**

Table 7-58 : Planned reactors for the Western Cape

Reactor type	2023 to 2027		2028 to 2032	
	Quantity	Total capacity (Mvar)	Quantity	Total capacity (Mvar)
400 Mvar 765 kV	-	-	1	400
Grand total	**-**	**-**	**1**	**400**

8 ANCILLARY SERVICES

8.1 ANCILLARY SERVICES CONSIDERATIONS

The South African Grid Code (SAGC) System Operation Code identifies obligations bestowed on the System Operator (SO) to ensure system reliability, security, safety, and efficient operation of the IPS. These services are covered by:

1. system reserves to combat generation/load contingencies and forecast errors;
2. system restoration services to expedite system restoration resulting from regional and system-wide interruption of supply;
3. reactive power and voltage control to maximise system security and reduce network losses; and
4. constrained generation to compensate those generators dispatched out of the merit order and who suffer financial loss due to a lack of related market rules dealing with transmission constraints and units in strategic positions.

Reactive power and voltage control, as well as constrained generation, are services that are directly affected by the development of the transmission network. Furthermore, as the network is strengthened, the possibility of getting reserves from generation is improved. In addition to the requirements from the SAGC and IRP stated above, expansion plans and their resultant effect on the TDP will also have an impact on ancillary services generally. (For example, increasing renewable generation and coal decommissioning will reduce reserve provision from conventional coal plant.)

Section 4 of the SAGC System Operation Code requires that the SO optimise related reliability targets annually for budgeting and publish opportunities for provision of ancillary services in line with section 7.4 of the SAGC Network Code. In the referenced section 7.4, the code requires that the NTC not only publish an updated TS development plan annually by the end of October, but also provide a five-year statement of opportunities to render ancillary services to mitigate network constraints and other IPS development plans as defined in the licence and/or market rules.

The Ancillary Services Technical Requirements (ASTR) is compiled based on an approved ASTR methodologies document and includes input from generation, load forecasting, and the IRP. This includes the use of approved information, updated annually, covering the forthcoming five-year time horizon. Once the ASTR has been approved, it is published on the

Eskom public website: https://www.eskom.co.za/wp-content/uploads/2022/04/Ancillary-Services-Technical-Requirements-2022_23-to-2026_27.pdf.

After the technical requirements have been approved, the SO procures ancillary services from generators, BESSs, distributors, or end-use customers. This is followed by a process of certification, contracting, monitoring, and payment of service providers, as required by section 4 of the SAGC System Operation Code.

The reserves requirements as stated in the 2022/23 ASTR are shown in Table 8-1.

Table 8-1: Reserves requirements as stated in the 2022/23 ASTR

Reserve	Season	Period	2022/23 MW	2023/24 MW	2024/25 MW	2025/26 MW	2026/27 MW
Instantaneous	**Summer**	**Peak**	650	650	650	650	650
		Off-peak	850	850	850	850	850
	Winter	**Peak**	650	650	650	650	650
		Off-peak	850	850	850	850	850
Regulating	**Summer**	**Peak**	530	545	560	575	600
		Off-peak	530	545	560	575	600
	Winter	**Peak**	530	545	560	575	600

Reserve	Season	Period	2022/23 MW	2023/24 MW	2024/25 MW	2025/26 MW	2026/27 MW
		Off-peak	530	545	560	575	600
Ten-minute	**Summer**	**Peak**	1 020	1 005	990	975	950
		Off-peak	820	805	790	775	750
	Winter	**Peak**	1 020	1 005	990	975	950
		Off-peak	820	805	790	775	750
Operating	**Sum-mer/ Winter**	**Peak/ Off-peak**	2 200	2 200	2 200	2 200	2 200
Emergency			1 400	1 300	1 200	1 100	1 000
Supplemental			200	300	400	500	600
Total			**3 800**	**3 800**	**3 800**	**3 800**	**3 800**

- The current providers of these services are mainly Eskom Generation as well as Demand Response.
- The system restoration service requirements, reactive power and voltage control, and constrained generation are specified as outlined in the published ASTR.
- The SO expects the procurement of more services through the IPP programmes, which include renewable energy, battery energy storage, and gas.
- It is anticipated that the changing generation mix will require new ancillary services, including fast-frequency response, self-start, and inertia.

9 CAPITAL EXPENDITURE PLAN

The total capital expenditure for Transmission amounts to approximately R72 168 billion for the five-year period from FY2023 to FY2027 and is summarised in Table 9-1.

Almost R50,8 billion is required for capacity expansion projects to address the following:

- The increase in generation capacity of ~53 GW in the next 10 years, mainly in areas with limited network capacity, which will require a significant amount of investments in transmission networks to connect and develop new corridors and substations to dispatch the power to the load centres
- Completing the integration of the Medupi and Kusile Power Stations, as well as the Bid Window 4 and 5 IPPs, resolving network reliability constraints (N-1), connecting customers, ensuring that safety and regulatory compliance requirements are met, and sustaining the network for future growth and the acquisition of servitudes

Further to the above, an amount of R21,4 billion in capital expenditure is required for:

- refurbishments that address the life extension of existing assets to ensure network sustainability;
- production equipment;
- refurbishment of ageing telecommunications infrastructure; and
- strategic spares for emergency works.

Table 9-1: Capital expenditure per category of projects for FY2023 to FY2027

Transmission capex categories	R million
Capacity expansion:	47 761
IRP 2019 – integration of RE	*22 058*
Network strengthening	*25 703*
Refurbishment	9 726
Production equipment	2 102
EIA and servitude	3 029
Telecoms	3 116
Strategic spares	6 434
Total	**72 168**

10 CONCLUSION

The major change from the 2021 TDP to this revision of the 2022 TDP is associated with assumptions about the future generation capacity of the country. The 2022 TDP was informed by the IRP 2019, which was gazetted in November 2019. The IRP does not have capacities per annum beyond 2030; as a result, values for 2032 and beyond were assumed for wind, PV, battery storage, and gas.

The bulk of the changes in this version of the TDP can be attributed to two main factors, namely, utility-scale RE integration and the executability of this. These factors necessitated the reprioritisation of the plan based on need criticality assessment and readiness to implement.

The result is a realistic and achievable development plan, within the constraints imposed by site and servitude acquisition, and supplier and construction lead times. The slower rate of completion of projects regrettably increases the overall risk to the network. However, this risk can be managed, as the N-1 criterion refers to the strict deterministic level, which assumes that an N-1 contingency event will happen at the time of the peak loading. In reality, there is a limited chance of this happening, and operational mitigation plans will cater for most of the events until the required projects have been completed. Some of the risk mitigation measures under consideration are higher reliance on the utilisation of strategic spares, the use of capacitors in the short term for voltage support, and the implementation of emergency preparedness plans. The affected customers are consulted when compiling or reviewing emergency preparedness plans to ensure that emergencies necessitating load reduction are managed in a way that minimises the impact on individual customers and South Africa at large.

Robust and efficient planning requires the timely exchange of credible information between stakeholders. In particular, stakeholders are requested to note that spatial data and development timeline information are critical for the effective planning and development of the transmission network. Transmission infrastructure is generally on the critical path of connecting and integrating large new loads and generation due to the long lead times for securing corridors. It is recommended that, for planning purposes, developers should allow for at least seven years' lead time for new corridors. It should also be noted that, in the EIA process, there are increasing objections from landowners and other stakeholders to proposed power line routes, which may further prolong the time to implement projects. The EIA and environmental approval process is prescribed by law. Changes to the relevant environmental legislation can significantly affect lead times for new projects.

The transmission projects in this TDP will result in the overall network becoming Grid Code compliant, while catering for increased load growth and the integration of new generation, albeit at a later date than previously envisaged, mainly due to protracted land acquisition processes and funding constraints.

11 ACKNOWLEDGEMENTS

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This document and the public forum presentation are available for download via the Eskom website.

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