Transmission Ten-Year Development Plan

2013-2022

Eskom

> FOREWORD BY GROUP EXECUTIVE

"I would also like to take this opportunity to thank the team that has worked and continues to work on the development of these plans."

A reliable electricity supply of acceptable quality is essential for the economic development of South Africa. It is also a prerequisite for socio-economic development, as it paves the way to access to education, improved nutrition and health care, and jobs, amongst others. The transmission system plays a vital role in the delivery of a reliable, high quality electricity supply throughout South Africa and the region, by delivering electricity in bulk to load centres and very large end-users. From there, the distribution networks owned by Eskom and municipalities deliver electricity to end-users. The transmission system needs to be well-maintained to deliver a reliable supply of electricity, and it also needs to be strengthened to meet changing customer needs.

The National Energy Regulator of South Africa (NERSA) is the custodian of the South African Grid Code, which contains the rules governing investment in the transmission network. Eskom, as the licensed Transmission Network Service Provider, plans the network according to this Code, and subject to funding and other resource constraints, builds the network according to these plans. Where insufficient funds are available to develop the network, a consistent set of rules is applied to prioritise projects and allocate funding in such a way that the maximum benefit is gained for Eskom and South Africa, whilst ensuring alignment of this plan to the IRP 2010 country plan and fair and equitable access to the grid for Independent Power Producers (IPPs), as well as Eskom Generation.

The plans are firstly focused on ensuring that the network complies with the minimum reliability criteria specified in the Grid Code for both loads and power stations. Secondly, the new power stations developed by Eskom and IPPs must be connected to the network. The first two phases of preferred bidders for the Department of Energy's REFIT renewable energy programme (wind, solar photovoltaic, solar thermal, etc.) have been announced to help meet South Africa's commitment to reduce carbon emissions. Thirdly, new loads need to be connected to the network.

The provision of a reliable electricity supply, which will enable South Africa to meet its economic growth targets, requires significant capital investment, which is ultimately funded by electricity consumers through the tariff. There is a need for stakeholders to understand what is required to ensure a reliable and secure supply. Improved reliability and quality of electricity supply needs to be balanced against the cost of providing it, to create maximum value for South Africa. I hope that this document will assist in this dialogue, and I welcome comments and queries on the content and format.

I would also like to take this opportunity to thank the team that has worked and continues to work on the development of these plans. It is a difficult and complex process, requiring extensive consultation and multiple iterations.

Mongezi Ntsokolo

GROUP EXECUTIVE (TRANSMISSION)

> DISCLAIMER

The purpose of publishing the Transmission Ten-Year Plan is to inform stakeholders about the proposed developments in the Eskom transmission network. These plans are subject to change as and when better technical solutions are identified or when more accurate developmental information becomes available. The information contained in Transmission's Ten-Year Plan should therefore not be used for any other purpose other than for sharing this information.

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"The publication of the Transmission Ten-Year Plan is to inform stakeholders about Eskom's plans for the development of the transmission network."

Eskom Holdings is a vertically integrated company licensed to generate, transmit and distribute electricity in South Africa. The Transmission Division of Eskom Holdings has the responsibility of developing the transmission network. The publication of the Transmission Ten-Year Plan is to inform stakeholders about Eskom's plans for the development of the transmission network. This publication fulfils the requirements of the South African Grid Code, which requires the Transmission Network Service Provider (TNSP) to publish plans annually on how the network will develop. This is the fourth publication of the Transmission Ten-Year Plan.

A public forum will be held with identified stakeholders to disseminate further and get feedback on the contents of this plan. These comments will be taken into account when the plan is revised. This publication contains information about projects intended to extend or reinforce the transmission system, which have been completed in the past year, as well as about projects which are planned for the next ten years.

The transmission network is the primary network of interest covered in this publication. This covers electrical networks with voltages ranging from 220kV to 765kV and the transmission substations where these networks terminate. A few 88kV and 132kV electrical networks are included due to their strategic nature.

The projects covered in this document include the generation integration projects required to ensure that the network is adequate to evacuate and dispatch power from the source to the load centres. The publication also includes the plans for strengthening the transmission network that is required to carry the power from the new power stations, and the reliability projects required to ensure that the reliability and adequacy of the transmission network are sustained as load demand increases on the network.

The estimated rand value of the planned projects is approximately R149 billion (excluding IDC) in the next ten years, of which approximately R3 billion is for customer related projects; R25 billion for generation integration projects, and approximately R121 billion is related to reliability projects. 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 and commodity prices and to global demand.

In general, the impact of reliability projects on the customers is to improve availability of supply under normal and contingency operating conditions, whereas customer and generation integration projects allow generating plant and the load to be optimally connected to the network.

Eskom Transmission also undertakes capital expenditure in respect of the refurbishment of ageing infrastructure, facilities, production equipment and strategic capital spares. Facilities consist of buildings located at sites other than substations, which Transmission uses for offices, the operation and control of the system, or as maintenance depots and workshops. Production equipment consists of vehicles, office furniture and equipment, computer hardware and software, tools and other equipment used by maintenance staff. Strategic capital spares are items not available from suppliers ex stock, for example: large power transformers, circuit breakers, etc., that are kept as a strategic stock to allow units which fail in service and cannot be repaired on site, to be replaced as soon as practicable, thereby minimising the risk that customers may experience a lengthy outage.

Projects dealing with the refurbishment of ageing infrastructure, facilities, production equipment and strategic capital spares are not explained in greater detail in this document, but a summary of their costs appears in the chapter dealing with capital expenditure.

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> ABBREVIATIONS

CLN (Customer Load Network)
The network within a specific geographical area, which in turn is a subdivision of a Grid, e.g. Johannesburg CLN falls within the Central Grid

DOE – Department of Energy

TNSP (Transmission Network Service Provider)
A legal entity that is licensed to own, operate, and maintain a transmission network

MW (Megawatt)
A million watts – a watt is a unit of electrical power production or demand

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

MVA (Megavolt-ampere)
A million volt-amperes of apparent power, being the vector sum of real power (MW) and reactive power (MVAr)

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

MTS – Main Transmission Substation
These are substations owned and operated by a TNSP

RTS – Return to Service
A previously mothballed Power Station undergoing re-commissioning

REFIT – Renewable Energy Feed in Tariff
The NERSA promulgated tariffs payable to producers of renewable energy

RE – Renewable Energy

IPP – Independent Power Producer
These are power stations owned by independent parties other than Eskom

TDP – Transmission Development Plan
A development plan produced annually by Grid Planning detailing how the network will develop in the next ten years. This comprises the proposed new projects listed in this document as well as the customer projects omitted from this document owing to their commercial sensitivity.

OCGT – Open Cycle Gas Turbine
Combustion turbine fuelled by liquid fuel or gas, used to drive a generator

CCGT – Combined Cycle Gas Turbine
OCGT fitted with a waste heat recovery boiler and steam turbines to increase electricity output by using the combustion turbine's exhaust gases to raise steam

HVDC – High Voltage Direct Current

IQ – Indicative Quote
Quotation giving a non-binding indication of the order of magnitude costs

FQ – Feasibility Quote
Quotation giving customers costs and scope at a 65% accuracy level

BQ – Budget Quote
Quotation giving customers costs and scope at an 85% accuracy level

TOSP – Time of System Peak

1. INTRODUCTION

1.1 CONTEXT OF THE TRANSMISSION TEN-YEAR PLAN

Eskom Holdings is the biggest producer of electricity in South Africa; it also transmits electricity via a 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. The transmission licence is held by Eskom Transmission, the transmission network service provider (TNSP). Planning the transmission network is the responsibility of the Grid Planning Department in the Transmission Division.

The TNSP is required to abide by the regulatory requirements to publish a document annually, detailing the plans for the way that the transmission network will develop in the next five years. This plan covers a 10 year window. The requirements furthermore stipulate that the published document should include –

- the acquisition of servitudes for strategic purposes;
- a list of planned investments, including costs;
- diagrams displaying the planned changes to the transmission system (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 that the TNSP should hold public forums to share such plans with stakeholders in order to facilitate a joint planning process with them. The fourth Ten-Year Plan was published early in October 2011; this is the fifth publication based on the TDP for 2013 to 2022 (also called the 2012 TDP internally to Eskom) which was finalised internally during September 2012.

1.2 STRUCTURE OF THE DOCUMENT

The document is structured in the following manner:

Chapter 2 deals with the electricity demand forecast and generation assumptions. The demand forecast determines how the network is planned and it contextualises the planning activity whereas the generation assumptions outline the generation build that informs some of the planned transmission network, as a significant transmission network is required to evacuate power from the power stations to the load.

Chapter 3 focuses on the major changes that have occurred since the completion of the previous published Yen-Year plan. The changes that occurred include the enhancement of geospatial forecasting, which improves the forecasting of load at a spatial level, and the changes from the previous generation assumptions to the ones informing this plan.

Chapter 4 focuses on projects that have been completed in the past year and the impact they have had on network reliability. This is partly to demonstrate the value of the projects as they are completed and to also inform stakeholders about the progress made with projects so far.

Chapter 5 deals with the national overview, which gives a high-level explanation of the planned transmission infrastructure. This is intended to give a snapshot of the major projects that are planned for the entire period of the Ten-Year Plan and a high-level summary of the installed transmission infrastructure.

Chapter 6 focuses in detail on the planned projects and the impact they will have on the network. Generation integration and reliability projects are discussed per Grid. In both instances, sites and servitudes are required to accommodate substations and lines respectively. In either case, the National Environmental Management Act requires Eskom to conduct an Environmental Impact Assessment (EIA) and obtain environmental approval, which includes consultation with affected stakeholders, prior to construction.

Chapter 7 deals with the capital expenditure of the Ten-Year Plan.

Chapter 8 deals with various conclusions based on the content of this document.

2. LOAD DEMAND FORECAST AND GENERATION ASSUMPTIONS

The 10 Year Transmission Development Plan (TDP) seeks to meet the long-term requirements of the electricity consumers in South Africa by maintaining the legislated adequacy and reliability of the transmission grid.

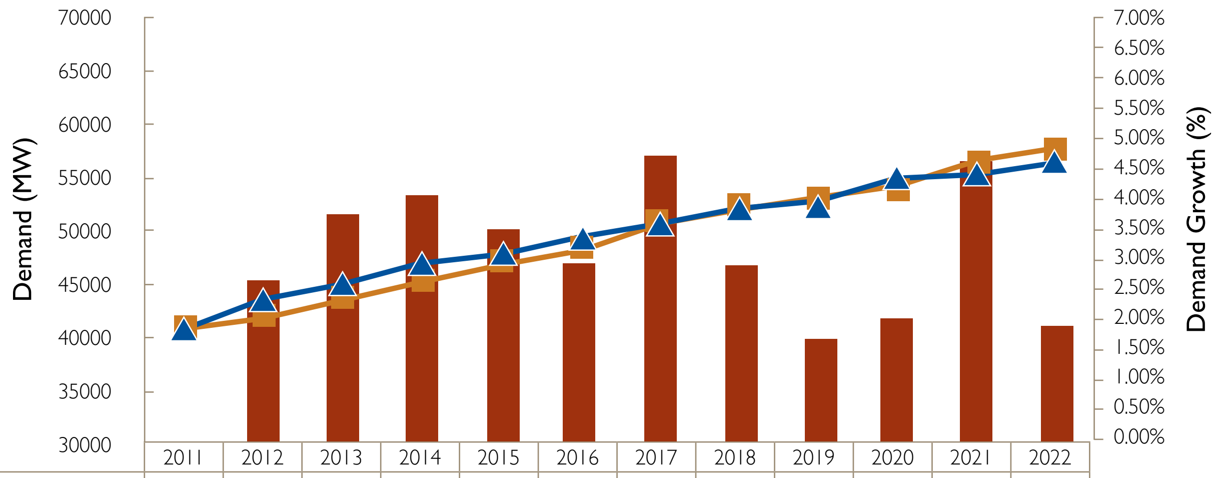
The objective is to produce a plan containing the expected development projects for the transmission system for this 10 year period. These expected projects will consist of the approved projects, the projects that are to be prepared for approval and the projects likely to be taken for approval over the defined period.

In order to undertake the system adequacy studies to determine the weakness in the system, a number of assumptions need to be made. These assumptions are required in order to assure consistency in the network studies and analysis, as well as to inform the organisation of the basis of Transmission Development Plan (TDP) for the defined period.

2.1 LOAD FORECAST

Load forecasting is a fundamental requirement for a Transmission planning cycle. The availability of sufficient transmission network capacity in any country is important for economic growth. Grid Planning, in consultation with the relevant Distribution Regions, compiles a forecast per point of supply for the network computer model. A number of improvements have been made to the forecast for this TDP. The most notable improvement is the enhanced spatial format of the forecast as well as a link to the economic forecast for the country in terms of Gross Value Added (GVA) estimates.

At the Combined Forecasting Forum, forecasts were discussed with all parties and it was agreed that the Balanced Base Line System Demand at the time of System Peak (illustrated by the 2012 TDP forecast in Figure 2.1 below) and its associated point of supply and area forecasts would be used for transmission planning purposes by the Grid Planning Department for the Transmission Development Plan (TDP) network studies for the period 2013 to 2022. The expected peak demand for 2022 is 57,8 GW.



	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
2012 TDP Growth (%)		2.7%	3.8%	4.1%	3.5%	3.0%	4.8%	3.0%	1.7%	2.1%	4.6%	1.9%
2012 TDP Demand (MW)	40900	42000	43600	45400	47000	48400	50700	52200	53100	54200	56700	57800
2011 TDP Demand (MW)	40700	43400	44800	46600	47800	49200	50700	52100	52600	54700	55700	56600

Figure 2.1: The Eskom Transmission System demand Forecast

The 2012 TDP forecast is marginally lower than the 2011 TDP forecast between the years 2012 to 2016. This is attributed to more accurate forecasting linked to spatial forecasting techniques and economic sector growth. This forecast also assumes maximum load usage by existing customers. For the purposes of the TDP, loads are allocated to a CLN according to the location of the transmission substation supplying them, even if they are physically located in a different CLN.

2.2 GENERATION ASSUMPTIONS

The TDP Generation Plan for the period 2013 to 2022 is based on the IRP 2010 report. There is only one Generation Plan to be considered for this TDP update and associated network studies.

In order to achieve the proposed IRP 2010 Plan, a number of assumptions regarding size and location of the future planned generation plant had to be made. These assumptions are discussed below.

Return to Services stations

Komati will be completed in time for the 2013 system peak.

DoE OCGT power stations

The IRP indicates that the Department of Energy (DoE) will implement the two OCGT power stations by 2013 and it is assumed that they will be completed in time for the 2013 system peak. These are assumed to be located as previously proposed by the DoE with one close to the Dedisa MTS and one at close to the Avon MTS. They will be based on 147MW units and will be modelled as follows:

- 2 x 147MW units at Dedisa
- 5 x 147MW units at Avon

These will be treated as peaking plant and in the TDP studies where they will only be used under contingency conditions, or, if required, during system peak. However for integration studies they will be studied at full output under the local Grid peak conditions to ensure that all the power can be evacuated.

Ingula Pumped Storage

The Ingula pumped storage power station is an approved project. The project has been rescheduled and it is now assumed to have unit 1 completed in time for the 2013 system peak and units 2, 3 and 4 completed in 2014, but unit 4 will only be completed time for the 2015 system peak.

Base Load Coal (Medupi and Kusile)

The Base Load Coal power stations at Medupi and Kusile are approved projects. However both projects have been delayed, particularly Kusile, and the new units are now assumed to be completed between 2013 and 2020 in line with the 2010 IRP.

The first unit for Medupi will come on line in time for the 2013 peak and the last in time for the 2017 peak. The first two units of Kusile will come on line in time for the 2017 peak and the last unit in time for the 2020 peak.

No further large Eskom built base load coal fired power stations are expected for the TDP period of 2013 to 2022.

Co-generation Projects and MTPPP

A total of 390MW of co-generation plant is included in the 2010 IRP by 2013. There is no indication of what size plant and where they will be located. Based on the studies for the proposed SASOL co-generation plant two 200MW units will be assumed to be located at Sol B as per the project studies. The third 200MW unit as assumed for the previous TDP study will not be included until there is clarity on the program. The MTPPP program which offered PPA contracts to any generators that fall below a certain price level was not considered at Transmission level as most will be less than 20MW in size.

New Coal options

The 2010 IRP has provision for new coal fired power stations under the New Build options. These are smaller than the traditional Eskom base load coal power stations and it has been assumed that these will be IPP coal stations with smaller units to match the 2010 IRP requirements.

A total of three new IPPs have been assumed, referred to as Coal IPP 1, Coal IPP 2 and Coal IPP 3. The first two, Coal IPP 1 and Coal IPP 2, have been allocated as two 600MW stations for 2014 and 2015 based on current IPP projects under investigation. This is slightly in excess of the two 500MW stations in the 2010 IRP. Coal IPP 1 will be in the Mpumalanga Province in the Witbank area and Coal IPP 2 will be in the Limpopo Province in the Lephalale area.

The final 2010 IRP allocation of 1000MW from 2019 to 2022 was allocated to the Mpumalanga and Limpopo Provinces.

Wind Generation

The Government RE IPP program (previously known as REFIT) has gone out for procurement for the following:

- Wind
- Small hydro
- Landfill gas
- Concentrated Solar
- Photovoltaic (PV)

The majority of the RE IPP is expected to be wind generation. This is reflected in the 2010 IRP with 4400MW of wind allocated by 2022, including the Eskom 100MW Sere project. A total of 400MW has been added each year from 2012 (which has been assumed to be available for the 2013 system peak) until 2022.

Based on the response and knowledge of status of some of the IPP developers in terms of connection application, cost estimate letter and EIA status a number of proxy IPP wind farms have been allocated with unit sizes varying from 30MW to 140MW for the 2012/2013 allocation (i.e. available for the 2013 system peak). These have been placed at the following substations to be connected to their 132kV busbars:

- Aurora
- Delphi
- Droerivier
- Grassridge
- Juno
- Palmiet
- Poseidon

From 2014 onwards to 2022 the wind generation has been allocated as 100MW units to various transmission substations (four per year) to determine the overall impact on the transmission power flows. The locations are aligned overall by 2022 to the expected "Wind Area" allocation assumed in the "Assumptions Paper for the 2040 Transmission Network Study", report GP_11/102 dated August 2011. The units are connected to the 66kV, 132kV or 220kv busbars of the Transmission Substations as appropriate.

Without the actual location and size of the wind farms it is difficult to determine the exact transmission requirements for the TDP. Taking into account that the normal average load factor of wind farms is of the order of 25% to 35%, this means that they will not have a significant impact on the capacity design of the network. The impact is very localised and it is proposed that all wind farm applications will be handled on a case by case basis.

Concentrated Solar Power (CSP) Generation

The Concentrated Solar Power (CSP) generation has been set at 900MW in the 2010 IRP document. This is expected to increase again in later versions of the IRP. For the purposes of this TDP update the 900MW is assumed to be nine 100MW plants connected in the Upington and Paulputs areas.

Based on the assessment of the potential bidders in the RE IPP program the first units to come on line are expected in the Paulputs and Upington area and according to the 2010 IRP will be in by 2014. It will be modelled as a 100MW unit connected directly to the existing 220kV busbar of Paulputs substation and another 100MW unit connected to a Distribution substation (Gordonia) which is linked to the Garona Transmission substation.

The rest of the CSP plants are expected to be connected in the Upington area in line with proposed 1000MW Solar Park proposal that was studied in 2011. For the purposes of the studies the 100MW units will be modelled at a new 400kV busbar at Upington, initially connected to the new Nieuwehoop substation by a single 400kV line. The integration of the Upington 400kV substation will be in accordance with the proposed 1000MW Solar Park scheme. One 100MW unit will be added each year starting from 2015 up until 2022.

These units will be run at maximum output during the both the System peak and the Local peak. They will not be run during the low load conditions at night.

Open and Combined Cycle Gas Generation (OCGT & CCGT)

There are a number of Open Cycle Gas Turbine (OCGT) and Combined Cycle Gas Turbine (CCGT) generation plants proposed as New Build options in the 2010 IRP, giving a total of 711MW OCGT and 805MW CCGT. Based on the assumption that the CCGT would require a LNG plant and that a minimum of 2000MW would be required to make this economically viable, Dedisa has been selected as the site. This will result in more than 2000MW of gas generation in the COEGA area to allow for a LNG plant.

The unit sizes at Dedisa to match the 2010 IRP have been assumed as follows:

- OCGT (2 x 237MW) from 2019 to 2021
- CCGT (3 x 269MW) in 2022

In the previous TDP it was assumed that a number of 237MW units were installed at the existing OCGT sites of Gourikwa, Avon and Dedisa based on the then draft IRP expectations. The new assumptions are in line with the official 2010 IRP.

The OCGT units are to be run only as peaking units and only to be despatched as the last resort due to their operating costs. The CCGT units can be run at Time-of-System Peak and local Time-of-Grid peak if required as they are more efficient than OCGT units. However they should not be run during Low Load conditions.

Imported Hydro power

In the 2010 IRP there is an assumption of 1143MW of imported hydro power in 2022. The most likely location is from Northern Mozambique. This will be transported down to the Maputo area via the proposed Mozambique Transmission Backbone project (referred to as CESUL). This will in effect relocate the power to Maputo. For the purposes of the TDP studies this will relieve the MOZAL load in Maputo which Eskom are required to supply. Therefore the hydro import can be modelled as two 570MW generators placed at the Maputo 400kV substation to relieve this load. This import option will be studied in detail as a separate study and only serves to hold the place for the potential generation.

PV and the other RE IPP Renewable Generation

A significant amount of PV has been allocated under New Build options in the 2010 IRP with over 3300MW by 2022. However, there is no indication of location or size per location. PV can only operate when there is sunlight and will therefore not be available for the system peak which occurs in the evening during winter. Effectively PV does not contribute to meeting the peak system demand and can be ignored.

While it is acknowledged that the cumulative effect of PV during the daylight hours will have an impact, particular at peak output during low daytime loading or connected to other generation injection points on the transmission grid, PV will not be modelled for the TDP studies for this TDP update. The initial PV installations will be absorbed in the Distribution networks and any large PV installations will be studied on a case by case basis. When more detailed information on the location and sizing of PV installations is available this will be included in the assumptions for the next TDP update.

Decommissioning of Coal Units

The 2010 IRP indicates that the first decommission of large coal units will start in 2022. This will be an equivalent of five 380MW units at Camden in 2022. This will be assumed for these TDP update studies.

New generation summary

A summary of the new plant and the year that the last unit at the power station will become commercially available appear in Appendix A. These generation units were assumed to be in service at the expected dates. This is graphically illustrated in Figure 2.2 and Figure 2.3 below.

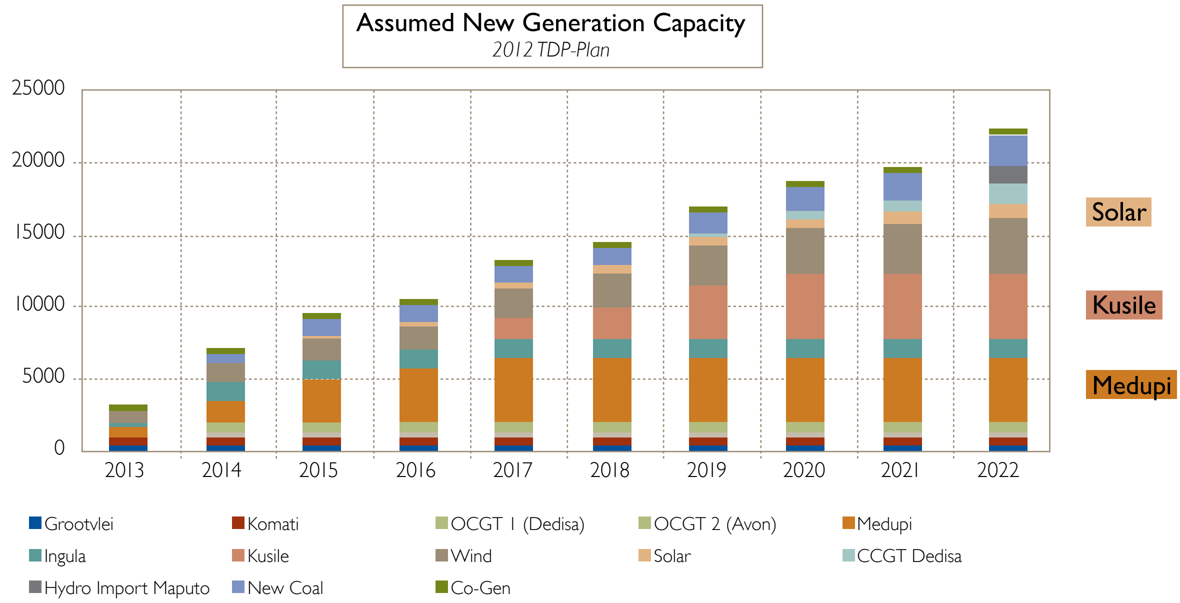


Figure 2.2: Power station capacity introduction by year

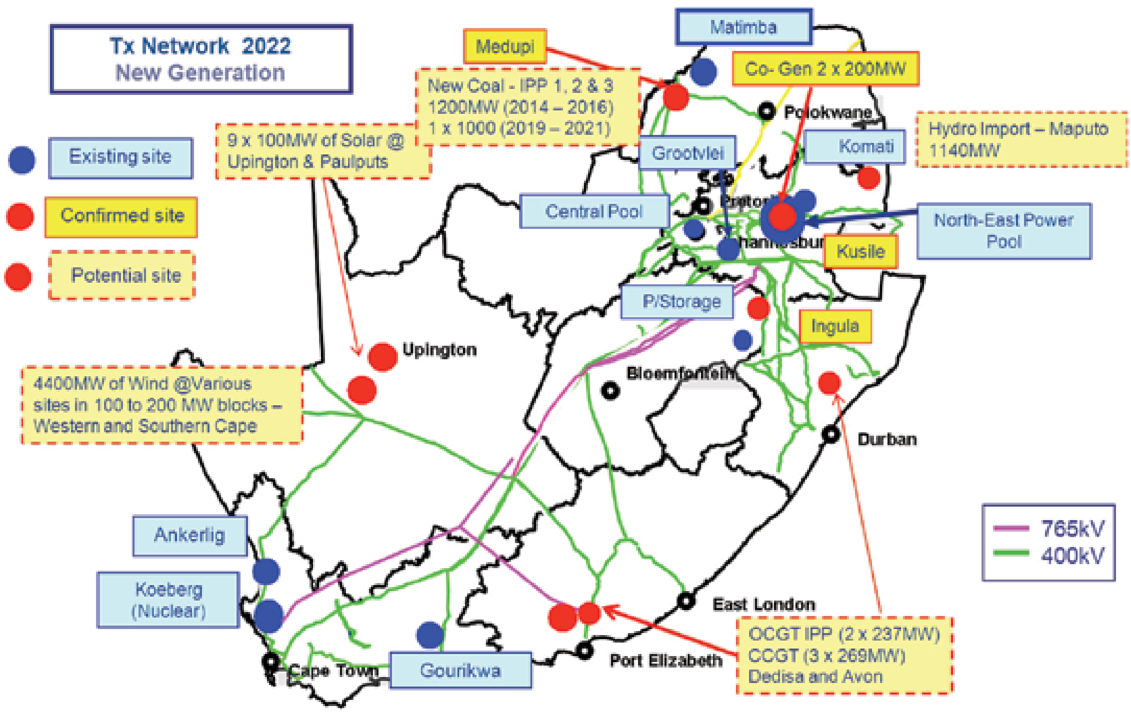


Figure 2.3: Planned Power Station Capacity by 2022

3. MAJOR FACTOR CHANGES FROM PREVIOUS TDP

There have been some changes in the factors influencing the selection and timing of projects for this TDP from the previous TDP. The main factor was related to an even better understanding of the geospatial load centres and forecast, and the potential generation scenarios. These two factors are briefly discussed in this section as background to the motivation of the projects and their timing in the TDP.

3.1 Geospatial Load Forecast

The 2012 TDP forecast is marginally lower than the 2011 TDP forecast between the years 2012 to 2016. This is attributed to more accurate forecasting linked to spatial forecasting techniques and economic sector growth. This forecast also assumes maximum load usage by existing customers. For the purposes of the TDP, loads are allocated to a CLN according to the location of the transmission substation supplying them, even if they are physically located in a different CLN.

3.2 Generation Assumptions

A number of generation projects that were assumed to be in place for the TDP studies for the period 2011 to 2020 have been changed in the generation assumptions for this TDP update period. These are discussed below.

Medupi and Kusile schedules

The Medupi and Kusile projects have both had their rollout periods extended with Medupi only completed in 2017 instead of 2015 and the first unit of Kusile delayed from 2015 to 2017. Kusile will only be completed in 2020 instead of 2019.

Co-Generation SASOL

This has been reduced from three 200MW to two 200MW units, but will be completed by 2013 instead of 2015.

Wind Generation

The wind generation was assumed to be 200MW units at various locations for the previous TDP which has now been changed to 100MW units at various locations in line with the 2010 IRP schedule.

CSP locations

In the previous TDP it was assumed that 100MW units would be placed at Upington, Ferrum and Gordonia. This has been changed to one 100MW unit at Paulputs, one 100MW unit in the Upington area connected at Gordonia and seven 100MW units at a new Upington 400kV transmission substation (100MW per year in line with the 1000MW Solar Park proposal).

Gas Generation

New CCGT gas generation was allocated at three sites in the previous TDP, namely Gourikwa, Avon and Dedisa. For this TDP update all new gas generation (OCGT & CCGT) have been placed at Dedisa based on the minimum generation of 2000MW to economically justify the required LNG plant.

Hydro import

The previous TDP had hydro power imported from Mozambique in 2020 and 2021. This has been changed to a single import value in 2022.

4. UPDATE ON PROJECTS AND CONNECTION APPLICATIONS

4.1 UPDATE ON TRANSMISSION RELIABILITY

This section discusses all the projects completed since the year 2010 and projects projected to be completed by the end of the 2012/13 Financial Year. The project list excludes Feeder Bay projects resulting from Connection Applications received.

Completed Projects:

SUB-PROJECT NAME	Province
Series Compensation on Alpha-Beta 1st and 2nd 765kV lines	FS
Nevis 275kV Turn-in 1 (Matla-Esselen 1st 275kV) (disconnect the two Nevis-Matla section 275kV lines)	GP
Snowdown Upgrade 3x 160MVA 275/88kV transformers	GP
Glockner Ext 3rd 800MVA 400/275kV transformer	GP
Croydon Ext 3rd 250MVA 275/132kV transformer	GP
Eiger Ext 3rd 80MVA 88/33kV transformer	GP
Esselen Ext 2nd 315MVA 275/88kV transformer	GP
Kookfontein Ext 2x 88kV 48MVAr capacitors	GP
Majuba-Umfolozi 1st 765kV line (operate @ 400kV)	KZN
Eros Ext 2nd 500MVA 400/132kV transformer	KZN
Hector Ext 3rd 800MVA 400/275kV transformer	KZN
Spitskop Ext 1st 500MVA 400/132kV transformer	Lim
Spencer Ext 2nd 250MVA 275/132kV transformer	Lim
Spencer-Tabor 1st 275kV line	Lim
Gumeni 132kV line loop-ins (Prairie-Sappi 1st and 2nd 132kV lines) (includes 132kV switchyard)	MP
Duvha-Leseding 1st 400kV line	MP
Ferrum Ext 132kV 1x 72MVAr shunt capacitors	NC
Olien Ext 132kV 2x 36MVAr shunt capacitors	NC

Projects planned to be completed by FY 2012/13:

SUB-PROJECT NAME	Province
Gamma Ext 765kV busbar establishment	WC
Beta - Perseus 1st 765kV line	FS
Gamma - Perseus 1st 765kV line	FS
Mercury - Perseus 1st 765kV (Operate @ 400kV)	FS
Perseus Ext 765/400kV transformation	FS
Relocate Beta - Hydra 765kV line to form Perseus - Hydra 1st 765kV line	FS
Zeus - Mercury 1st 765kV line (to form Zeus - Perseus 1st 765kV) (By-pass Mercury)	FS
Hydra - Gamma 1st 765kV line	WC
Series Compensation on Mercury - Perseus 1st 765kV line	FS
Series Compensation on Zeus - Mercury 1st 765kV line	FS
Zeus 400kV By-pass (create new Camden - Sol 1st & 2nd 400kV lines)	MP
Khanyazwe (Malelane) 275kV loop-in (Marathon - Komatipoort 1st 275kV line)	MP
Khanyazwe (Malelane) 275/132kV Substation (1st 250MVA 275/132kV transformer)	MP
Medupi - Spitskop 1st 400kV line	Lim
Medupi - Spitskop 2nd 400kV Line	Lim
Bighorn 2nd 800MVA 400/275kV transformer	NW
Phase 1: Sishen - Saldanha Spoornet new traction stations (1x275/50kV substation with 2x40MVA transformers)	NC
Hera - Bernina 275kV Link closed (uprate of breakers)	GP

4.2 GRID CONNECTIONS APPLICATIONS

Table 4.1 outlines the number of Indicative Quotations (IQs), Feasibility Quotations (FQs) and Budget Quotations (BQs) that have been processed during the period August 2011 to August 2012. These are as a result of applications for grid connections, as per the Grid Code.

Table 4.1: Connection applications quoted and accepted

	Indicative Quotations	Feasibility Quotations		Budget Quotations	
	Issued	Issued	Accepted	Issued	Accepted
Total	134	32	12	29	12
% Acceptance			38%		41%

As shown in Table 4.1 above, the number of customer applications for grid connections that were processed is fairly high, indicating high connection requirements due to increasing load and generation activity. The acceptance rates for budget quotations are fairly low. Further analysis and consultation with customers are required to understand the opportunities that would improve this acceptance rate. A large number of Indicative Quote applications (most of the 134 applications above) were received to connect Renewable Energy Generation onto the Transmission Grid.

5. NATIONAL OVERVIEW

The map in Figure 5.1 below shows a high-level view of the major TDP scheme projects. The relative location of the new transmission lines and the associated MTS substations are indicated schematically in the figure. Please note that Transmission is currently in the process of moving toward managing the Transmission Grid according to the nine provincial boundaries compared to the seven internal grid boundaries that existed previously. This TDP (and future TDP's) will report according to the nine provincial boundaries as indicated in Figure 5.1 as well.

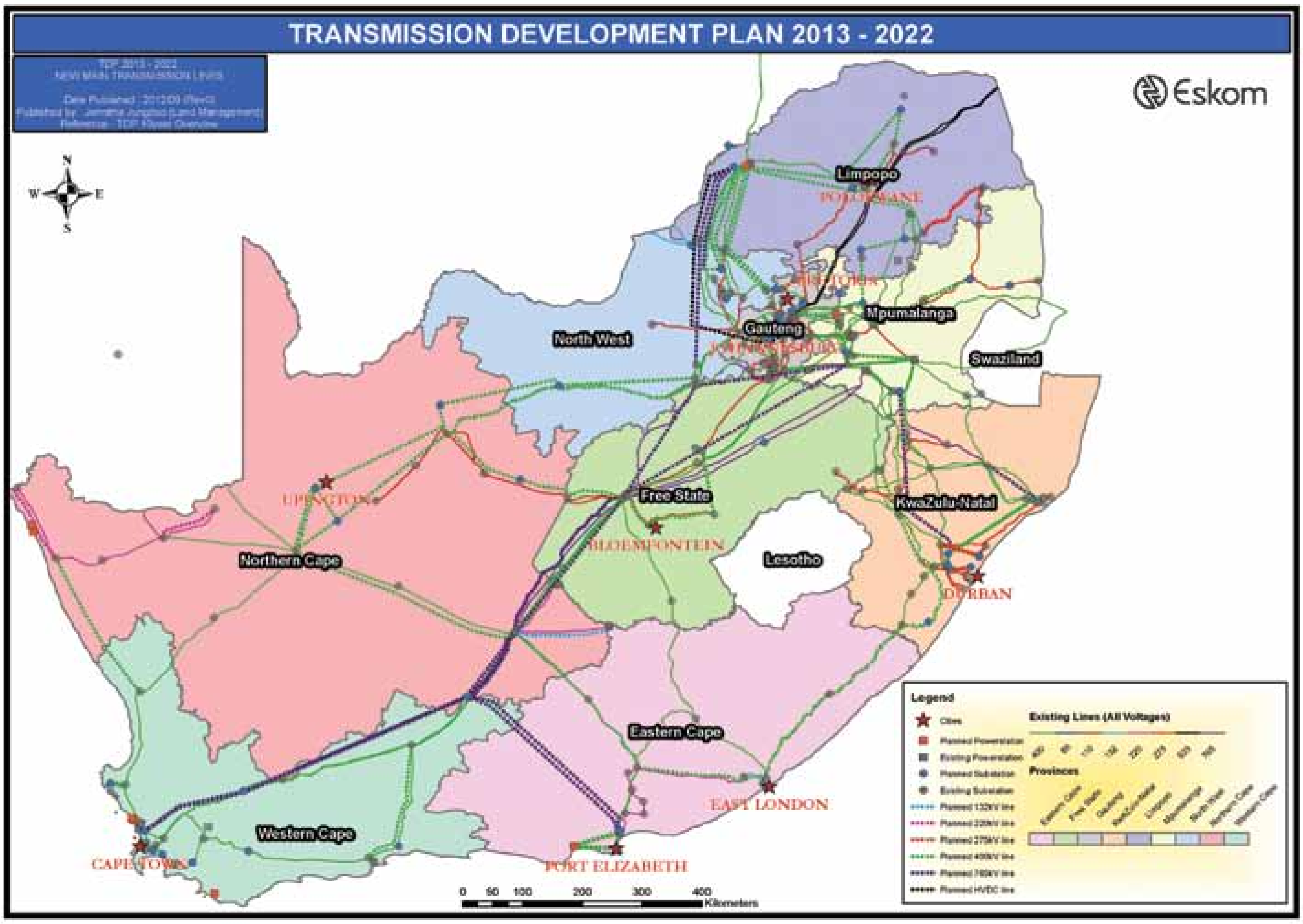


Figure 5.1: Map showing relative location of the major TDP scheme projects

The major new assets that have either been approved or it is proposed should be added to the transmission system over the next ten years are summarised in Table 5.1 below.

TDP New Asset	Total
HVDC Lines (km)	0
765kV Lines (km)	3,700
400kV Lines (km)	8,631
275kV Lines (km)	402
Transformers 250MVA+	135
Transformers <250MVA	29
Total installed MVA	83,725
Capacitors	26
Total installed MVAr	2,634
Reactors	51
Total installed MVAr	9,203

Table 5.1: Major TDP transmission assets expected to be installed

Significant lengths of new transmission lines are being added to the system: 3 700 km of 765kV and over 8 600 km of 400kV lines have either been approved or proposed over the 10-year TDP period. This addition is mainly due to the major network reinforcements required for the supply to the Cape and KwaZulu-Natal. The integration of the new Medupi Power Station in the developing Limpopo West Power Pool also requires significant lengths of transmission line as it is a long distance from the main load centres. Additional 765kV lines that were not required in the previous TDP have been brought back into this TDP (based on recent studies) to export this power to load centres. Lines that were required for local and backbone strengthening for Nuclear 1 (at Thyspunt) are not included in Table 5.1. The DC lines/system required for further generation developments in the Limpopo province are not included in the above table until further studies(currently in progress) are concluded. They are however included in the diagrams for illustration.

The large length of 400kV transmission line is also the result of the development of a more meshed transmission 400kV network to provide greater reliability and thus improve the levels of network security.

These new transmission lines form part of the long-term strategy to develop a main transmission backbone from which regional power corridors can be supported. These power corridors will connect generation pools to one another and to the major load centres in the country. This backbone and regional power corridor network structure will allow the increasing system demand to be supplied and the power from new power stations to be integrated more efficiently into the Transmission network and distributed where required, both under system-healthy and system-contingency conditions.

The development of the transmission backbone and the associated regional power corridors were 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 generation future options and those of the growing and future load centres. This Strategic Grid Study has enabled the 10-Year TDP to be aligned with the future long-term development of the whole Eskom system. The new Strategic Grid Study (covering the period up to 2040) has not been concluded as yet, however, the work done internally has influenced this latest TDP.

The addition of over 83 500 MVA of transformer capacity to the transmission system is an indication of the increase in load demand and in the firm capacity requirements of the customers. This figure also includes the transformation capacity required to integrate an assumed Renewable Energy Generation plan.

Approximately 2 600 MVars of capacitive support are required to support areas of the network under contingency conditions to ensure that the required voltage levels are maintained. They also improve system efficiency by reducing network losses. A number of series compensation projects are also required on the 765kV and 400kV lines in order to improve the power transfer capability of the Cape power corridors.

Approximately 9 200 MVars of reactors are a direct result of the long lengths of the 765kV and the 400kV transmission lines that will be constructed over this period.

Two new SVCs are proposed for supporting the Northern Cape and the proposed Sishen-Saldanha Spoornet expansion, namely a +200/-100 MVAr SVC at Aries and a smaller one of +45/-100 MVars at Garona. Two additional SVCs have been added, owing to Wind and Solar generation Integration requirements. SVCs are required to manage the voltage variation on the Transmission Grid.

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

6 BREAKDOWN OF THE TDP PROJECTS BY GRID

6.1 GAUTENG PROVINCE (GP)

The current transmission network and CLNs are shown in Figure 6.1 below.

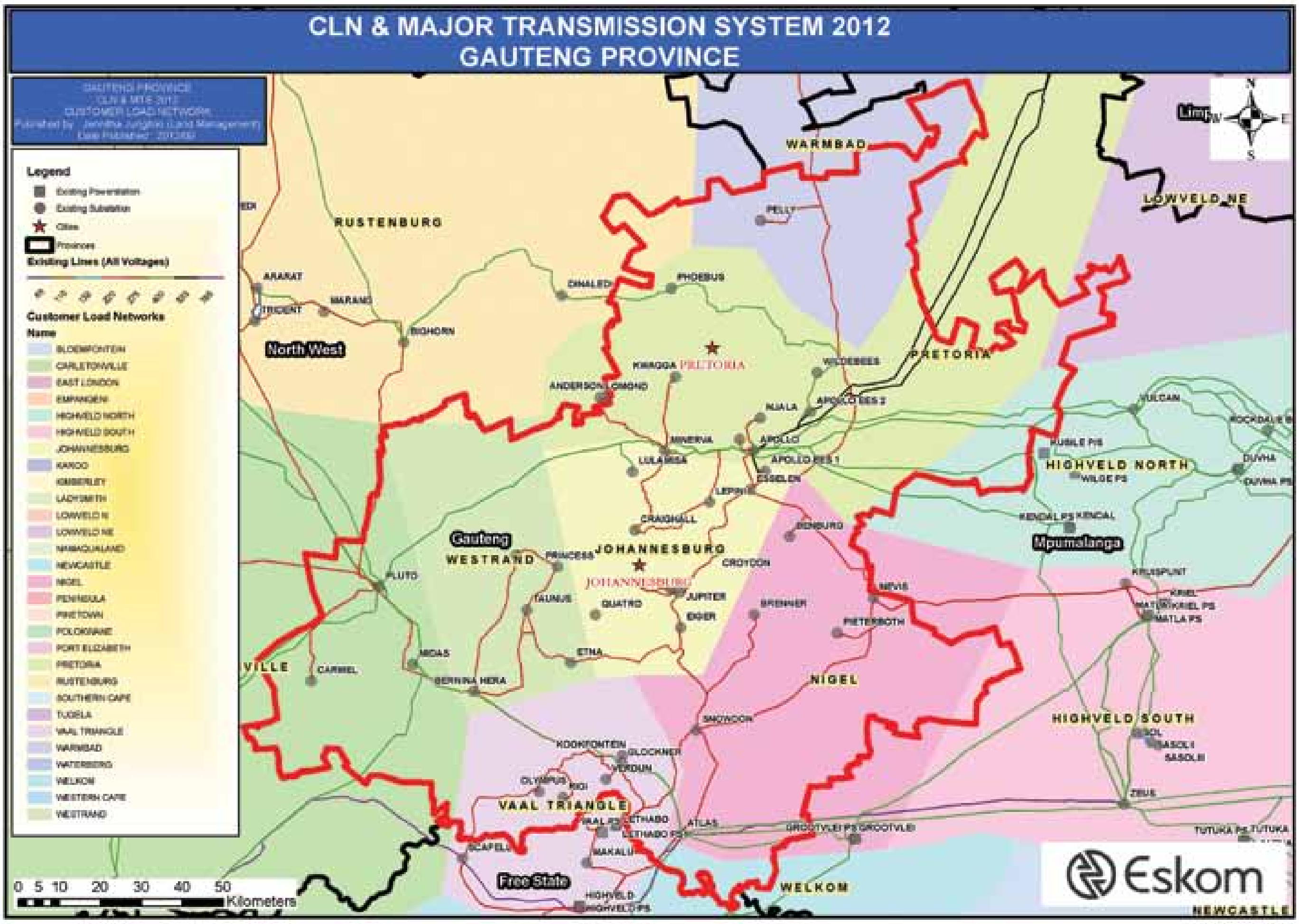


Figure 6.1: Current Gauteng Province network and CLNs

The expected peak CLN demands (apportioned for certain CLN's were overlap with other provinces occur) by 2022 at TOSP and the average percentage load increase for the period for each CLN are given in Table 6.1 below.

CLN	Forecast load (MW)			Ave. annual % load increase
	2013	2018	2022	
Johannesburg	4 974	5 887	6 480	2.9%
West Rand	2 100	2 435	2 672	2.2%
Nigel	1 709	1 791	1 868	1.7%
Vaal Triangle	1 860	1 977	2 139	1.4%
Pretoria	2 237	2 543	2 985	3.0%
Warmbad	330	424	456	4.2%

Table 6.1: Gauteng Province CLN load forecast and percentage load increases

The TDP schemes for the Gauteng Province consist of extending the 275kV network (built at 400kV insulation level to allow for future upgrading to 400kV) and the installation of additional transformers at existing substations, as well as the construction of new substations. The increase in transmission assets by the end of 2017 and end of 2022 and the cumulative total are shown in Table 6.2.

Table 6 2: New transmission assets for the Gauteng Province.

Transmission Assets for Gauteng Province	New Assets expected in 2013-2017	New Assets expected in 2018-2022	Total New Assets expected
Total kms of line	813	91	904
765kV Lines (km)	0	0	0
400kV Lines (km)	763	59	822
275kV Lines (km)	50	32	82
Total installed Transformer MVA	5,390	5,215	10,605
Transformers (no. of)	16	13	29
Capacitors (no. of)	6	0	6
Reactors (no. of)	0	0	0

The following projects are planned for the 2013 to 2022 period:

SUB-PROJECT NAME	TDP SCHEME PROJECT	Province	New Expected Year
Benburg Ext 3rd 250MVA 275/132kV	Benburg Ext 3rd 250MVA 275/132kV	GP	2014
Demeter Ext 400/88kV transformation (1st, 2nd and 3rd 315MVA transformers and 400kV busbar)	Demeter 400kV Integration	GP	2017
Loopin Pluto-Verwoerdburg 400kV into Demeter	Demeter 400kV Integration	GP	2017
Benburg 132kV 72MVAr shunt capacitor	JHB Reactive Power Project	GP	2014
Croydon 132kV 72MVAr shunt capacitor	JHB Reactive Power Project	GP	2014
Eiger 88kV 48MVAr shunt capacitor bank	JHB Reactive Power Project	GP	2014
Jupiter 88kV 48MVAr shunt capacitor bank	JHB Reactive Power Project	GP	2014
Johannesburg CLN Fault Level Management	Johannesburg CLN Fault Level Management	GP	2014
Esselen-North Rand 1st 275kV line upgrade (existing 132kV)	Johannesburg East Strengthening - Phase 1B	GP	2015
North Rand Ext 1st 500MVA 275/132kV transformer (line banked) and Esselen 275kV busbar rearrangement	Johannesburg East Strengthening - Phase 1B	GP	2015
North Rand Ext 2nd 500MVA 275/132kV transformer and 275kV busbar establishment	Johannesburg East Strengthening - Phase 2	GP	2015
Esselen-North Rand 2nd 275kV line upgrade (existing 132kV)	Johannesburg East Strengthening - Phase 2	GP	2016
North Rand-Chloorkop 1st and 2nd 132kV lines	Johannesburg East Strengthening - Phase 2	GP	2016
Apollo-Esselen 1st 400kV (energised @ 275kV)	Johannesburg East Strengthening - Phase 3 A-D	GP	2014
Jupiter B 275kV Loop-ins (Prospect-Sebenza 1 & 2, Jupiter-Prospect 1, Jupiter-Fordsburg 1)	Johannesburg East Strengthening - Phase 3 A-D	GP	2015
Prospect-Sebenza 1st 275kV line (energise existing 88kV line)	Johannesburg East Strengthening - Phase 3 A-D	GP	2015
Prospect-Sebenza 2nd 275kV line (energise existing 88kV line at 275kV)	Johannesburg East Strengthening - Phase 3 A-D	GP	2015
Jupiter B 275kV Switching station	Johannesburg East Strengthening - Phase 3 A-D	GP	2017

Matla-Jupiter B 1st 400kV line (operated @ 275kV)	Johannesburg East Strengthening - Phase 3 A-D	GP	2017
Matla-Jupiter B 2nd 400kV line (operated @ 275kV)	Johannesburg East Strengthening - Phase 3 A-D	GP	2017
North Rand-Sebenza 1st 275kV line	Johannesburg East Strengthening - Phase 3 E-F	GP	2015
North Rand-Sebenza 2nd 275kV line	Johannesburg East Strengthening - Phase 3 E-F	GP	2015
Sebenza Substation (400kV busbar operated @ 275kV)	Johannesburg East Strengthening - Phase 3 E-F	GP	2018
Lepini Ext 275kV 2x 150Mvar capacitors	Johannesburg North - Phase 2a	GP	2014
Apollo-Lepini 1st 275kV line	Johannesburg North - Phase 2b	GP	2014
Kookfontein Ext 3rd 315MVA 275/88kV transformer and 3rd Glockner - Kookfontein 275kV Line establishment	Kookfontein Phase 2	GP	2016
Kyalami 400kV Loop-in (Bravo-Lulamisa 1st 400kV) (Kyalami bays are GIS)	Kyalami Integration	GP	2017
Kyalami 400/132kV substation (1st & 2nd 500MVA transformers) (All bays are GIS)	Kyalami Integration	GP	2017
Pelly 1st 20MVA 132/22kV transformer	Pelly 132/22kV transformation upgrade	GP	2014
Decommissioning of the Apollo 400kV Fault limiting reactors	Reactive Power support for JHB	GP	2016
Simmerpan Extension 275/132kV transformation (2x 250MVA)	Simmerpan 275/132kV substation	GP	2021
Jupiter B-Simmerpan 1st & 2nd 275kV lines (uprate of 88kV lines)	Simmerpan 275/88kV substation	GP	2016
Simmerpan 275/88kV substation (expand existing Distribution station)	Simmerpan 275/88kV substation	GP	2016
Quattro 275/88kV substation (1st and 2nd 315MVA transformers) (400/88kV construction)	Soweto Strengthening Phase 1 - 275kV	GP	2015
Etna-Quattro 1st and 2nd 400kV Lines (energised @ 275kV)	Soweto Strengthening Phase 1 - 275kV	GP	2016
Quattro 275/132kV substation (1st and 2nd 500MVA transformers) (400/132kV construction)	Soweto Strengthening Phase 2 - 275/132kV	GP	2016
Anderson 400/132kV substation (1st & 2nd 250MVA transformers)	Tshwane Reinforcement - Anderson Phase 1	GP	2018
Pelly-Phoebus 1st 275kV line (energise Hangklip-Pelly 132kV line)	Tshwane Reinforcement - Phoebus Phase 1	GP	2019
Pheobus 400/275/132kV Substation (1st & 2nd 400MVA 400/275kV transformer)	Tshwane Reinforcement - Phoebus Phase 1	GP	2019
Pheobus 400kV loop-in (Apollo-Dinaledi 1st 400kV line)	Tshwane Reinforcement - Phoebus Phase 1	GP	2019
Pheobus Ext 400/132kV transformation (1st 250MVA 400/132kV transformer)	Tshwane Reinforcement - Phoebus Phase 1	GP	2019
Phoebus-Kwagga 1st 275kV line	Tshwane Reinforcement - Phoebus Phase 2	GP	2018
Apollo-Pluto 400kV loop in-out Verwoerdburg	Tshwane Reinforcement - Verwoerdburg Phase 1	GP	2014
Verwoerdburg 400/132kV substation (1st & 2nd 250MVA transformers)	Tshwane Reinforcement - Verwoerdburg Phase 1	GP	2014

Verwoerdburg 400/132kV substation (3rd 250MVA transformer)	Tshwane Reinforcement - Verwoerdburg Phase 2	GP	2018
Wildebees 400/132kV substation (Customer 250MVA Trfrs)	Tshwane Reinforcement - Wildebees Phase 1	GP	2015
Wildebees 400kV Loop in-out (Apollo - Dinaledi 1st 400kV)	Tshwane Reinforcement - Wildebees Phase 1	GP	2015
Glockner-Etna 1st 400kV line (operate @ 275kV)	Vaal Strengthening Phase 2	GP	2015
Glockner-Etna 2nd 400kV line (operate @ 275kV)	Vaal Strengthening Phase 2	GP	2015
Etna Ext 400/275kV transformation (2x 800MVA)	West Rand Strengthening - Phase: Etna 400kV	GP	2022
Etna Ext 400/88kV 315MVA transformation	West Rand Strengthening - Phase: Etna 400kV	GP	2022
Etna-Glockner 1st & 2nd 400kV lines upgrade	West Rand Strengthening - Phase: Etna 400kV	GP	2022
Hera-Westgate 1st 400kV line	West Rand Strengthening - Phase: Westgate and Taunus 400kV	GP	2018
Westgate 400/132kV substation (1st 500MVA transformer)	West Rand Strengthening - Phase: Westgate and Taunus 400kV	GP	2018
Etna-Taunus 1st 400kV line (energised @ 275kV)	West Rand Strengthening - Phase: Westgate and Taunus 400kV	GP	2022
Taunus Ext 400/132kV transformation (1 x 500MVA)	West Rand Strengthening - Phase: Westgate and Taunus 400kV	GP	2022

Changes compared to the 2011 TDP:

Removed from the TDP:

- Johannesburg East Strengthening - Phase 3 B

New projects/schemes in the TDP:

- Johannesburg CLN Fault Level Management

Modified (mainly date changes):

- Johannesburg East Strengthening - Phase 2
- Johannesburg East Strengthening - Phase 3 A-D (Phase B removed)
- Johannesburg East Strengthening - Phase 3 E-F
- Johannesburg North - Phase 2a
- Johannesburg North - Phase 2b
- Kookfontein Phase 2
- Reactive Power support for JHB
- Soweto Strengthening Phase 1 - 275kV
- Tshwane Reinforcement - Phoebus Phase 1
- Tshwane Reinforcement - Verwoerdburg Phase 1
- Tshwane Reinforcement - Anderson Phase 1
- Tshwane Reinforcement - Phoebus Phase 2
- Tshwane Reinforcement - Verwoerdburg Phase 2
- Tshwane Reinforcement - Wildebees Phase 1
- Vaal Strengthening Phase 2
- West Rand Strengthening - Phase: Westgate and Taunus 400kV

A network diagram of the major projects in the Gauteng Province network is shown in Figure 6.2 below:

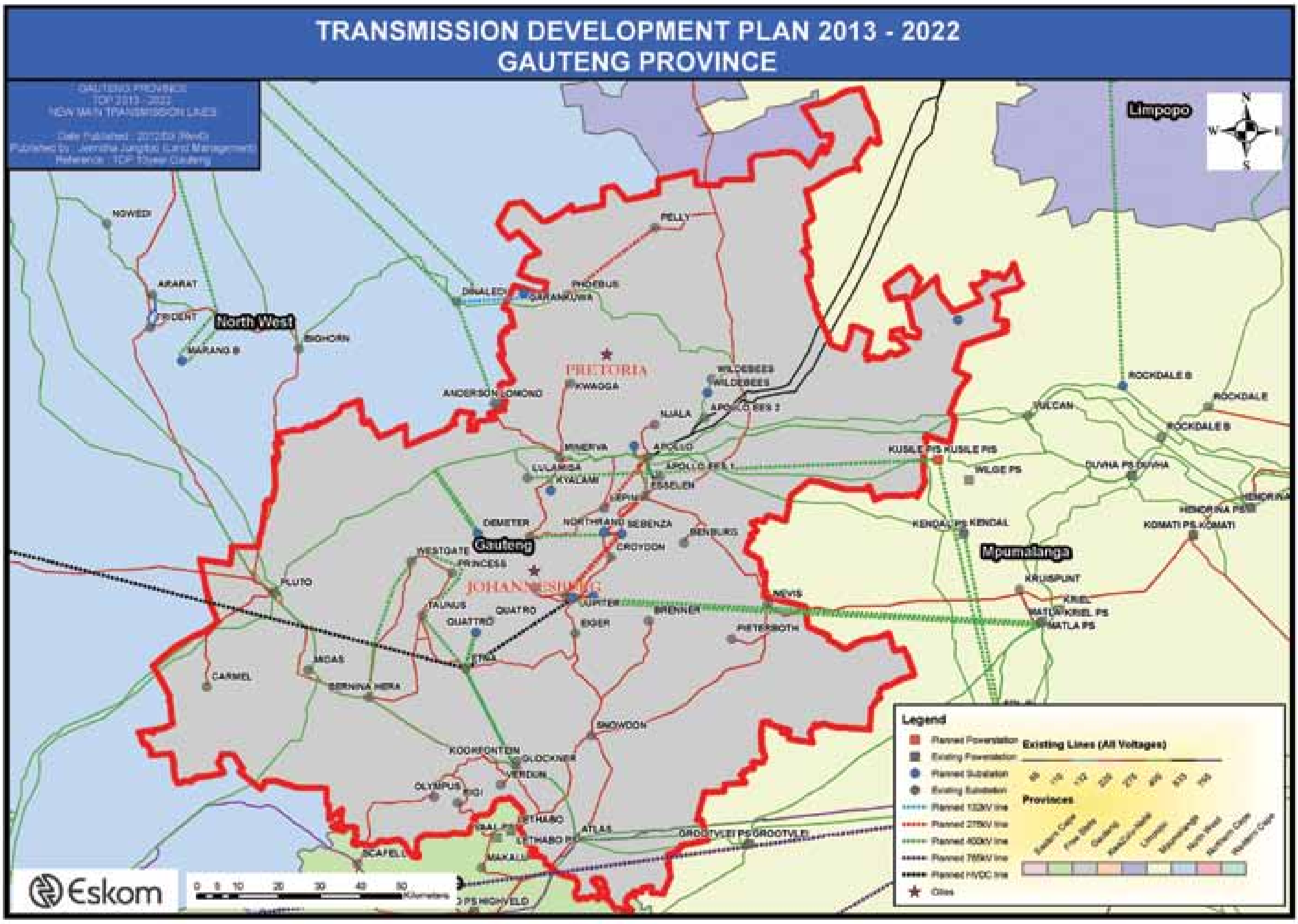


Figure 6.2: Gauteng Province network diagram

6.2 KWAZULU-NATAL (KZN) PROVINCE

The current transmission network and CLNs are shown in Figure 6.3 below.

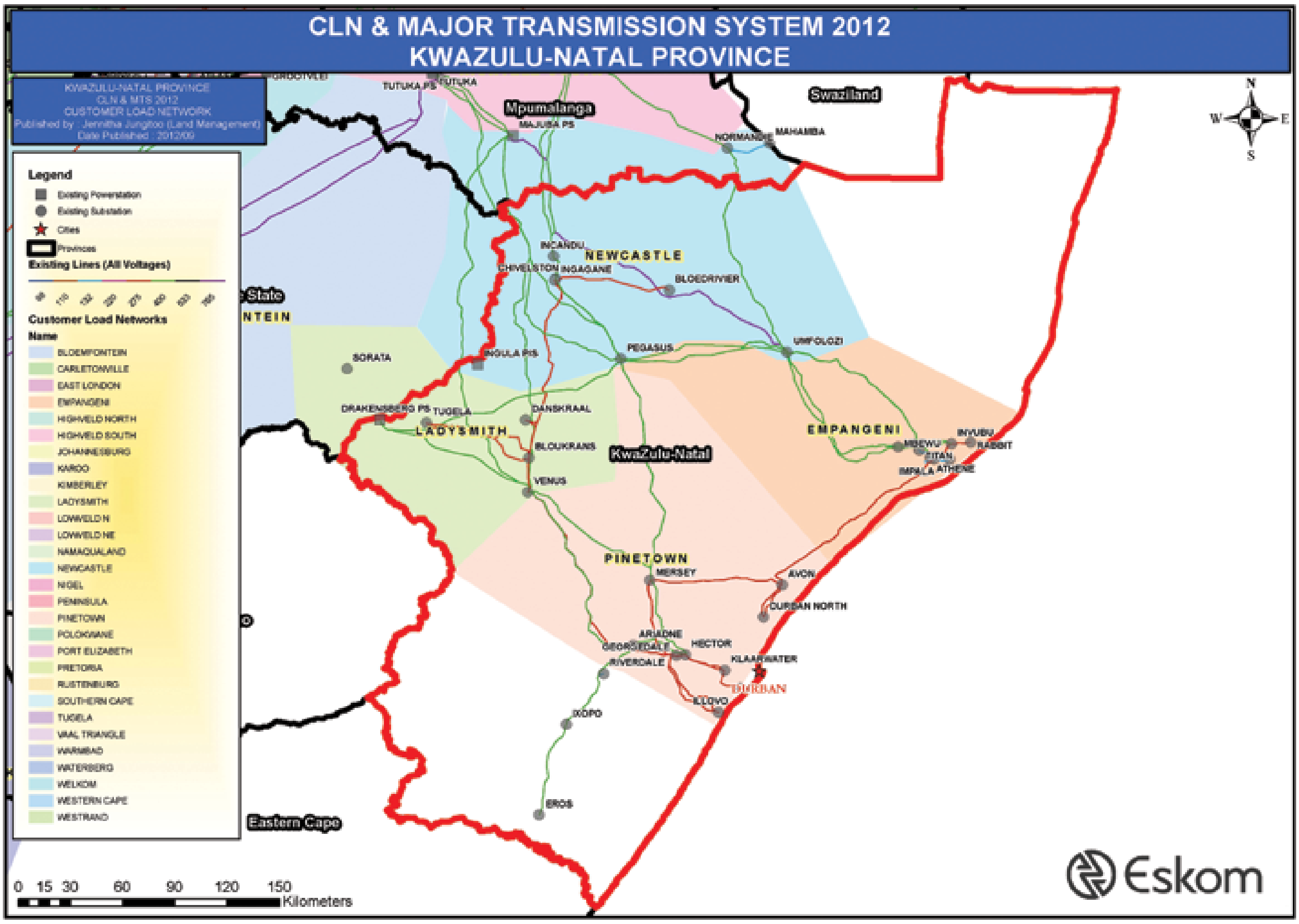


Figure 6.3: Current KZN Province network and CLNs

The expected peak CLN demands by 2022 at TOSP and the average percentage load increase for the period for each CLN are given in Table 6.3 below.

CLN	Forecast load (MW)			Ave. annual % load increase
	2013	2018	2022	
Ladysmith and Newcastle	1 351	1 568	1 750	2.9%
Empangeni	2091	2 439	2 594	2.2%
Pinetown	3 604	4 148	5 068	3.6%

Table 6.3: KZN Province CLN load forecast and percentage load increase

The TDP scheme projects for the KZN Province consist primarily of strengthening the 400kV networks that transmit power to the Empangeni and Pinetown CLNs and the introduction of 765kV. In addition to the above TDP scheme projects, other projects are listed in the project summary, which are required to strengthen the network.

Transmission Assets for KwaZulu Natal Province	New Assets expected in 2013-2017	New Assets expected in 2018-2022	Total New Assets expected
Total kms of line	585	818	1,403
765kV Lines (km)	80	300	380
400kV Lines (km)	505	450	955
275kV Lines (km)	0	68	68
Total installed Transformer MVA	5,545	4,000	9,545
Transformers (no. of)	9	5	14
Capacitors (no. of)	0	0	0
Reactors (no. of)	5	2	7

Table 6.4: KZN Province new transmission assets

The following projects are planned for the 2013 to 2022 period:

SUB-PROJECT NAME	TDP SCHEME PROJECT	Province	New Expected Year
Ariadne-Venus 2nd 400kV Line	Ariadne-Venus 2nd 400kV Line	KZN	2016
Avon Ext 3rd 250MVA 275/132kV transformer	Avon Ext 3rd 250MVA 275/132kV transformer	KZN	2014
Avon Ext 2x 275kV feeders bays (DME OCGT IPP Pinetown)	DME OCGT Integration at Avon 275kV (Pinetown)	KZN	2014
Hector - Umgeni 1st and 2nd 275kV lines	eThekwini Electricity Network Strengthening	KZN	2018
Klaarwater - Umgeni 1st 275kV line (recycle Klaarwater - Umgeni 132kV double circuit line)	eThekwini Electricity Network Strengthening	KZN	2018
Mersey - Ottawa 1st and 2nd 400kV line (Operated @ 275kV)	eThekwini Electricity Network Strengthening	KZN	2018
Umgeni Ext 1st and 2nd 500MVA 275/132kV transformers	eThekwini Electricity Network Strengthening	KZN	2018
Incandu Ext 3rd 500MVA 400/132kV transformer	Incandu Ext 3rd 500MVA 400/132kV transformer	KZN	2014
Ingula 400kV busbar establishment (integration of P/S gens)	Ingula Pumped Storage P/S Integration	KZN	2013
Ingula-Venus 2nd 400kV line	Ingula Pumped Storage P/S Integration	KZN	2013
Loop in Majuba - Venus 2 400kV line into Ingula	Ingula Pumped Storage P/S Integration	KZN	2013
Invubu-Theta (Mbewu) 2nd 400kV line	KZN 765kV Strengthening - Empangeni Integration	KZN	2017
Loop-in Athene-Umfolozi 1 400kV & Invubu-Umfolozi 1 400kV line into Mbewu	KZN 765kV Strengthening - Empangeni Integration	KZN	2017
Umfolozi-Theta (Mbewu) 765kV line (ext. of the Majuba - Umfolozi 765kV line)	KZN 765kV Strengthening - Empangeni Integration	KZN	2017
Theta (Mbewu) 1 x 765/400kV 2000MVA Substation	KZN 765kV Strengthening - Empangeni Integration	KZN	2017
Lambda 400/765kV Substation and transformation	KZN 765kV Strengthening - Lambda Substation	KZN	2017
Majuba - Lambda 1st & 2nd 400kV lines	KZN 765kV Strengthening - Lambda Substation	KZN	2017
Lambda - Sigma (Isundu) 1st 765kV line	KZN 765kV Strengthening - Pinetown Integration	KZN	2018
Loop in Ariadne - Hector 400kV line into Isundu	KZN 765kV Strengthening - Pinetown Integration	KZN	2018

Sigma (Isundu) 1 x 765/400kV 2000MVA Substation	KZN 765kV Strengthening - Pinetown Integration	KZN	2018
Sigma (Isundu)-Theta (Mbewu) 1st and 2nd 400kV Line	KZN 765kV Strengthening Isundu - Mbewu 1st & 2nd 400kV lines	KZN	2018
Mersey Ext 3rd 250MVA 275/132kV transformer	Mersey Ext 3rd 250MVA 275/132kV transformer	KZN	2015
Normandie Ext 2nd 250MVA 400/132kV transformer	Normandie Ext 2nd 250MVA 400/132kV transformer	KZN	2014
Ariadne-Eros 2nd 400kV line	South Coast Strengthening	KZN	2017
St Faiths (Previously Oribi) Loop - in Ariadne - Eros 2nd 400kV line	South Coast Strengthening	KZN	2020
St. Faiths (Previously Oribi) 2 x 500MVA 400/132kV Substation	South Coast Strengthening	KZN	2020
Transnet 3 of 1 x 160MVA 400/88kV substations	Transnet Coal - Line Upgrade	KZN	2016

Changes compared to the 2011 TDP:

Removed from the TDP:

- Hector Ext 4th 800MVA 400/275kV transformer
- Hector – Klaarwater lines/development.

New projects/schemes in the TDP:

- Umgeni Ext 1st and 2nd 500MVA 275/132kV transformers
- Hector - Umgeni 1st and 2nd 275kV lines
- Klaarwater - Umgeni 1st 275kV line (recycle Klaarwater - Umgeni 132kV double circuit line)

The above projects have been added as a result of eThekwini Electricity Network Strengthening requirements.

Modified (mainly due to date changes):

- Avon Ext 2x 275kV feeder bays (DME OCGT IPP Pinetown)
- Ariadne-Eros 2nd 400kV line
- Majuba - Lambda 1st & 2nd 400kV lines
- Lambda 400/765kV substation and transformation
- Lambda - Sigma (Isundu) 1st 765kV line
- Sigma (Isundu) 1 x 765/400kV 2000MVA Substation
- Mersey Ext 3rd 250MVA 275/132kV transformer
- Normandie Ext 2nd 250MVA 400/132kV transformer
- Sigma (Isundu)-Theta (Mbewu) 1st and 2nd 400kV Line
- Loop in Ariadne - Hector 2 400kV (de-energised) Circuit into Isundu (was previously the Hector-Sigma (Isundu) 1st 400kV Line & Hector-Sigma (Isundu) 2nd 400kV Line)

A geographical network diagram indicating the major projects in the KZN Province for the ten-year period is shown in Figure 6.4.

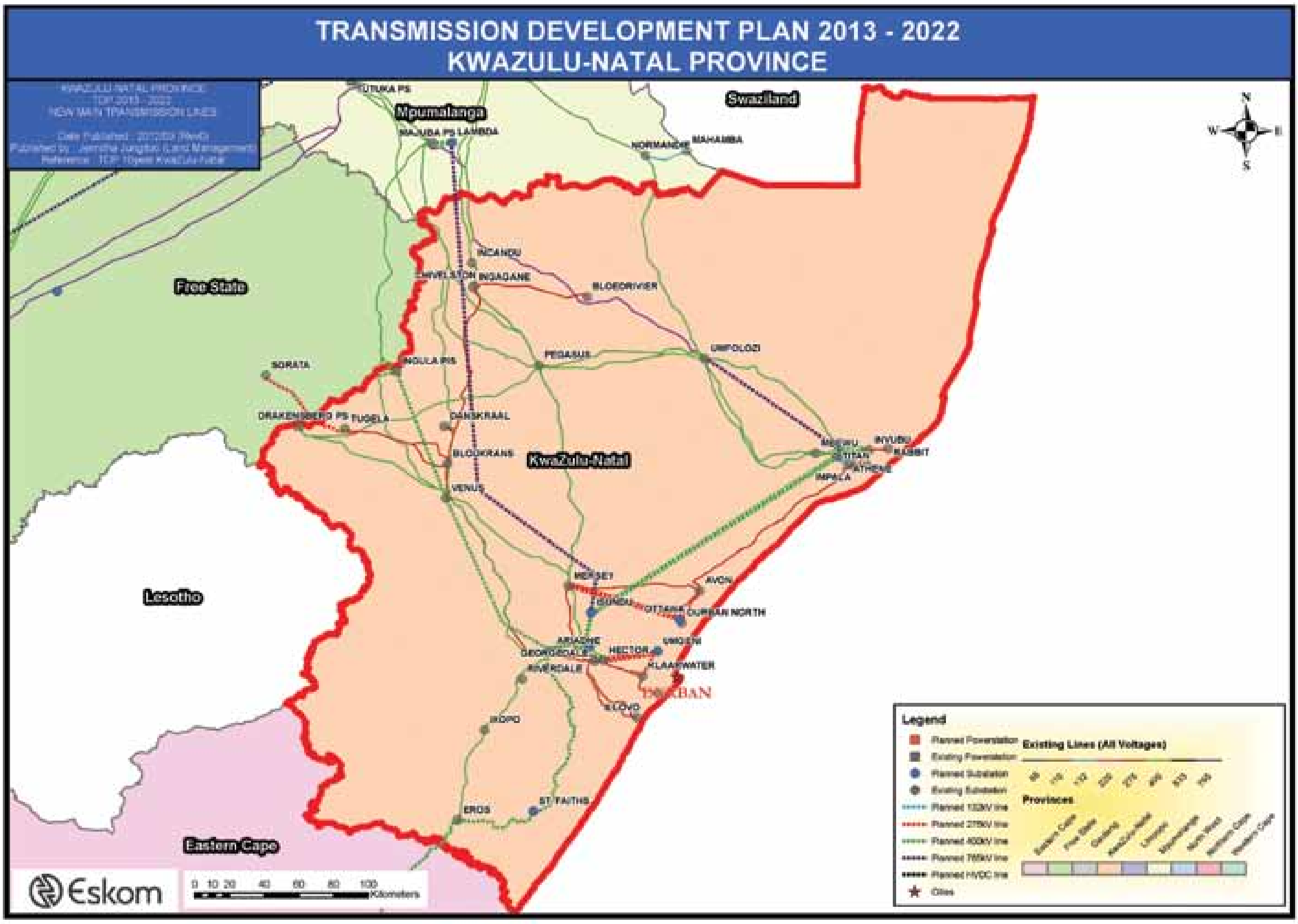
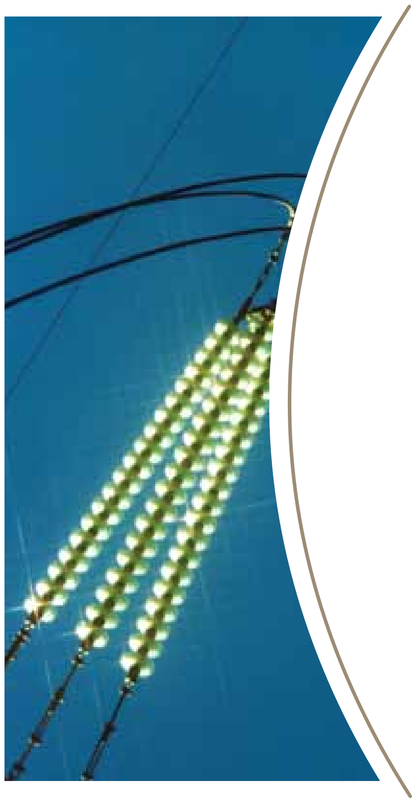


Figure 6.4: KZN Province geographical network diagram



6.3 LIMPOPO (LIM) PROVINCE

The current transmission network and CLNs are shown in Figure 6.5 below.

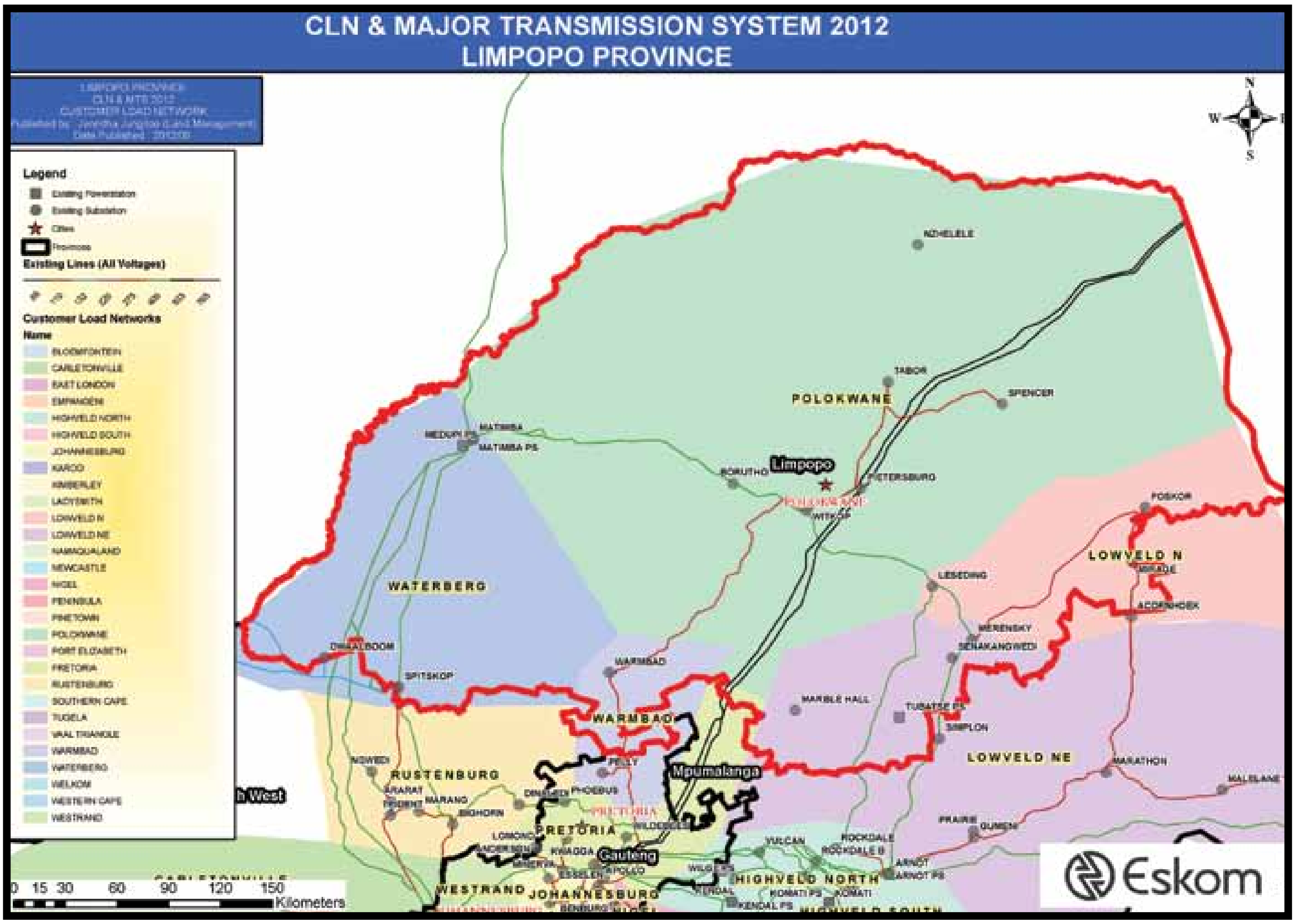


Figure 6.5: Current Limpopo Province network and CLNs

The expected peak CLN demands (apportioned for certain CLN's were overlap with other provinces occur) by 2022 at TOSP and the average percentage load increase for the period for each CLN are given in Table 6.5 below.

CLN	Forecast load (MW)			Ave. annual % load increase
	2013	2018	2022	
Waterberg	534	704	865	4.9%
Lowveld	1 113	1 528	1 713	6.3%
Warmbad	330	424	456	4.2%
Polokwane	1 329	1 582	1 842	4.8%

Table 6.5: Limpopo Province CLN load forecast and percentage load increases

The Limpopo Province load growth is mainly due to the platinum group metals (PGM) and ferrochrome mining and processing activities.

The TDP Scheme Projects for the province consist of extending the 400kV and 275kV networks as well as establishing the 765kV network, integrating the Medupi Power Station and installing additional transformers at existing and new substations.

The increase in transmission assets by the end of 2017 and the end of 2022 and the cumulative total are shown in Table 6.6.

Transmission Assets for Limpopo Province	New Assets expected in 2013-2017	New Assets expected in 2018-2022	Total New Assets expected
Total kms of line	2,260	730	2,990
765kV Lines (km)	900	0	900
400kV Lines (km)	1,360	580	1,940
275kV Lines (km)	0	150	150
Total installed Transformer MVA	7,770	500	8,270
Transformers (no. of)	13	2	15
Capacitors (no. of)	0	0	0
Reactors (no. of)	4	2	6

Table 6.6: Limpopo Province new transmission assets

The following projects are planned for the 2013 to 2022 period:

SUB-PROJECT NAME	TDP SCHEME PROJECT	Province	New Expected Year
Foskor 3rd 250MVA 275/132kV transformer	Foskor & Acornhoek 275/132kV transformation upgrades	Lim	2015
Foskor-Merensky 2nd 275kV line	Foskor & Acornhoek 275/132kV transformation upgrades	Lim	2018
Medupi-Marang 1st 400kV	Medupi Integration (Alpha) Phase 1B: Marang	Lim	2013
Medupi-Ngwedi (Mogwase) 1st 400kV line	Medupi Integration (Charlie) Phase 2A: Mogwase	Lim	2014
Medupi-Ngwedi (Mogwase) 1st 765kV line(Energised at 400kV)	Medupi Integration (Charlie) Phase 2A: Mogwase	Lim	2014
Medupi-Burotho(Mokopane) 1st 400kV line	Medupi Integration (Charlie) Phase 2B: Mokopane	Lim	2015
Burotho(Mokopane) 400/132kV Substation (2x 500MVA transformers)	Medupi Integration (Charlie) Phase 2B: Mokopane	Lim	2015
Burotho(Mokopane) 400kV Loop-in (Matimba-Witkop 1st 400kV line)	Medupi Integration (Charlie) Phase 2B: Mokopane	Lim	2015
Medupi-Masa 1st 400kV line (link to Masa-Ngwedi 1st 400kV line)	Medupi Integration (Charlie) Phase 2C: Epsilon	Lim	2014
Burotho(Mokopane)-Witkop 2nd 400kV line	Medupi Phase 3	Lim	2015
Masa Ext 765/400kV transformation (1st and 2nd 2000MVA transfromers)	Medupi Phase 3	Lim	2017
Masa-Selemo 1st 765kV line (energised @ 765kV)	Medupi Phase 3	Lim	2017
Masa-Selemo 2nd 765kV line (utilise old Medupi-Nqwedi 765kV line)	Medupi Phase 3	Lim	2017
Masa-Witkop 1st 400kV line	Medupi Phase 3	Lim	2017
Medupi-Masa 2nd 400kV line	Medupi Phase 3	Lim	2017
Medupi 400/132kV 2 x 250MVA Substation	Medupi Substation Integration	Lim	2013
Burotho(Mokopane)-Nzhelele 1st 400kV line	Nzhelele 400kV reinforcement	Lim	2020
Tabor - Nzhelele 400kV line	Nzhelele 400kV reinforcement	Lim	2020
Witkop Solar Park - 30MW PV Integration	REBID 1 preferred bidders	Lim	2014
Spitskop 2 x 500MVA 400/132kV Transformer Upgrade (Replace old 2 x 250MVA transformers)	Spitskop Transformation Upgrade	Lim	2016

Tabor Ext 1st 500MVA 400/132kV transformer	Tabor and Spencer Reinforcement - Phase 2	Lim	2013
Tabor-Witkop 1st 400kV line	Tabor and Spencer Reinforcement - Phase 2	Lim	2013
Witkop - Senakangwedi B 400kV line (160km)	Tubatse Strengthening Scheme Phase 3	Lim	2020

Changes compared to the 2011 TDP:

Removed from the TDP:

- None

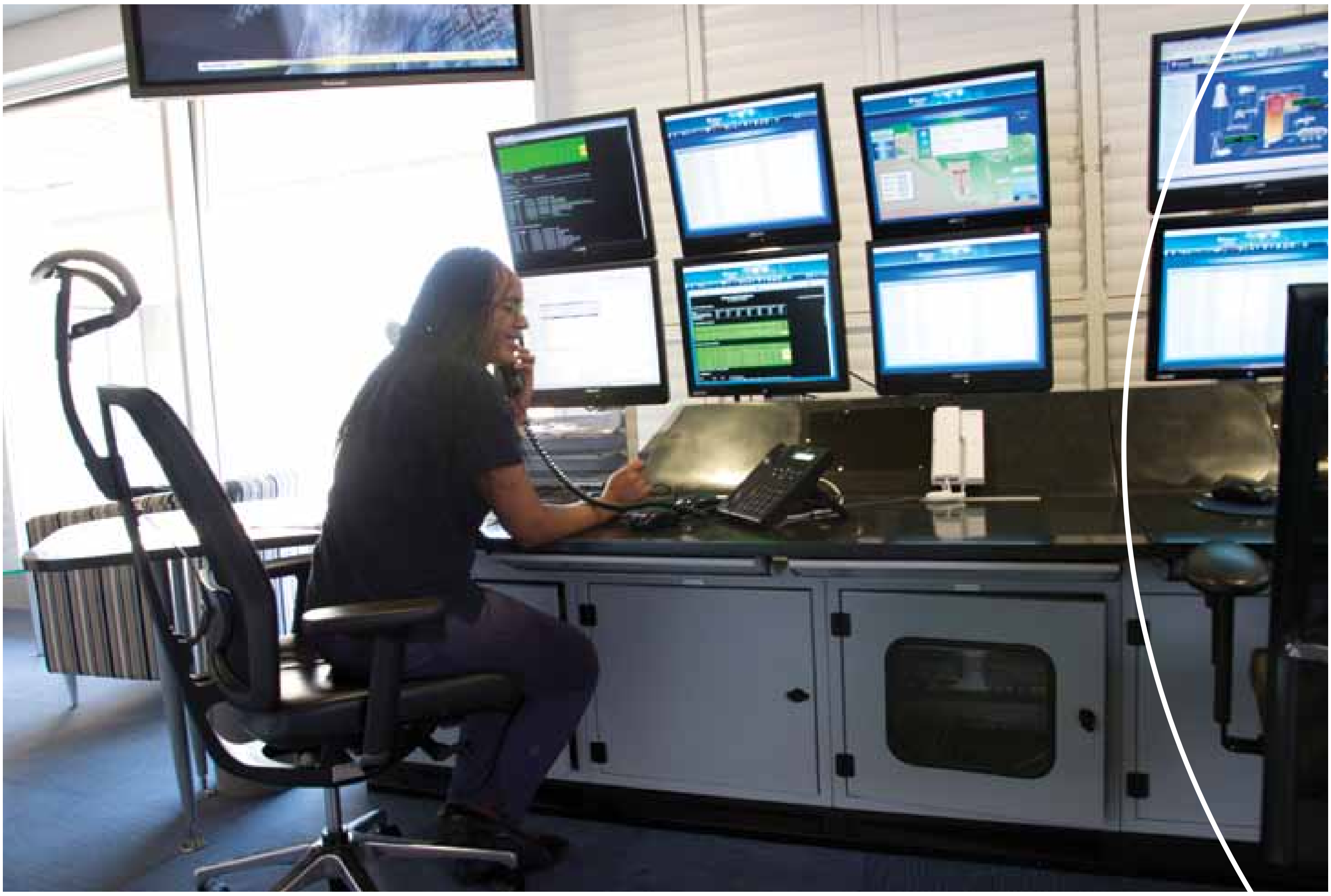
New projects/schemes in the TDP:

- Masa Ext 765/400kV transformation (1st and 2nd 2000MVA transformers)
- Masa-Selemo 1st 765kV line (energised @ 765kV)
- Masa-Selemo 2nd 765kV line (energised @ 765kV)
- Witkop - Senakangwedi B 400kV line (160km)
- Medupi 400/132kV 2 x 250MVA Substation
- Spitskop 2 x 500MVA 400/132kV transformer Upgrade
- Foskor 2nd 20MVA 132/22kV transformer
- Witkop Solar Park - 30MW PV Integration

Modified (mainly due to date changes):

- Foskor 3rd 250MVA 275/132kV transformer
- Foskor-Merensky 2nd 275kV line
- Medupi-Marang 1st 400kV
- Burotho(Mokopane) 400kV Loop-in (Matimba-Witkop 1st 400kV line)
- Burotho(Mokopane) 400/132kV Substation (2x 500MVA transformers)
- Medupi-Burotho(Mokopane) 1st 400kV line
- Medupi-Masa 1st 400kV line (link to Masa-Selemo 1st 400kV line)
- Medupi-Masa 2nd 400kV line
- Masa-Witkop 1st 400kV line Burotho(Mokopane)-Witkop 2nd 400kV line
- Tabor - Nzhelele 400kV line
- Nzhelele 400/132kV substation (1st & 2nd 250MVA)
- Burotho(Mokopane)-Nzhelele 1st 400kV line
- Spencer Ext 132kV feeder bay (Bolubedu)
- Tabor-Witkop 1st 400kV line
- Tabor Ext 1st 500MVA 400/132kV transformer

A network diagram of the major projects in the Limpopo Province is shown in Figure 6.6 below.



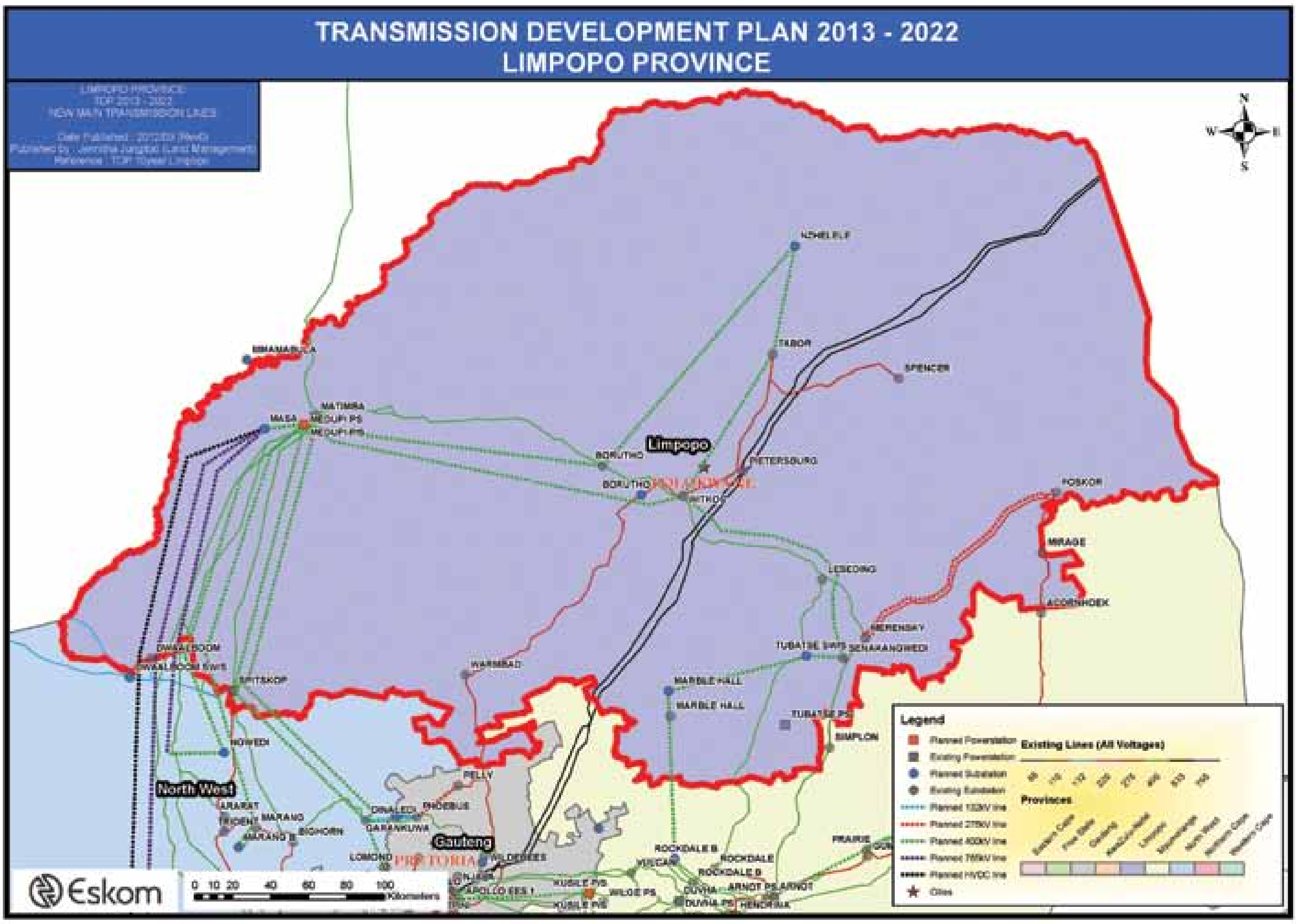


Figure 6.6: Limpopo Province geographical network diagram

6.4 MPUMALANGA PROVINCE (MP)

The current transmission network and CLNs are shown in Figure 6.7 below.

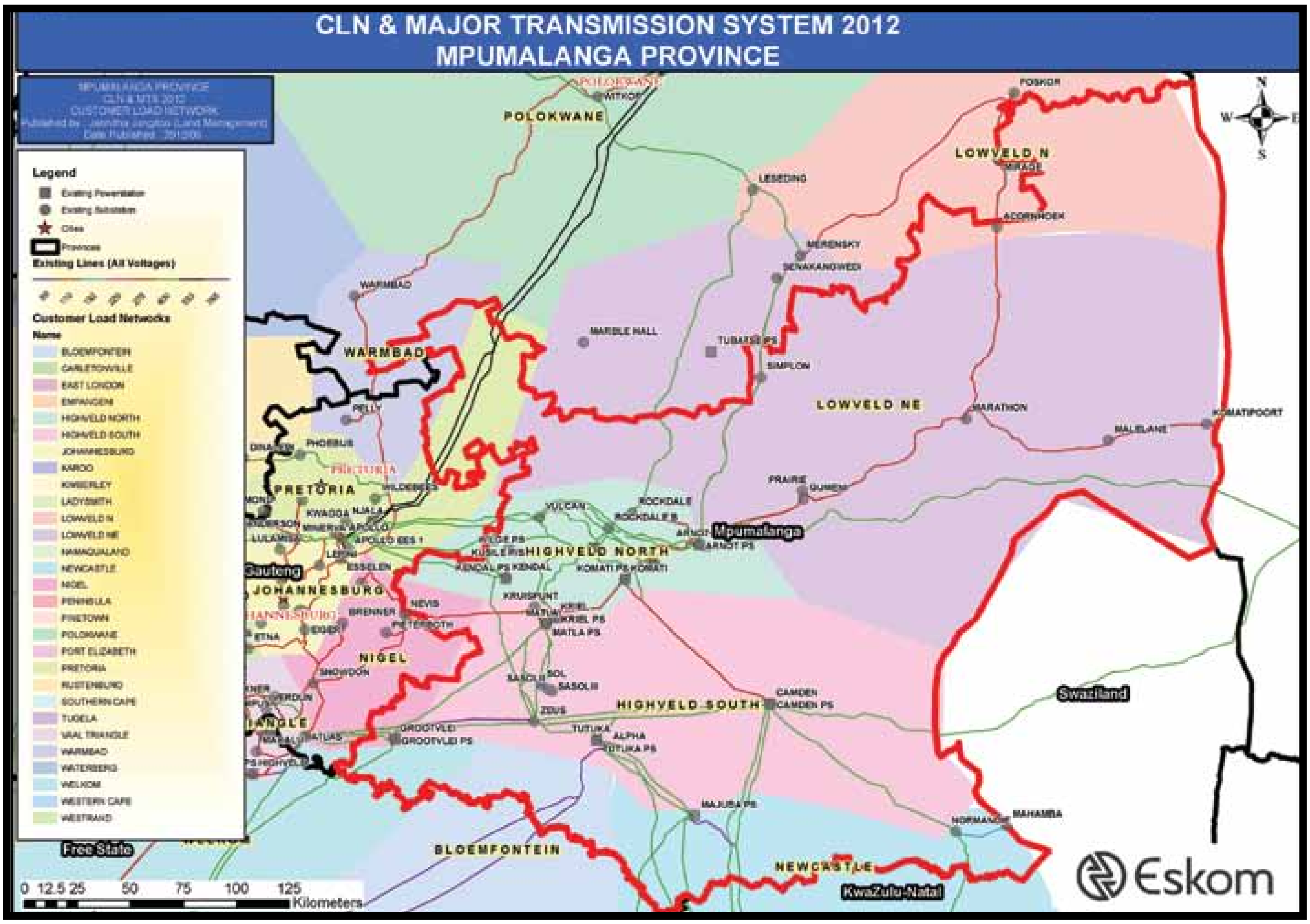


Figure 6.7: Current Mpumalanga network and CLNs

The expected peak CLN demands (apportioned for certain CLNs where overlap with other provinces occur) by 2022 at TOSP and the average percentage load increase for the period for each CLN are given in Table 6.7 below.

CLN	Forecast load (MW)			Ave. annual % load increase
	2013	2018	2022	
Highveld North	2 224	2 806	3 385	3.5%
Highveld South	1 431	2 051	2 081	6.2%
CLN - Lowveld	763	1 221	1 319	6.9%

Table 6.7: Mpumalanga Province CLN load forecast and percentage load increases

The TDP schemes for the Mpumalanga Province consist of extending the 400kV network, the integration of the Kusile Power Station and the installation of additional transformers at existing and any new substations added. The increase in transmission assets by the end of 2017 and the end of 2022 and the cumulative total are shown in Table 6.8

Transmission Assets for Mpumalanga Province	New Assets expected in 2013-2017	New Assets expected in 2018-2022	Total New Assets expected
Total kms of line	711	92	803
765kV Lines (km)	0	0	0
400kV Lines (km)	709	92	801
275kV Lines (km)	2	0	2
Total installed Transformer MVA	6,975	2,300	9,275
Transformers (no. of)	15	4	19
Capacitors (no. of)	3	0	3
Reactors (no. of)	0	0	0

Table 6.8: Cumulative TDP transmission assets for the Mpumalanga Province

The following projects are planned for the 2013 to 2022 period:

SUB-PROJECT NAME	TDP SCHEME PROJECT	Province	New Expected Year
Arnot-Kendal 400kV line loop in-out Rockdale B	Highveld North-West and Lowveld North Reinforcement - Phase 1	MP	2015
Rockdale 132kV breakers upgrading	Highveld North-West and Lowveld North Reinforcement - Phase 1	MP	2015
Rockdale B 400/132kV Substation (1st & 2nd 500MVA 400/132kV transformers)	Highveld North-West and Lowveld North Reinforcement - Phase 1	MP	2015
Marble Hall 400/132kV Substation (1st & 2nd 500MVA 400/132kV transformers)	Highveld North-West and Lowveld North Reinforcement - Phase 2	Lim	2017
Marble Hall-Rockdale B 1st 400kV line	Highveld North-West and Lowveld North Reinforcement - Phase 2	MP	2017
Marble Hall-Tubatse (Steelpoort) 1st 400kV line	Highveld North-West and Lowveld North Reinforcement - Phase 2	LP	2017
Tubatse 400kV Loop in (Duvha-Leseding 1st 400kV line)	Highveld North-West and Lowveld North Reinforcement - Phase 2	Lim	2017
Tubatse 400kV switching station	Highveld North-West and Lowveld North Reinforcement - Phase 2	Lim	2017
Rockdale B 400/132kV Substation extension (3rd 500MVA 400/132kV transformers)	Highveld North-West and Lowveld North Reinforcement - Phase 3	MP	2017
New Sol B 400/132kV Substation (1st, 2nd, 3rd and 4th 500MVA transformers)	Highveld South Reinforcement	MP	2017
Sol B 400kV Loop in (Kriel-Tutuka 1st 400kV line)	Highveld South Reinforcement	MP	2017
Sol B Ext Equip 8x132kV feeder bays	Highveld South Reinforcement	MP	2017
Sol B Turn in (Kriel-Zeus 1st 400kV to form new Kriel-Sol B 2nd 400kV line)	Highveld South Reinforcement	MP	2017
Khanyisa PS integration	Khanyisa PS Integration	MP	2014
Kruispunt 275kV loop-in (Komati-Matla 1st 275kV line)	Kruispunt Reinforcement	MP	2013
Kusile 400kV busbar HV yard establishment (integration of P/S gens)	Kusile Integration Phase 1: 400kV Loop-ins	MP	2014
Kusile 400kV Loop-in (Duhva-Minerva 1st 400kV line)	Kusile Integration Phase 1: 400kV Loop-ins	MP	2014

Vulcan 400kV Bypass and Reconfiguration (Loop in Duvha-Kendal 1st 400kV line and loop out Arnot-Vulcan 1st 400kV lines to form Duvha-Vulcan 2nd 400kV and Arnot-Kendal 1st 400kV)	Kusile Integration Phase 1: 400kV Loop-ins	MP	2014
Kusile-Lulamisa 1st 400kV line	Kusile Integration Phase 2: Lulamisa	MP	2017
Kusile 400kV by-pass Duvha (To form Kusile - Vulcan 400kV line)	Kusile Integration Phase 3A: 400kV Duvha by-pass	MP	2016
Kusile 400kV Loop-in (Apollo-Kendal 1st 400kV line)	Kusile Integration Phase 3B: 400kV Loop-in	MP	2016
Kendal-Zeus 1st 400kV line	Kusile Integration Phase 4A	MP	2017
Kendal - Zeus 2nd 400kV line	Kusile Integration Phase 4B	MP	2017
Kusile 400kV by-pass Kendal (Kendal by-pass required to form the Kusile-Zeus 400kV line from Kusile-Kendal and Kendal-Zeus lines)	Kusile Integration Phase 4B	MP	2017
Hendrina-Gumeni 1st 400kV line	Lowveld 400kV Strengthening - Phase 1: Gumeni	MP	2014
Gumeni 400/132kV substation (1st 500MVA 400/132kV transformer)	Lowveld 400kV Strengthening - Phase 1: Gumeni	MP	2014
Gumeni-Marathon 1st 400kV line	Lowveld 400kV Strengthening - Phase 2: Marathon B	MP	2015
Marathon 400/275kV substation (1st 800MVA 400/275kV transformer)	Lowveld 400kV Strengthening - Phase 2: Marathon B	MP	2015
Arnot - Gumeni 400kV line	Lowveld 400kV strengthening - Phase 3a	MP	2019
Gumeni Ext 2nd 500MVA 400/132kV transformer	Lowveld 400kV strengthening - Phase 3a	MP	2019
Gumeni-Marathon 2nd 400kV line	Lowveld 400kV strengthening - Phase 3b	MP	2019
Marathon B Ext 2nd 800MVA 400/275kV transformer	Lowveld 400kV Strengthening - Phase 3b	MP	2019
Khanyazwe (Malelane) 132kV, 72MVar Capacitor bank	Malelane 275kV Reinforcement - Phase 2	MP	2017
Arnot - Merensky 400kV loop-in into Senakangwedi B	Tubatse Strengthening Scheme Phase 1	MP	2017
Senakangwedi B 400/275kV Substation (1st 800MVA 400/275kV transformers)	Tubatse Strengthening Scheme Phase 1	MP	2017
Tubatse-Senakangwedi B 1st 400kV line	Tubatse Strengthening Scheme Phase 1	Lim	2017
Senakangwedi B 400/132kV Substation (1st and 2nd 500MVA 400/132kV)	Tubatse Strengthening Scheme Phase 2	Lim	2020
Senakangwedi Ext 275kV Shunt Cap	Xstrata Phase 2 customer project - Transmission Reinforcement	Lim	2013

Changes compared to the 2011 TDP:

Removed from the TDP:

- Alpha Ext 4th 2000MVA 765/400kV Transformer
- Rockdale B 400/132kV Substation (the 4th 500MVA Transformer)
- Rockdale B 400/88kV Substation (2 x 250MVA Transformers)

New projects/schemes in the TDP:

- Acornhoek Strengthening Phase 2 - Acornhoek 3rd 1x 125MVA 275/132kV transformers

Modified (mainly due to date changes):

- Acornhoek Upgrade Phase 1 - 2x 125MVA 275/132kV transformers
- Rockdale 132kV breakers upgrading
- Arnot-Kendal 400kV line loop in-out Rockdale B
- Rockdale B 400/132kV Substation (1st & 2nd 500MVA 400/132kV transformers)
- Marble Hall-Rockdale B 1st 400kV line
- Marble Hall-Tubatse (Steelpoort) 1st 400kV line
- Marble Hall 400/132kV Substation (1st & 2nd 500MVA 400/132kV transformers)
- Tubatse 400kV Loop in (Duvha-Leseding 400kV line)
- Tubatse 400kV switching station
- Sol B 400kV Loop in (Kriel-Tutuka 1st 400kV line)
- New Sol B 400/132kV Substation (1st, 2nd, 3rd and 4th 500MVA transformers)
- Sol B Turn in (Kriel-Zeus 1st 400kV to form new Kriel-Sol B 2nd 400kV line)
- Sol B Ext Equip 8x132kV feeder bays
- Kusile 400kV Loop-in (Duvha-Minerva 1st 400kV line)
- Kusile 400kV busbar HV yard establishment (integration of P/S gens)
- Vulcan 400kV Bypass and Reconfiguration (Loop in Duvha-Kendal 1st 400kV line and loop out Arnot-Vulcan 1st 400kV lines to form Duvha-Vulcan 2nd 400kV and Arnot-Kendal 1st 400kV)
- Kusile 400kV by-pass Duvha (to form Kusile - Vulcan 400kV line)
- Kusile 400kV Loop-in (Apollo-Kendal 1st 400kV line)
- Kusile 400kV by-pass Kendal (Kendal by-pass required to form the Kusile-Zeus 400kV line from Kusile-Kendal and Kendal-Zeus lines)
- Kendal-Zeus 1st 400kV line
- Kendal - Zeus 2nd 400kV line
- Hendrina-Gumeni 1st 400kV line
- Gumeni 400/132kV Substation (1st 500MVA 400/132kV transformer)
- Gumeni-Marathon 1st 400kV line
- Marathon 400/275kV Substation (1st 800MVA 400/275kV transformer)
- Gumeni Ext 2nd 500MVA 400/132kV transformer
- Tubatse-Senakangwedi B 1st 400kV line
- Senakangwedi B 400/275kV Substation (1st 800MVA 400/275kV transformers)
- Senakangwedi Ext 275kV Shunt Cap

The network diagrams of the major projects in the Mpumalanga Province are shown in Figure 6.8 a-b below.

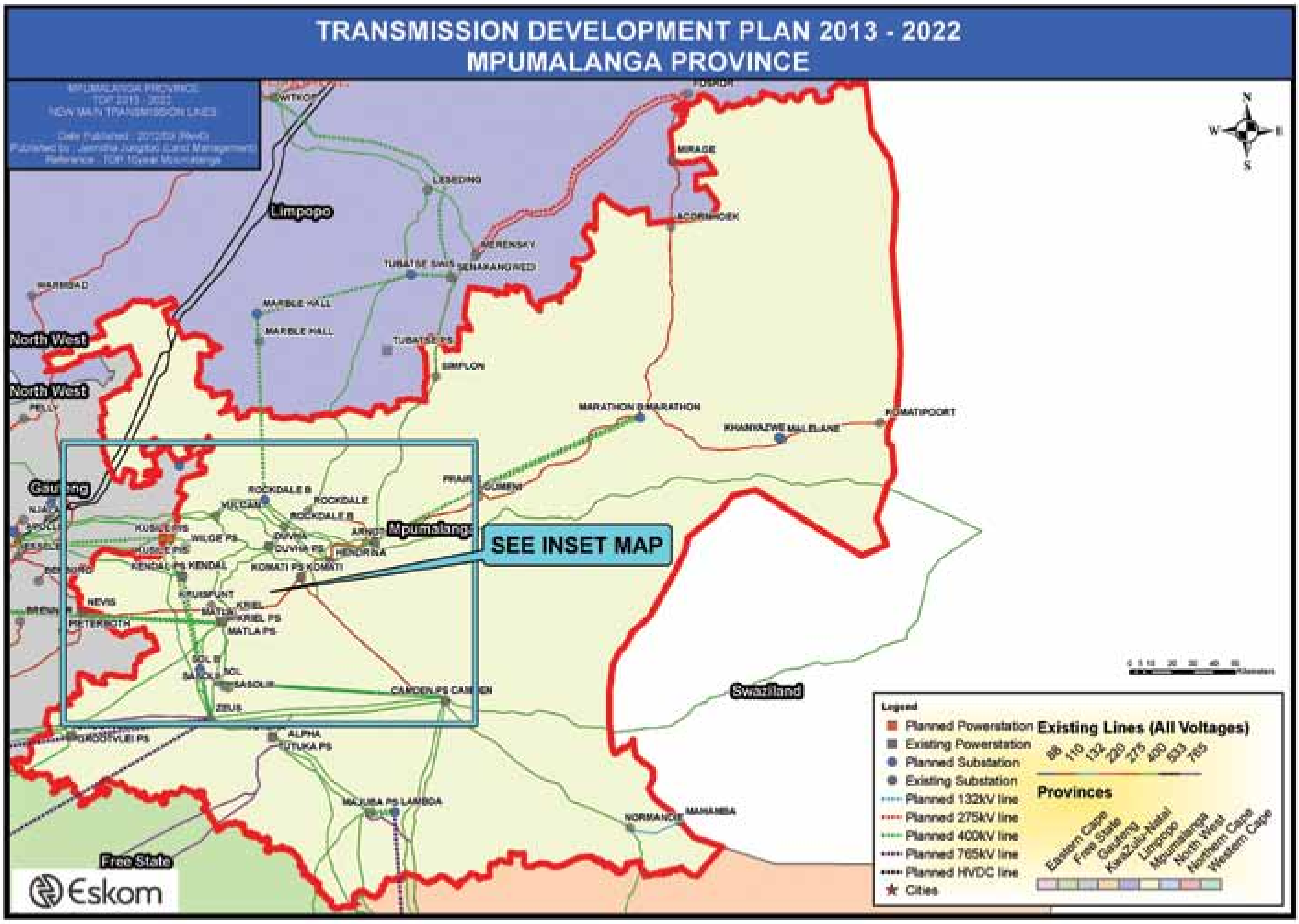


Figure 6.8a: Mpumalanga Province network diagram

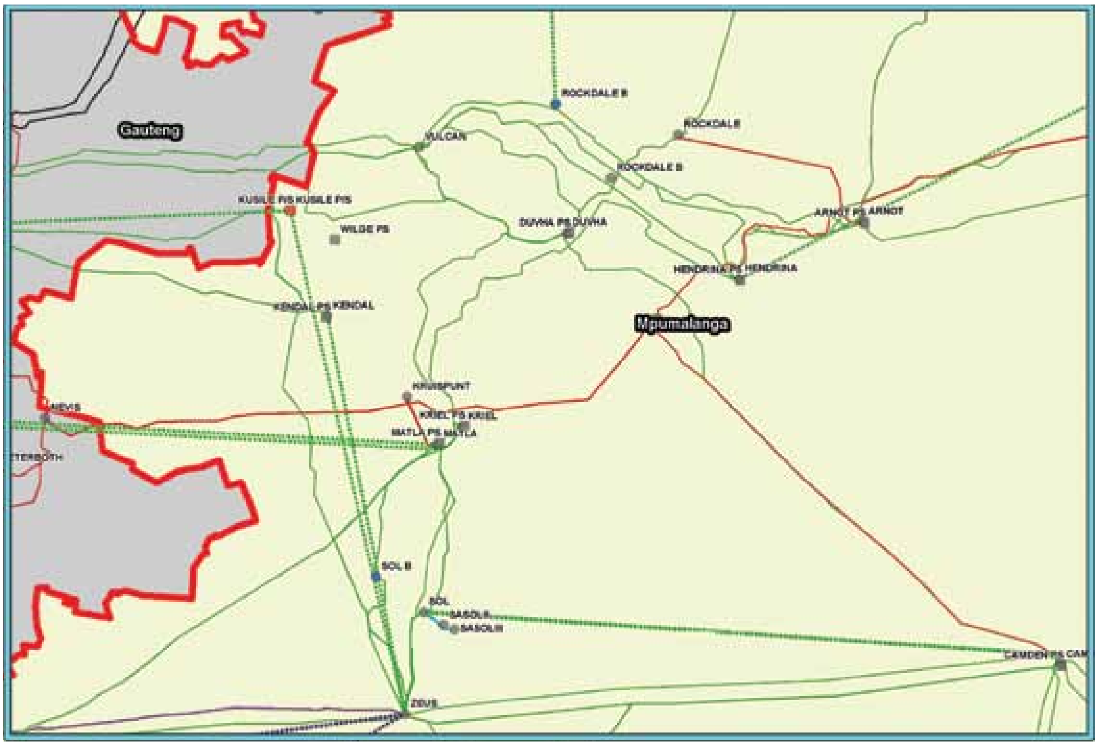


Figure 6.8b: Mpumalanga Province (Inset Map) network diagram

6.5 NORTH WEST (NW) PROVINCE

The current transmission network and CLNs are shown in Figure 6.9 below.

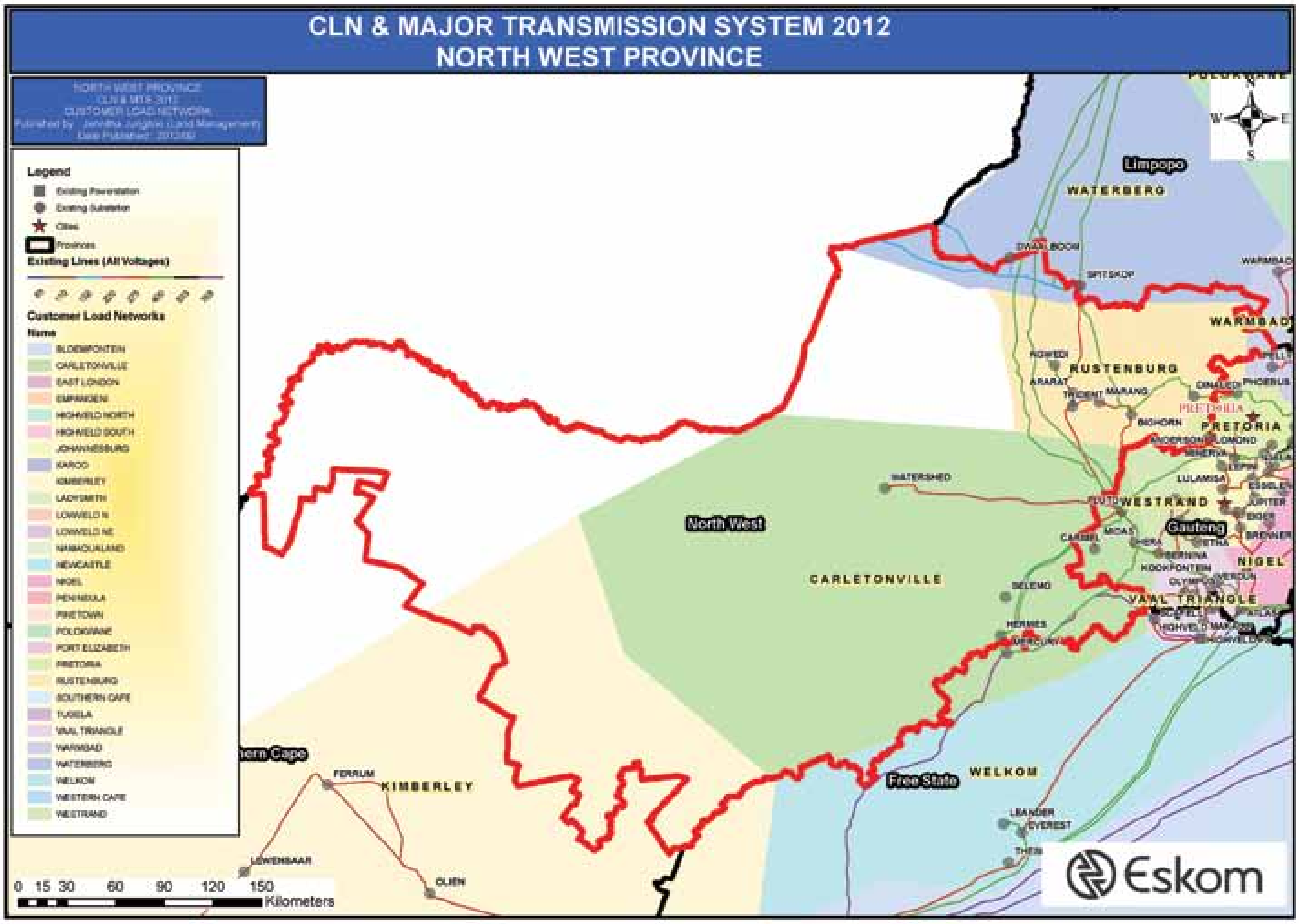


Figure 6.9: Current North West Province network and CLNs

The 765kV network is primarily used for the transportation of power through the grid to the Cape. The projects for the North West Province are mainly the introduction of 400kV lines and transformation to support or relieve the 275kV networks. The load growth in the grid is shown in Table 6.9 below.

CLN	Forecast load (MW)			Ave. annual % load increase
	2013	2018	2022	
Rustenburg	471	519	554	2.9%
Carletonville	1 580	1 558	1 574	0.7%

Table 6.9: North West Grid CLN load forecast and percentage load increases

The North West Province includes the 765kV integration required for the power transfer of generation from the Limpopo Province and 400kV integration to enable load growth in the local areas.

The increase in transmission assets by the end of 2017 and the end of 2022 and the cumulative total are shown in Table 6.10.

Transmission Assets for North West Province	New Assets expected in 2013-2017	New Assets expected in 2018-2022	Total New Assets expected
Total kms of line	566	225	791
765kV Lines (km)	0	0	0
400kV Lines (km)	566	225	791
275kV Lines (km)	0	0	0
Total installed Transformer MVA	12,250	315	12,565
Transformers (no. of)	14	1	15
Capacitors (no. of)	4	0	4
Reactors (no. of)	2	1	3

Table 6.10: Cumulative assets for North West Province

The following projects are planned for the 2013 to 2022 period:

SUB-PROJECT NAME	TDP SCHEME PROJECT	Province	New Expected Year
Dinaledi 3rd 500MVA 400/132kV Transformer	Dinaledi 3rd 500MVA 400/132kV Transformer	NW	2015
Dinaledi Ext 2x 132kV feeder bays (Brits Industries)	Dinaledi Ext 2x 132kV feeder bays (Brits Industries)	NW	2015
Dwaalboom 132kV switching station	Dwaalboom 132kV switching station	NW	2016
Mercury-Mookodi (Vryburg) 1st 400kV line	Kimberley 400kV Strengthening Phase 2	NW	2014
Mookodi (Vryburg) 400/132kV Substation (1st and 2nd 250MVA 400/132kV transformers)	Kimberley 400kV Strengthening Phase 2	NW	2014
Hermes-Mookodi (Vryburg) 1st 400kV line	Kimberley Strengthening Phase 3	NW	2018
Lomond 3rd 275/88kV transformer (1X315MVA)	Lomond MTS transformation upgrade	NW	2018
Marang Ext 88V feeder bay (Turk)	Marang Ext 88V feeder bay (Turk)	NW	2014
Dinaledi-Spitskop 1st 400kV line	Medupi Integration (Alpha) Phase 1A: Spitskop and Dinaledi	NW	2017
Dinaledi-Spitskop 2nd 400kV line	Medupi Integration (Alpha) Phase 1A: Spitskop and Dinaledi	NW	2017
Ngwedi (Mogwase) 400/132kV Substation (2x 500MVA transformers)	Medupi Integration (Charlie) Phase 2A: Mogwase	NW	2016
Ngwedi (Mogwase) 400kV loop in (Matimba-Midas 1st 400kV)	Medupi Integration (Charlie) Phase 2A: Mogwase	NW	2016
Selemo 400kV loop-in (Hermes-Pluto 2nd 400kV line to form 1st 400kV lines from Selemo to s/s)	Medupi Integration (Charlie) Phase 2C: Epsilon	NW	2017
Selemo Ext 765/400kV transformation (1st and 2nd 2000MVA transformers)	Medupi Integration (Charlie) Phase 2C: Epsilon	NW	2017
Selemo-Midas 1st 400kV line (Pluto 400kV by-pass of Selemo-Pluto and extension to Midas)	Medupi Integration (Charlie) Phase 2C: Epsilon	NW	2017
Nzhelele 400/132kV substation (1st & 2nd 250MVA)	Nzhelele 400kV reinforcement	NW	2020
Bighorn 400/132kV 2 x 500MVA Substation Extension	Rustenburg Strengthening Phase 1	NW	2016
Rustenburg Strengthening Phase 2 (Marang B)	Rustenburg Strengthening Phase 2	NW	2017
Dinaledi-Anderson 1st 400kV line	Tshwane Reinforcement - Anderson Phase 1	NW	2018

Watershed MTS 132kV Reactive power compensation	Watershed Strengthening	NW	2015
Watershed MTS 88kV Reactive power compensation	Watershed Strengthening	NW	2015
Watershed 275/132kV substation 250MVA 275/132kV transformer	Watershed Strengthening	NW	2016

Changes compared to the 2011 TDP:

Removed from the TDP:
- None

New projects/schemes in the TDP:
- Selemo Ext 765/400kV transformation (1st and 2nd 2000MVA transformers)
- Selemo 400kV loop-in (Hermes-Pluto 2nd 400kV line to form 1st 400kV lines from Selemo to s/s)
- Selemo-Midas 1st 400kV line (Pluto 400kV by-pass of Selemo-Pluto and extension to Midas)
- Bighorn 400/132kV 2 x 500MVA Substation Extension
- Selemo Ext 765/400kV transformation (1st and 2nd 2000MVA transformers)

Modified (mainly due to date changes):
- Mercury-Mookodi (Vryburg) 1st 400kV line
- Mookodi (Vryburg) 400/132kV Substation (1st and 2nd 250MVA 400/132kV transformers)
- Hermes-Mookodi (Vryburg) 1st 400kV line
- Dinaledi-Spitskop 1st 400kV line
- Dinaledi-Spitskop 2nd 400kV line
- Ngwedi (Mogwase) 400kV loop in (Matimba-Midas 1st 400kV)
- Ngwedi (Mogwase) 400/132kV Substation (2x 500MVA transformers)
- Rustenburg Strengthening Phase 2 (Marang B)
- Dinaledi-Anderson 1st 400kV line
- Watershed MTS 132kV Reactive power compensation
- Watershed MTS 88kV Reactive power compensation
- Watershed 275/132kV Substation 250MVA 275/132kV transformer

A network diagram of the major projects in the North West Province is shown in Figure 6.10 below.

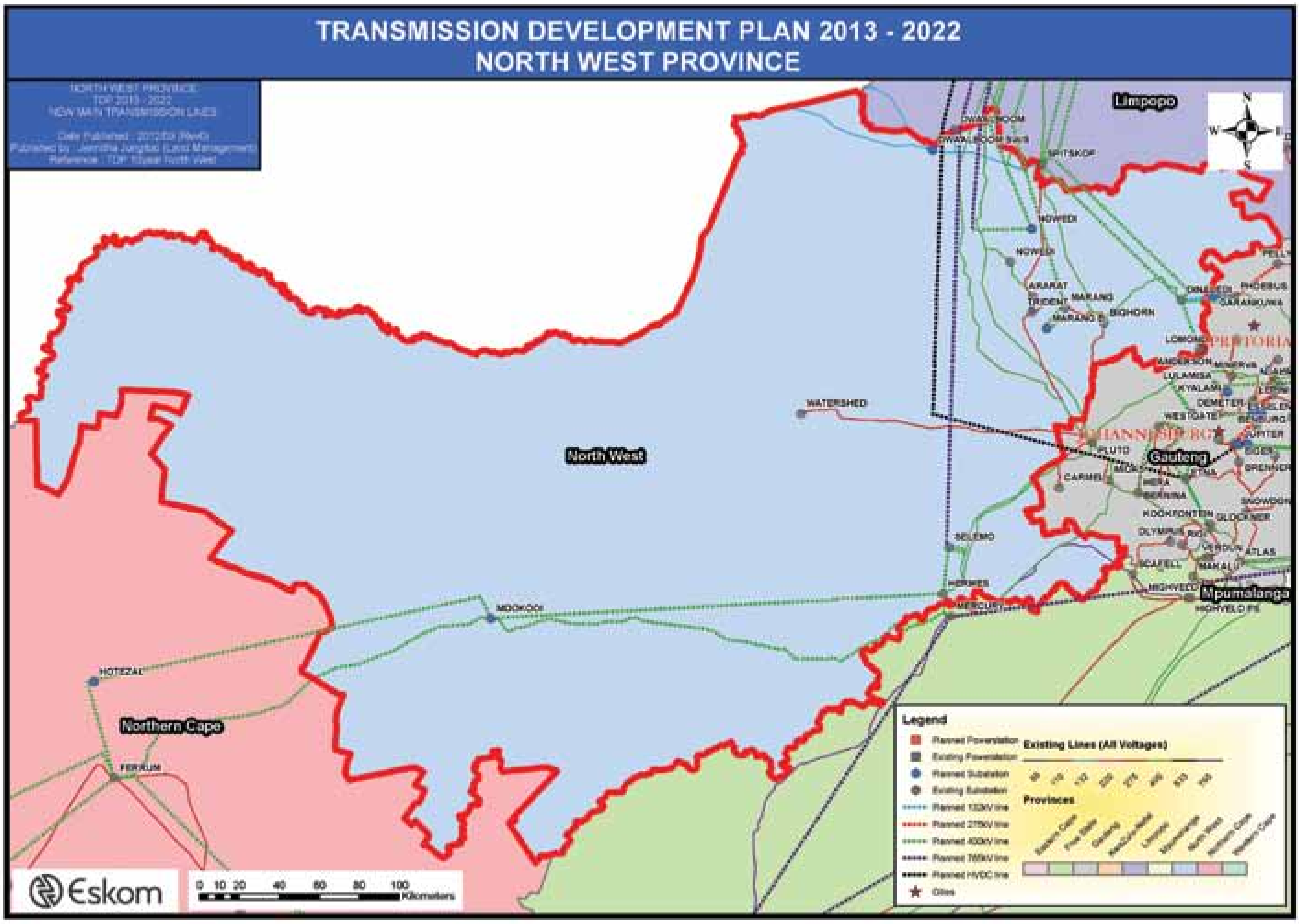


Figure 6.10: North West Province geographical network diagram

6.6 FREE STATE (FS) PROVINCE

The current transmission network and CLNs are shown in Figure 6.11 below.

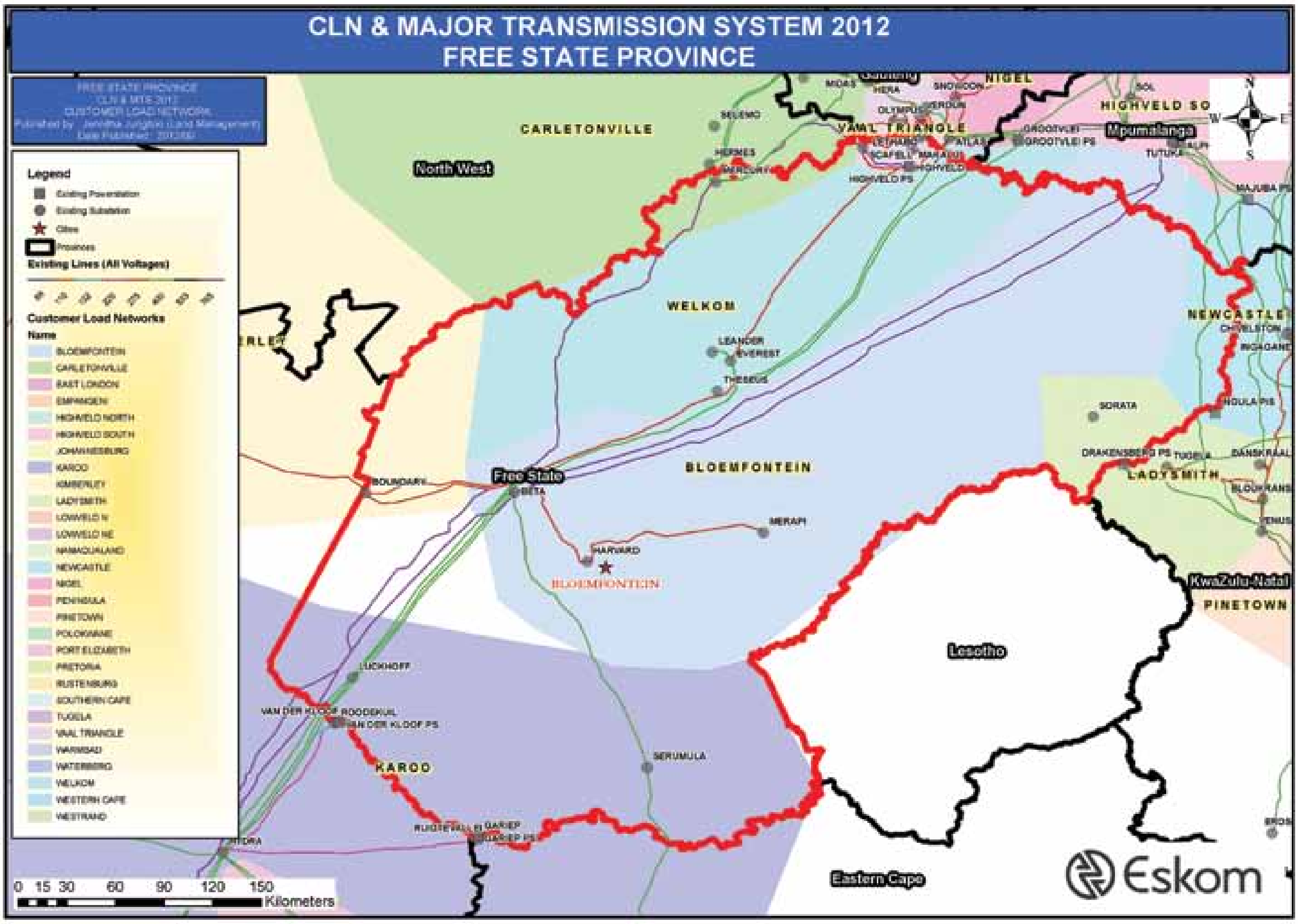


Figure 6.11: Current Free State Province network and CLNs

The 765kV network is primarily used for the transportation of power through the grid to the Cape. The projects for the Free State Province are mainly the introduction of 400kV lines and transformation to support or relieve the 275kV networks. The load growth in the grid is shown in Table 6.11 below.

CLN	Forecast load (MW)			Ave. annual % load increase
	2013	2018	2022	
Bloemfontein	486	615	649	3.1%
Welkom	848	874	893	0.6%
Kimberley	181	191	198	-1.7%
Carltonville	290	293	295	-0.2%

Table 6.11: Free State Province CLN load forecast and percentage load increases

The increase in transmission assets by the end of 2017 and the end of 2022 and the cumulative total are shown in Table 6.12.

Transmission Assets for Free State Province	New Assets expected in 2013-2017	New Assets expected in 2018-2022	Total New Assets expected
Total kms of line	110	663	773
765kV Lines (km)	0	430	430
400kV Lines (km)	110	233	343
275kV Lines (km)	0	0	0
Total installed Transformer MVA	250	1,000	1,250
Transformers (no. of)	1	3	4
Capacitors (no. of)	0	2	2
Reactors (no. of)	0	7	7

Table 6.12: Cumulative assets for Free State Province

The following projects are planned for the 2013 to 2022 period:

SUB-PROJECT NAME	TDP SCHEME PROJECT	Province	New Expected Year
Everest - Merapi 275kV (built at 400kV standards)	Bloemfontein Strengthening	FS	2016
Merapi Ext 3rd 250MVA 275/132kV transformer	Bloemfontein Strengthening	FS	2016
Beta - Harvard 400kV	Bloemfontein Strengthening Phase 2	FS	2022
Harvard 400/132kV S/S	Bloemfontein Strengthening Phase 2	FS	2022
Harvard-Merapi 400kV	Bloemfontein Strengthening Phase 2	FS	2022
Merapi 400/132kV S/S	Bloemfontein Strengthening Phase 2	FS	2022
Series Compensation on Zeus-Perseus 1st 765kV line	Cape Corridor Phase 4: 2nd Zeus-Per-Gam-Ome 765kV Line	FS	2022
Zeus-Perseus 2nd 765kV line (most direct line)	Cape Corridor Phase 4: 2nd Zeus-Per-Gam-Omega 765kV Line	FS	2022
Sorata 275/132kV S/S	Harrismith Strengthening Phase 1	FS	2022
Tugela-Sorata 275kV (energise existing line)	Harrismith Strengthening Phase 1	FS	2022
Theseus Ext 400kV 1st 100MVAr reactor	Kimberley Strengthening Phase 3	FS	2018
Merapi Ext 2X132kV feeder bay (Wind)	Merapi Wind Phase 1	FS	2019
Selemo 400kV loop-in (Hermes-Pluto 2nd 400kV line to form 1st 400kV lines from Selemo to s/s)	Medupi Integration (Charlie) Phase 2C: Epsilon	NW	2017
Selemo Ext 765/400kV transformation (1st and 2nd 2000MVA transformers)	Medupi Integration (Charlie) Phase 2C: Epsilon	NW	2017
Selemo-Midas 1st 400kV line (Pluto 400kV by-pass of Selemo-Pluto and extension to Midas)	Medupi Integration (Charlie) Phase 2C: Epsilon	NW	2017
Nzhelele 400/132kV substation (1st & 2nd 250MVA)	Nzhelele 400kV reinforcement	NW	2020
Bighorn 400/132kV 2 x 500MVA Substation Extension	Rustenburg Strengthening Phase 1	NW	2016
Rustenburg Strengthening Phase 2 (Marang B)	Rustenburg Strengthening Phase 2	NW	2017

Changes compared to the 2011 TDP:

Removed from the TDP:

- None

New projects/schemes in the TDP:

- Beta - Harvard 400kV
- Harvard 400/132kV S/S
- Harvard-Merapi 400kV
- Merapi 400/132kV S/S
- Tugela-Sorata 275kV (energise existing line)
- Sorata 275/132kV S/S

Modified (mainly due to date changes):

- Everest - Merapi 275kV (built at 400kV standards). This was previously specified to be built at 275kV standards.
- Series Compensation on Zeus-Perseus 1st 765kV line
- Zeus-Perseus 2nd 765kV line (most direct line)

A network diagram of the major projects in the Free State Province is shown in Figure 6.12 below.

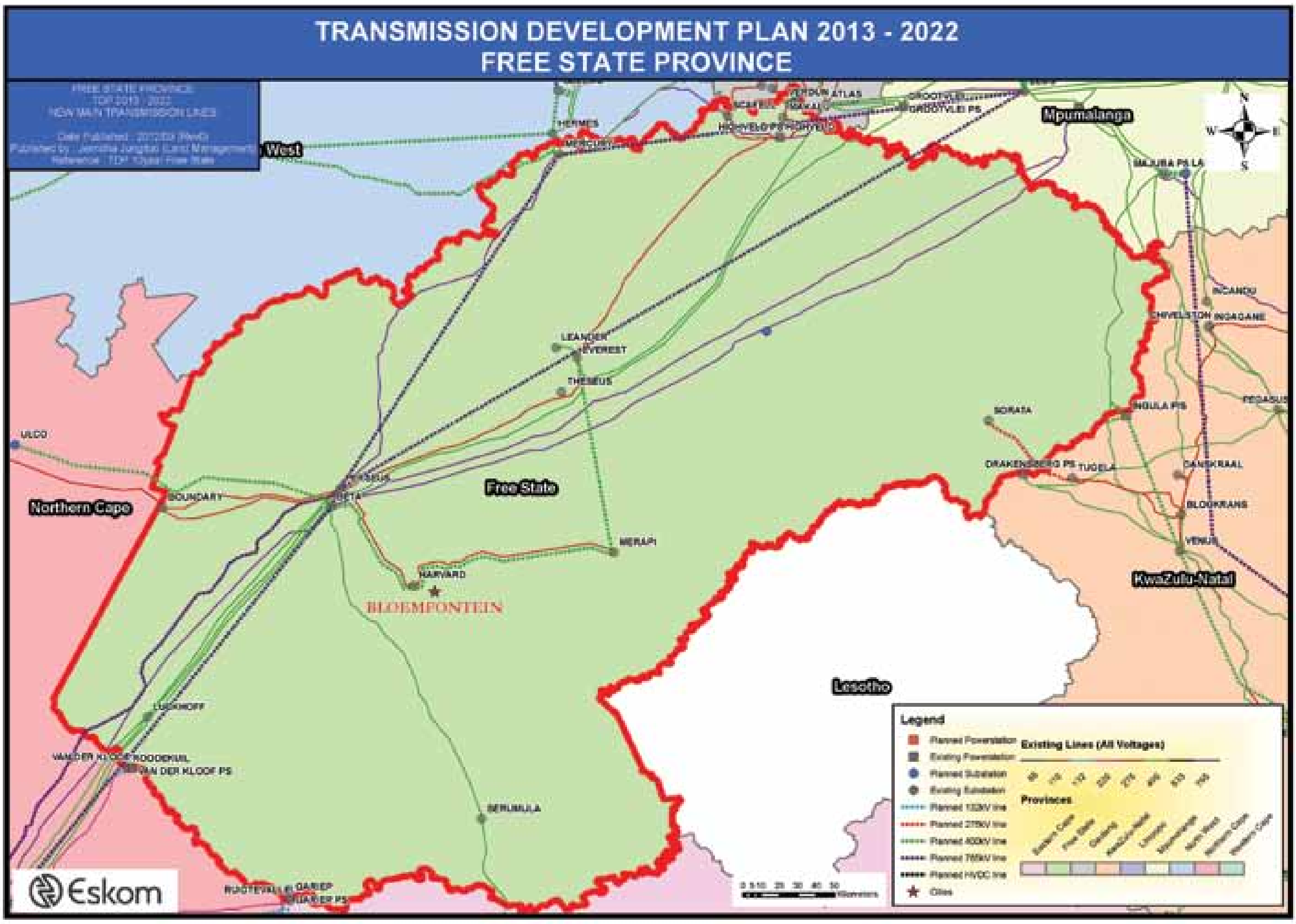


Figure 6.12: Free State Province geographical network diagram

6.7 NORTHERN CAPE (NC) PROVINCE

The current transmission network and CLNs are shown in Figure 6.13 below.

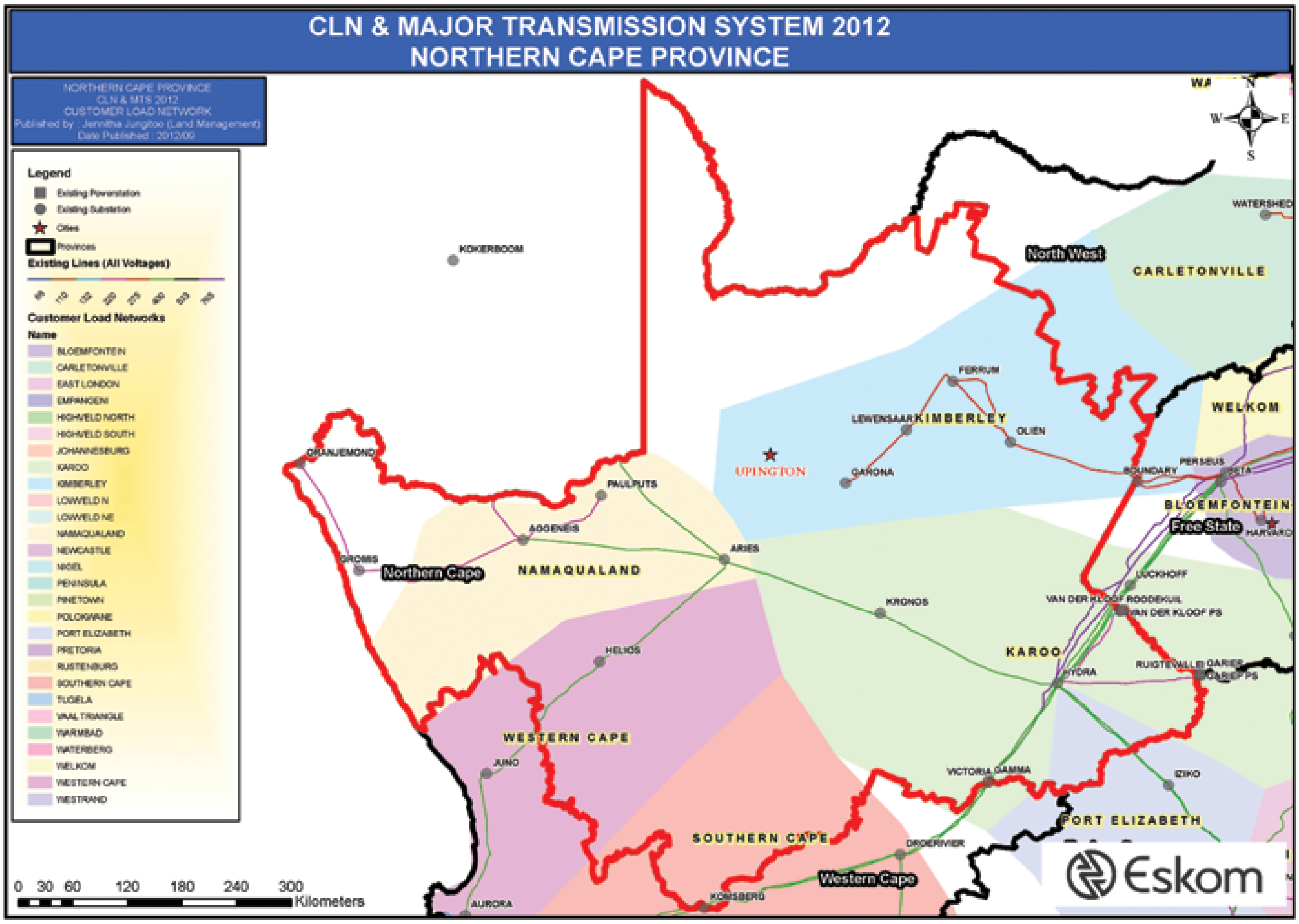


Figure 6.13: Current Northern Cape Province network and CLNs

The projects for the Northern Cape Province are mainly the introduction of 400kV lines and transformation to support or relieve the 400kV and 275kV networks. The load growth in the grid is shown in Table 6.13 below.

CLN	Forecast load (MW)			Ave. annual % load increase
	2013	2018	2022	
Namaqualand	136.3	263	266	7.5%
West Coast	12	13	13	1%
Kimberley	406	981	1 247	16.3%
Karoo	297	309	325	1.3%

Table 6.13: Northern Cape Province CLN load forecast and percentage load increases

Included in the TDP studies is the forecast export to Namibia via the 400kV and 220kV interconnections. The export amount has been assumed to remain constant over the TDP period. There is also a plan to integrate 1 100 MW of solar generation in the Upington area (as indicated in last year's TDP).

The increase in transmission assets by the end of 2017 and the end of 2022 and the cumulative total are shown in Table 6.14.

Transmission Assets for North Cape Province	New Assets expected in 2013-2017	New Assets expected in 2018-2022	Total New Assets expected
Total kms of line	1,089	1,290	2,379
765kV Lines (km)	0	440	440
400kV Lines (km)	1,089	750	1,839
275kV Lines (km)	0	100	100
Total installed Transformer MVA	5,445	1,815	7,260
Transformers (no. of)	20	4	24
Capacitors (no. of)	3	1	4
Reactors (no. of)	6	4	10

Table 6.14: Cumulative assets for Northern Cape Province

The following projects are planned for the 2013 to 2022 period:

SUB-PROJECT NAME	TDP SCHEME PROJECT	Province	New Expected Year
Gamma-Perseus 2nd 765kV line	Cape Corridor Phase 4: 2nd Zeus-Per-Gam-Omega 765kV Line	NC	2022
Ferrum Ext 132kV feeder bay (Kalahari)	Ferrum 132kV Feeder extension	NC	2013
Ruigtevallei - Hydra de-rate 220kV line to 132kV	Gariep Network Strengthening	NC	2013
Ruigtevallei 132kV Feeder bay to Dreunberg	Gariep Network Strengthening	NC	2013
Kronos 400/132kV transformation	Garona Strengthening	NC	2016
Kronos-Cuprum 1st & 2nd 132kV	Garona Strengthening	NC	2016
Gromis Ext 400/132kV(1X500MVA) Substation(dedicated 132kV Supply for New Wind Integration)	Gromis Wind Phase 1	NC	2018
Hydra 400 & 132kV equipment upgrade (Fault level requirements) and Hydra Ext 3rd 400/132kV transformer (250 or 500MVA)	Hydra 400 & 132kV equipment upgrade	NC	2017
Hydra – Aries 1st 400kV line	Hydra - Aries 1st 400kV line	NC	2021
Juno Ext 400/132kV(1X500MVA) substation(Dedicated 132kV Supply for New Wind Integration)	Juno Wind Phase 2	NC	2017
Kappa Ext 400/132kV(1X500MVA) substation(New Dedicated 132kV Supply for New Wind Integration)	Kappa Wind Phase 1	NC	2016
Ferrum Ext 1st & 2nd 500MVA 400/132kV transformers	Kimberley 400kV Strengthening Phase 2	NC	2014
Ferrum-Mookodi (Vryburg) 1st 400kV line	Kimberley 400kV Strengthening Phase 2	NC	2014
Ferrum-Mookodi (Vryburg) 2nd 400kV line (via Hotazel)	Kimberley Strengthening Phase 3	NC	2018
Hortazel Ext 132kV 1st 36MVAr capacitor	Kimberley Strengthening Phase 3	NC	2020
Hotazel 400/132kV Substation (1st and 2nd 500MVA 400/132kV transformers)	Kimberley Strengthening Phase 3	NC	2021
Hotazel 400kV loop-in (Ferrum-Mookodi(Vryburg) 2nd 400kV line)	Kimberley Strengthening Phase 3	NC	2021
Aggeneis-Paulputs 2nd 220kV line	N Cape reinforcement: Aggeneis-Paulputs 2nd 220kV	NC	2019
Nama MTS Transformers Upgrade	Nama MTS Transformers Upgrade	WC	2016
Gromis Ext 220kV SVC	Nama Wind Phase 1	WC	2018

Nama Ext 220kV feeder bay (Wind)	Nama Wind Phase 1	WC	2018
Aries Ext 400kV 1st SVC	N Cape reinforcement: Aries SVC	NC	2017
Aries - Nieuwehoop 400kV line	N Cape reinforcement: Ferrum - Nieuwehoop - Aries 400kV	NC	2015
Ferrum - Nieuwehoop 400kV line	N Cape reinforcement: Ferrum - Nieuwehoop - Aries 400kV	NC	2017
Juno - Gromis 400kV and 2nd Gromis - Oranjemond 220kV lines	Namaqualand Strengthening	NC	2021
Paulputs Ext 2nd 125MVA 220/132kV transformer	Paulputs Ext 2nd 125MVA 220/132kV transformer	NC	2017
Kaxu Solar 1 - 100MW CSP Plant	REBID 1 preferred bidders	NC	2014
Bokpoort 50MW CSP Project	REBID 2 preferred bidders	NC	2015
Solar Capital De Aar	REBID 2 preferred bidders	NC	2015
Garona Ext 275kV STATCOM	Sishen-Saldanha Full Solution (Supply for New Spoornet Traction)	NC	2017
Series Compensation of 400kV lines (Reconfiguration of Northern Cape capacitors)	Sishen-Saldanha Full Solution (Supply for New Spoornet Traction)	NC	2017
Sishen-Saldanha Spoornet new traction stations (4 sites with 8 transformers stepping down to 50kV)	Sishen-Saldanha Full Solution (Supply for New Spoornet Traction)	NC	2017
Aries-Upington 1st 400kV lines	Upington Strengthening Phase 1	NC	2016
Aries-Upington 2nd 400kV lines	Upington Strengthening Phase 1	NC	2016
Ferrum-Upington 1st 400kV line	Upington Strengthening Phase 1	NC	2016
Nieuwehoop -Upington 1st 400kV line	Upington Strengthening Phase 1	NC	2016
Upington 5x 500MVA 400/132kV Transformation	Upington Strengthening Phase 1	NC	2016

Changes compared to the 2011 TDP:

Removed from the TDP:
- Helio – Aggeneis 1st 400kV line (replaced by Juno – Gromis 1st 400kV line)

New projects/schemes in the TDP:
- Juno - Gromis 1st 400kV and 2nd Gromis - Orangemond 220kV lines
- Hydra – Aries 1st 400kV line
- Kaxu Solar 1 - 100MW CSP Plant - Paulputs
- Bokpoort 50MW CSP Project - Garona
- Solar Capital De Aar - Hydra

Modified (mainly due to date changes):
- Gamma-Perseus 2nd 765kV line
- Ferrrum Ext 132kV feeder bay (Kalahari)
- Kronos 400/132kV transformation
- Kronos-Cuprum 1st & 2nd 132kV
- Ferrum Ext 1st & 2nd 500MVA 400/132kV transformers
- Ferrum-Mookodi (Vryburg) 1st 400kV line
- Ferrum-Mookodi (Vryburg) 2nd 400kV line (via Hotazel)
- Hotazel 400kV loop-in Ferrum-Mookodi (Vryburg) 2nd 400kV line
- Hotazel 400/132kV Substation (1st and 2nd 500MVA 400/132kV transformers)
- Nama MTS Transformers Upgrade
- Aries Ext 400kV 1st SVC
- Garona Ext 275kV STATCOM
- Series Compensation of 400kV lines (reconfiguration of Northern Cape capacitors)
- Sishen-Saldanha Spoornet new traction stations (4 sites with 8 transformers stepping down to 50kV)
- Ferrum - Nieuwehoop 400kV line
- Aries - Nieuwehoop 400kV line

A network diagram of the major projects in the Northern Cape Province is shown in Figure 6.14 below.

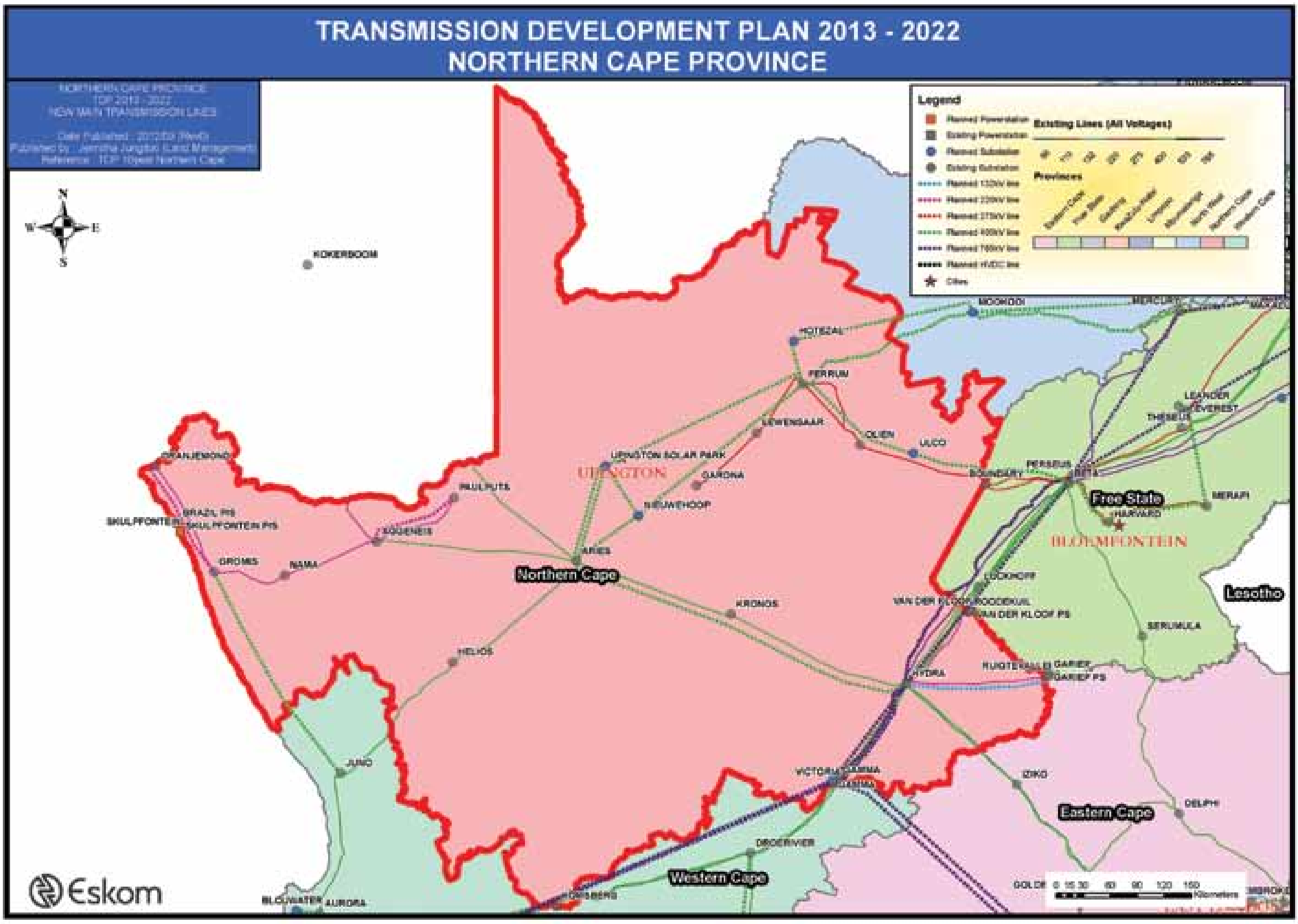


Figure 6.14: Northern Cape Province geographical network diagram

6.8 EASTERN CAPE (EC) PROVINCE

The current transmission network and primary CLNs are shown in Figure 6.15 below.

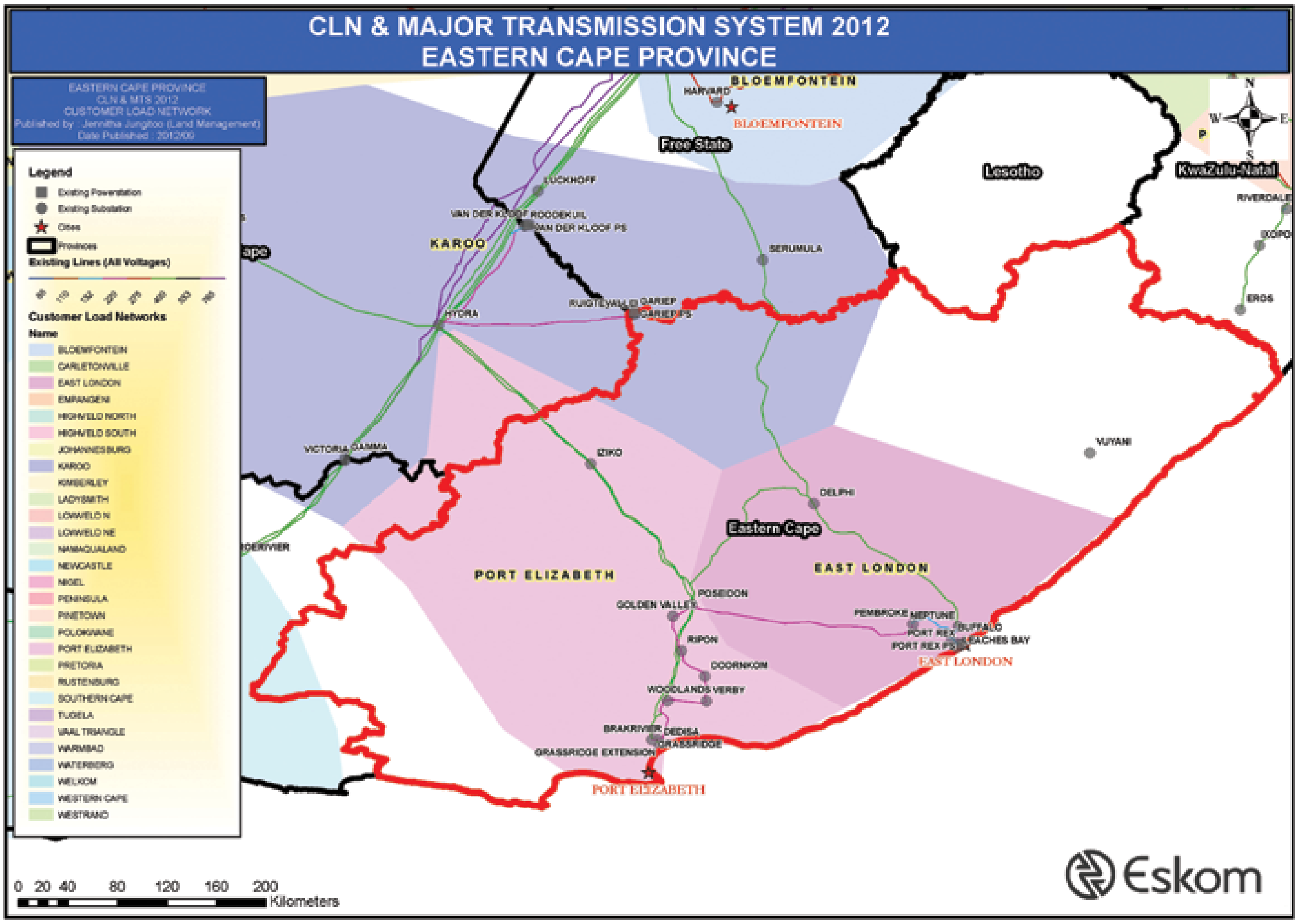


Figure 6.15: Current Eastern Cape Province network and CLNs

The expected peak demands by 2022 as well as the average percentage load increase for the period, for each CLN, are given in Table 6.15a below.

CLN	Forecast load (MW)			Ave. annual % load increase
	2013	2018	2022	
East London	685	791	877	4.2%
Port Elizabeth	1 042	1 556	1 967	7.7%

Table 6.15a: Eastern Cape Province CLN load forecast and percentage load increases

The TDP schemes for the Eastern Cape Province consist of the integration of the DME OCGT power station at Dedisa, the reinforcement of the greater Port Elizabeth metro area including the Coega IDZ, and the Greater East London strengthening scheme, which includes the integration of the Vuyani 400/132kV substation at Mthatha to supply the central and southern Transkei area. If the first Nuclear 1 unit materialises at Thyspunt , three additional 400kV lines would be required to link it to Grassridge and Dedisa via the new Port Elizabeth 400/132kV substation. The integration of Thyspunt has been excluded from this TDP as it falls outside the planning period. The increase in transmission assets by the end of 2017 and the end of 2022 as well as the cumulative total are shown in Table 6.15b.

Transmission Assets for Eastern Cape Province	New Assets expected in 2013-2017	New Assets expected in 2018-2022	Total New Assets expected
Total kms of line	886	541	1,427
765kV Lines (km)	350	350	700
400kV Lines (km)	536	191	727
275kV Lines (km)	0	0	0
Total installed Transformer MVA	6,080	2,215	8,295
Transformers (no. of)	11	7	18
Capacitors (no. of)	4	3	7
Reactors (no. of)	3	1	4

Table 6.15b: Cumulative TDP transmission assets for the Eastern Cape Province

The following projects are planned for the 2013 to 2022 period:

SUB-PROJECT NAME	TDP SCHEME PROJECT	Province	New Expected Year
Delphi 3rd 120MVA 400/132kV transformer	Delphi 3rd 120MVA 400/132kV transformer	EC	2020
Delphi Ext 132kV feeder bay (Wind)	Delphi Wind Phase 1	EC	2013
Delphi Ext 1st 400kV SVC	Delphi Wind Phase 2	EC	2019
Delphi Ext 400/132kV(1X500MVA) substation(dedicated 132kV Supply for New Wind Integration)	Delphi Wind Phase 2	EC	2019
Dedisa Ext 3x 400kV feeder bays (DME OCGT Integration)	DME OCGT Integration at Dedisa 400kV	EC	2013
Grassridge 132kV equipment upgrade (Fault level requirements)	Grassridge 132kV equipment upgrade (Fault level requirements)	EC	2017
Grassridge Ext 132kV feeder bay (Wind)	Grassridge Wind Phase 1	EC	2013
Grassridge Ext 2X132kV feeder bay (Wind)	Grassridge Wind Phase 2	EC	2016
Grassridge Ext 2X132kV feeder bay (Wind)	Grassridge Wind Phase 3	EC	2019
Grassridge Ext 3rd 400/132kV 500MVA transformer and busbar upgrade	Grassridge-Dedisa Strengthening	EC	2017
Dedisa Ext 3nd 500MVA 400/132kV transformer	Grassridge-Dedisa Strengthening	EC	2018
Grassridge-Dedisa 1st 132kV line	Grassridge-Dedisa Strengthening	EC	2014
Eros-Vuyani (Mthatha) 1st 400kV line	Greater East London Strengthening - Phase 1: Eros-Mthatha & SS	EC	2013
Vuyani (Mthatha) 400/132kV Substation (1st and 2nd 250MVA)	Greater East London Strengthening - Phase 1: Eros-Mthatha & SS	EC	2013
Neptune-Vuyani 1st 400kV line	Greater East London Strengthening - Phase 2: Neptune-Mthatha & SS	EC	2013
Poseidon-Neptune 1st 400kV Line	Greater East London Strengthening - Phase 3	EC	2019
Pembroke B 400/132kV substation	Greater East London Strengthening - Phase 3	EC	2019
Pembroke B loop-in and out Poseidon-Neptune 1st 400kV line	Greater East London Strengthening - Phase 3	EC	2019
Hydra Ext 132kV feeder bay (Wind)	Hydra Wind Phase 1	EC	2017
Dedisa Ext 400kV 1st 100MVAr capacitor	PE Phase 3: Poseidon, Delphi, Grassridge and Dedisa Shunt compensation	EC	2015
Delphi Ext 400kV 1st 100MVAr capacitor	PE Phase 3: Poseidon, Delphi, Grassridge and Dedisa Shunt compensation	EC	2015

Grassridge Ext 400kV 1st 100MVAr capacitor	PE Phase 3: Poseidon, Delphi, Grassridge and Dedisa Shunt compensation	EC	2015
Poseidon Ext 400kV 1st 100MVAr capacitor	PE Phase 3: Poseidon, Delphi, Grassridge and Dedisa Shunt compensation	EC	2015
Dedisa Ext 400kV 2nd 100MVAr capacitor	PE Phase 4: Poseidon, Delphi, Grassridge and Dedisa Shunt compensation	EC	2022
Grassridge Ext 400kV 2nd 100MVAr capacitor	PE Phase 4: Poseidon, Delphi, Grassridge and Dedisa Shunt compensation	EC	2022
Poseidon Ext 400kV 2nd 100MVAr capacitor	PE Phase 4: Poseidon, Delphi, Grassridge and Dedisa Shunt compensation	EC	2022
Pembroke 2 x 160MVA 132/66kV transformer	Pembroke Transformer Upgrade	EC	2019
Cookhouse - 140MW wind Integration	REBID 1 preferred bidders	EC	2014
Amakhala Emoyeni	REBID 2 preferred bidders	EC	2015
Grasssridge Innowind - 60MW Wind Farm	REBID 2 preferred bidders	EC	2015
Gamma Ext 765kV busbar extension	Southern Grid - Phase 3 : 1st Gamma Grassridge 765kV Line	EC	2017
Gamma-Grassridge 1st 765kV line	Southern Grid - Phase 3 : 1st Gamma Grassridge 765kV Line	EC	2017
Grassridge Ext 765/400kV transformation	Southern Grid - Phase 3 : 1st Gamma Grassridge 765kV Line	EC	2017
Gamma-Grassridge 2nd 765kV line 350km	Southern Grid - Phase 4: 2nd Gamma Grassridge 765kV Line	EC	2022
Buffalo, Pembroke Transformer LV Supply Normalisation	Southern Grid - Transmission Transformer Normalisation	EC	2014

Changes compared to the 2011 TDP:

Removed from the TDP:
- None

New projects/schemes in the TDP:
- Cookhouse - 140MW wind integration
- Grassridge - Innowind - 60MW Wind Farm
- Amakhala Emoyeni wind integration

Modified (mainly due to date changes):
- Delphi 3rd 120MVA 400/132kV transformer
- Dedisa Ext 3x 400kV feeder bays (DME OCGT Integration)
- Vuyani (Mthatha) 400/132kV Substation (1st and 2nd 250MVA)
- Neptune-Vuyani 1st 400kV line
- Pembroke B loop-in and out Poseidon-Neptune 1st 400kV line
- Poseidon-Neptune 1st 400kV Line
- Pembroke B 400/132kV Substation
- Pembroke 2 x 160MVA 132/66kV transformer

The geographical network of the Eastern Cape Province is shown in Figure 6.16 below.

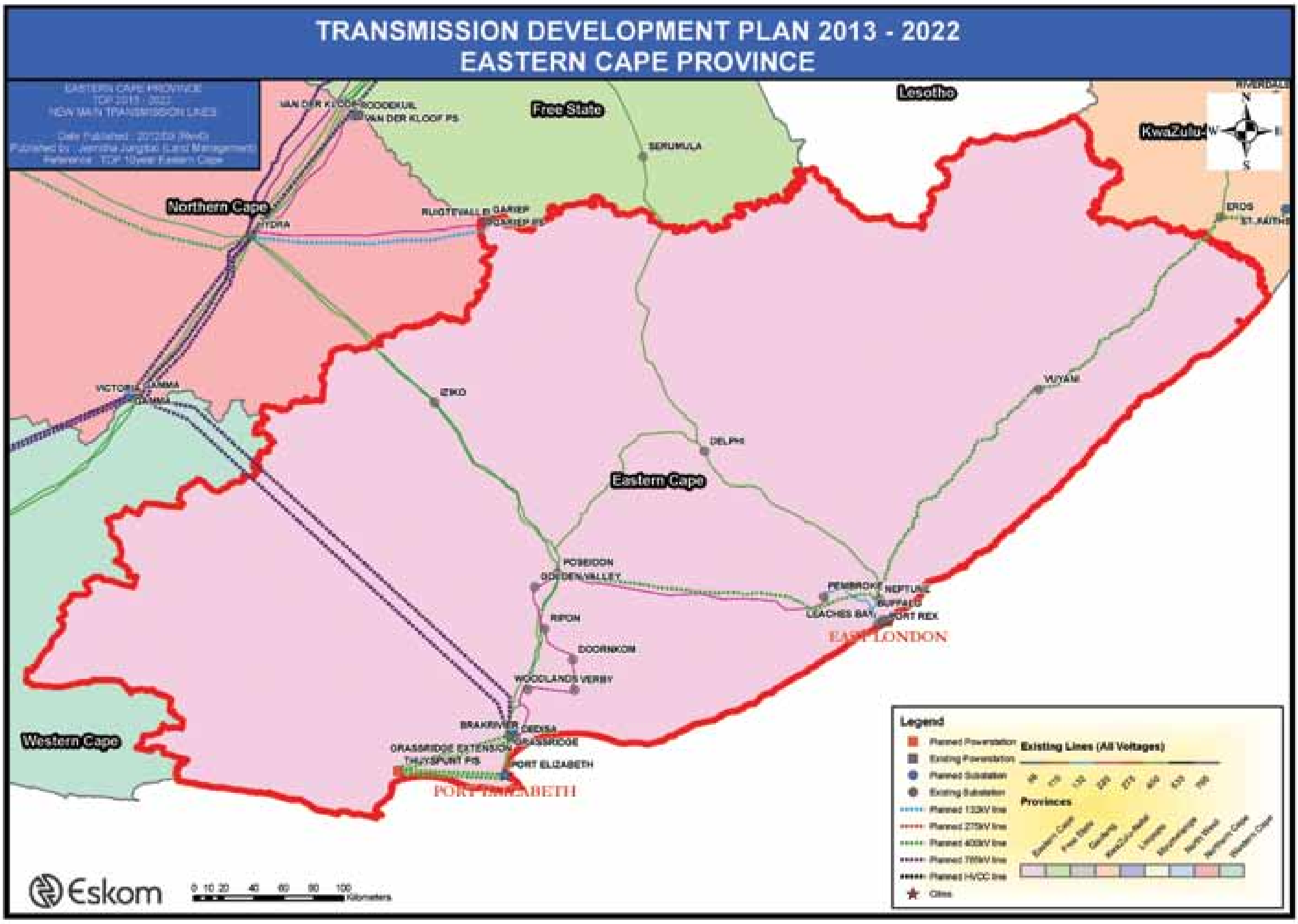


Figure 6.16: The Eastern Cape Province network diagram

6.9 WESTERN CAPE (WC) PROVINCE

The current transmission network and CLNs are shown in Figure 6.17 below.

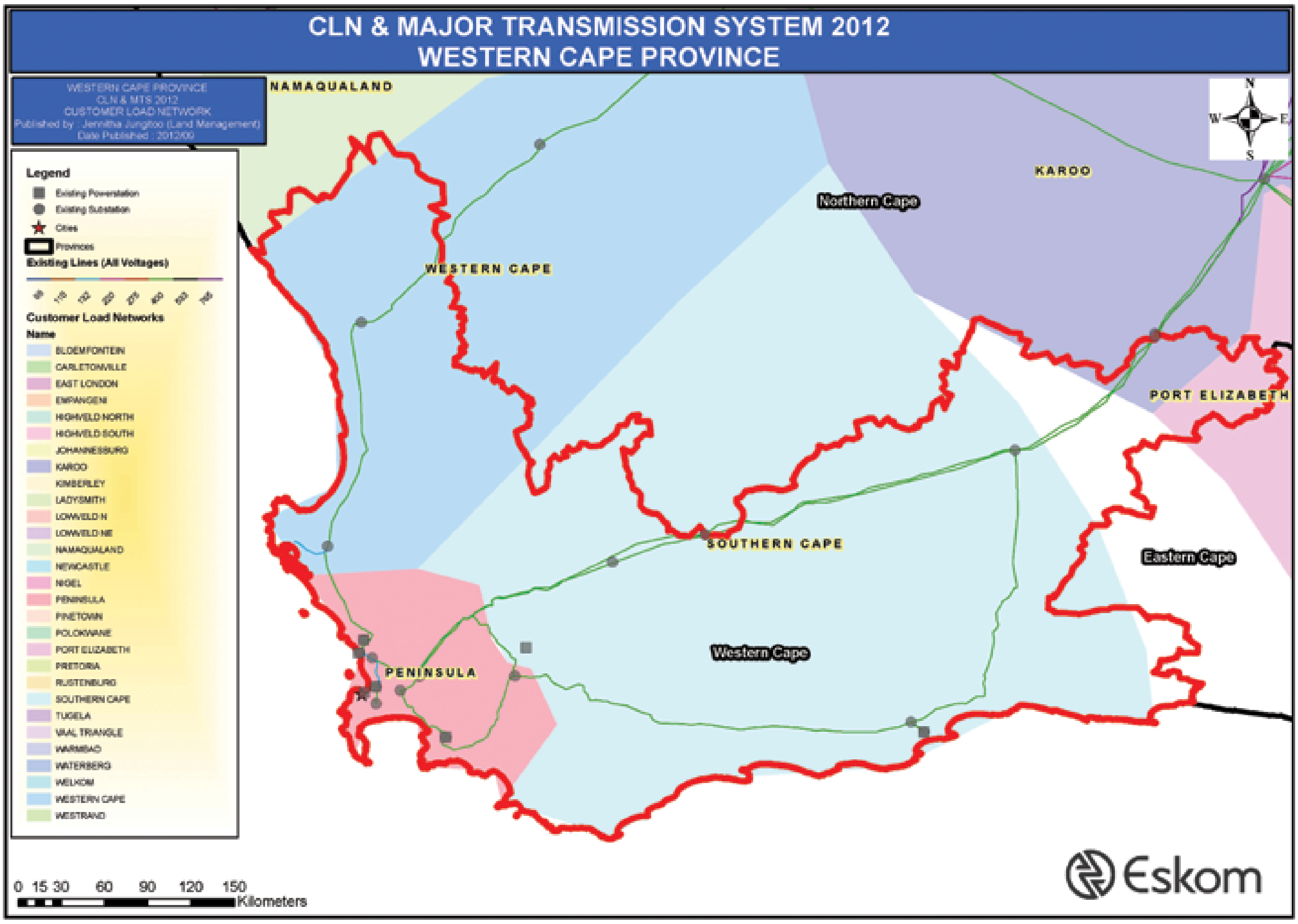


Figure 6.17: Current Western Province network and CLNs

The Western Cape Province development plan consists of 765kV and 400kV network integration. The expected peak demands by 2022 and the average percentage load increase for the period for each CLN are given in Table 6.16 below.

CLN	Forecast load (MW)			Ave. annual % load increase
	2013	2018	2022	
West Coast	474	519	543	1.6%
Southern Cape	945	1052	1157	2.7%
Peninsula	3 218	3 717	4 018	3.6%

Table 6.16: Western Cape Province CLN loads and percentage load increases

The TDP schemes for the Western Cape Province consist of extending the 400kV network and introducing 765kV injection. There is also the installation of additional transformers at existing and new substations.

The increase in transmission assets by the end of 2017 and the end of 2022 and the cumulative total are shown in Table 6.17.

Transmission Assets for Western Cape Province	New Assets expected in 2013-2017	New Assets expected in 2018-2022	Total New Assets expected
Total kms of line	590	943	1,533
765kV Lines (km)	560	560	1,120
400kV Lines (km)	30	383	413
275kV Lines (km)	0	0	0
Total installed Transformer MVA	9,660	7,000	16,660
Transformers (no. of)	16	11	27
Capacitors (no. of)	0	0	0
Reactors (no. of)	15	4	19

Table 6.17: Cumulative TDP transmission assets for the Western Cape Province

The following projects are planned for the 2013 to 2022 period:

SUB-PROJECT NAME	TDP SCHEME PROJECT	Province	New Expected Year
Aurora Ext 132kV feeder bay (Wind)	Aurora Wind Phase 1	WC	2014
Aurora Ext 2X132kV feeder bay (Wind)	Aurora Wind Phase 2	WC	2017
Bacchus Ext 2X132kV feeder bay (Wind)	Bacchus Wind Phase 1	WC	2016
Bacchus Ext 2X132kV feeder bay (Wind)	Bacchus Wind Phase 2	WC	2019
Blanco 400/132kV Substation (1st and 2nd 500MVA transformers)	Blanco Substation Establishment (2x 500MVA 400/132kV TRFR's)	WC	2018
Blanco 400kV line loop-in (Proteus-Droerivier 1st 400kV line)	Blanco Substation Establishment (2x 500MVA 400/132kV TRFR's)	WC	2018
Blouwater 400/132kV Substation (1st and 2nd 500MVA transformers)	Blouwater Substation Establishment (2x 500MVA 400/132kV TRFR's)	WC	2021
Aurora – Blouwater 1st and 2nd 400kV line	Blouwater Substation Establishment (2x 500MVA 400/132kV TRFR's)	WC	2021
Gamma-Kappa 1st 765kV line	Cape Corridor Phase 2: Gamma-Omega 765kV Integration	WC	2013
Kappa-Sterrekus (Omega) 1st 765kV line	Cape Corridor Phase 2: Gamma-Omega 765kV Integration	WC	2015
Sterrekus (Omega) 400kV Loop-in (Koeberg-Muldersvlei 400kV line)	Cape Corridor Phase 2: Gamma-Omega 765kV Integration	WC	2015
Sterrekus (Omega) 765/400kV Substation	Cape Corridor Phase 2: Gamma-Omega 765kV Integration	WC	2015
Gamma Ext 2nd 400MVar 765kV busbar reactor	Cape Corridor Phase 2: Kappa 765kV Integration	WC	2013
Kappa 765/400kV Substation	Cape Corridor Phase 2: Kappa 765kV Integration	WC	2013
Kappa Ext 400kV 100MVAr shunt reactor	Cape Corridor Phase 2: Kappa 765kV Integration	WC	2013
Kappa 400kV Loop-ins (Droerivier-Bacchus & Droerivier-Muldersvlei 400kV lines)	Cape Corridor Phase 2: Kappa 765kV Integration	WC	2015
Gamma-Kappa 2nd 765kV line	Cape Corridor Phase 4: 2nd Zeus-Per-Gam-Omega 765kV Line	WC	2022
Droerivier Ext 132kV feeder bay (Wind)	Droerivier Wind Phase 1	WC	2017
Droerivier Ext 400/132kV(1X500MVA) substation (Dedicated 132kV Supply for New Wind Integration)	Droerivier Wind Phase 2	WC	2017
Droerivier Ext 2X132kV feeder bay (Wind)	Droerivier Wind Phase 3	WC	2019

Droerivier-Proteus 2nd 400kV line	Droerivier-Proteus 2nd 400kV line	WC	2021
Firgrove 400/132kV Substation (1st and 2nd 500MVA transformers)	Firgrove Substation Establishment (2x 500MVA 400/132kV TRFR's)	WC	2016
Firgrove 400kV line loop-in (Palmiet-Stikland 1st 400kV line)	Firgrove Substation Establishment (2x 500MVA 400/132kV TRFR's)	WC	2016
Ankerlig 132kV Loop-in Koeberg-Dussenberg 132kV line	Gas 1 off-site relocation to Ankerlig	WC	2015
Ankerlig Ext Gas 1 generators 3x 57MW	Gas 1 off-site relocation to Ankerlig	WC	2015
Houhoek 400/132kV Substation (1st and 2nd 500MVA transformers)	Houhoek Substation Establishment (2x 500MVA 400/132kV TRFR's)	WC	2018
Houhoek 400kV line loop-in (Palmiet-Bacchus 1st 400kV line)	Houhoek Substation Establishment (2x 500MVA 400/132kV TRFR's)	WC	2018
Juno MTS Transformers upgrade project	Juno MTS transformers upgrade project	WC	2016
Koeberg 400kV busbar reconfiguration	Koeberg 400kV busbar reconfiguration and transformers upgrade project	WC	2018
Koeberg Transformers upgrade project	Koeberg 400kV busbar reconfiguration and transformers upgrade project	WC	2016
Mitchells Plain 400/132kV Substation (1st and 2nd 500MVA transformers)	Mitchells Plain 400kV Substation	WC	2018
Mitchells Plain Switching Station	Mitchells Plain 400kV Substation	WC	2018
Mitchells Plain Switching Station-Mitchells Plain 1st 400kV line	Mitchells Plain 400kV Substation	WC	2018
Mitchells Plain Switching Station-Mitchells Plain 2nd 400kV line	Mitchells Plain 400kV Substation	WC	2018
Philippi-Mitchells Plain 1st 400kV line	Mitchells Plain 400kV Substation	WC	2018
Muldersvlei Ext 3rd 500MVA 400/132kV transformer & 132kV Series Reactors	Muldersvlei Ext 3rd 500MVA 400/132kV transformer & 132kV Series Reactors	WC	2015
Philippi Ext 3rd 500MVA 400/132kV transformer	Philippi Ext 3rd 500MVA 400/132kV transformer	WC	2016
West Coast 1 (Aurora MTS)	REBID 2 preferred bidders	WC	2015
Stikland Ext 3rd 500MVA 400/132kV transformer	Stikland Ext 3rd 500MVA 400/132kV transformer	WC	2021
Vryheid 400/132kV Substation (1st and 2nd 250MVA transformers)	Vryheid Substation Establishment (2x 250MVA 400/132kV TRFR's)	WC	2020
Vryheid 400kV line loop-in (Bacchus - Proteus 400kV line)	Vryheid Substation Establishment (2x 250MVA 400/132kV TRFR's)	WC	2020
Windmill 400kV line loop-in (Bacchus - Muldersvlei 400kV line)	Windmill Substation Establishment (2x 500MVA 400/132kV TRFR's)	WC	2022
Windmill 400/132kV Substation (1st and 2nd 500MVA transformers)	Windmill Substation Establishment (2x 500MVA 400/132kV TRFR's)	WC	2022

Changes compared to the 2011 TDP:

Removed from the TDP:
- None

New projects/schemes in the TDP:
- Aurora - Blouwater 1st 400kV line
- Blouwater 400/132kV Substation (1st and 2nd 500MVA transformers)
- Aurora - Blouwater 2nd 400kV line
- Vryheid 400kV line loop-in (Bacchus - Proteus 400kV line)
- Vryheid 400/132kV Substation (1st and 2nd 250MVA transformers)
- Windmill 400kV line loop-in (Bacchus - Muldersvlei 400kV line)
- Windmill 400/132kV Substation (1st and 2nd 500MVA transformers)
- Stikland Ext 3rd 500MVA 400/132kV transformer
- Ankerlig - Sterrekus 400kV lines
- Koeberg 400kV busbar reconfiguration
- Koeberg Transformers upgrade project
- Juno MTS Transformers upgrade project
- West Coast 1 wind integration (Aurora MTS)

Modified (mainly due to date changes):
- Sterrekus (Omega) 400kV Loop-in (Koeberg-Muldersvlei 400kV line)
- Kappa-Sterrekus (Omega) 1st 765kV line
- Sterrekus (Omega) 765/400kV Substation
- Kappa 400kV Loop-ins (Droerivier-Bacchus & Droerivier-Muldersvlei 400kV lines)
- Gamma-Kappa 2nd 765kV line
- Sterrekus Ext 2nd 2000MVA 765/400kV transformer
- Droerivier-Proteus 2nd 400kV line
- Firgrove 400kV line loop-in (Palmiet-Stikland 1st 400kV line)
- Firgrove 400/132kV Substation (1st and 2nd 500MVA transformers)
- Ankerlig Ext Gas 1 generators 3x 57MW
- Ankerlig 132kV Loop-in Koeberg-Dassenberg 132kV line
- Mitchells Plain Switching Station-Mitchells Plain 1st 400kV line
- Mitchells Plain Switching Station-Mitchells Plain 2nd 400kV line
- Philippi Ext 3rd 500MVA 400/132kV transformer
- MP Switching Station
- Philippi-Mitchells Plain 400kV line

A diagram of the major projects in the West Grid is shown in Figure 6.18 below.

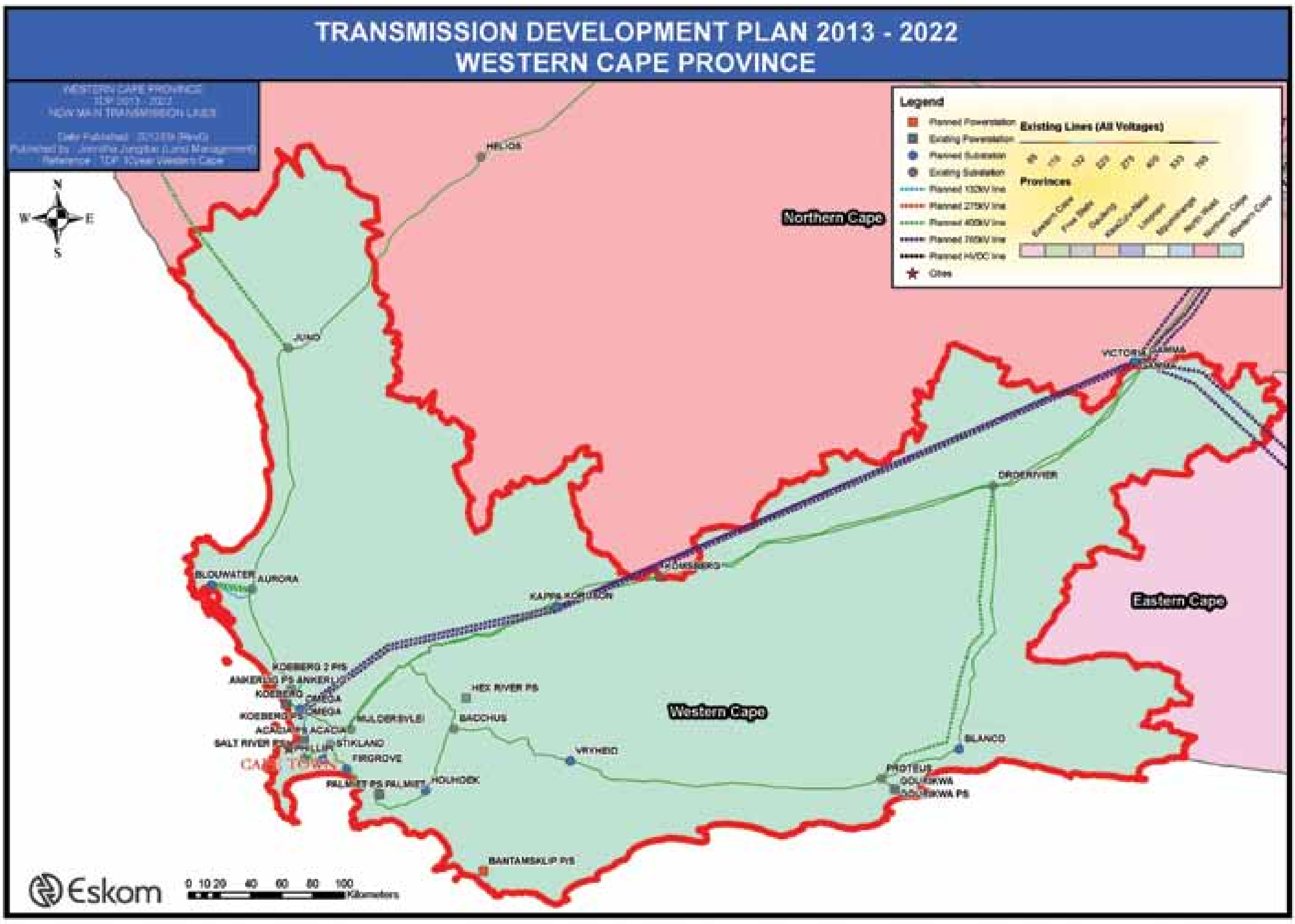


Figure 6.18: Western Cape Province geographical network diagram

6.10 A PLAN FOR WIND AND SOLAR

The preferred bidders connecting to Transmission substations that were selected as part of the DOE IPP Renewable Energy Programme round 1 and round 2 have been added to the plan. This is illustrated in Figure 6.19 below. The rest of the preferred bidders are scheduled to be connected to the Eskom Distribution/Municipality networks.

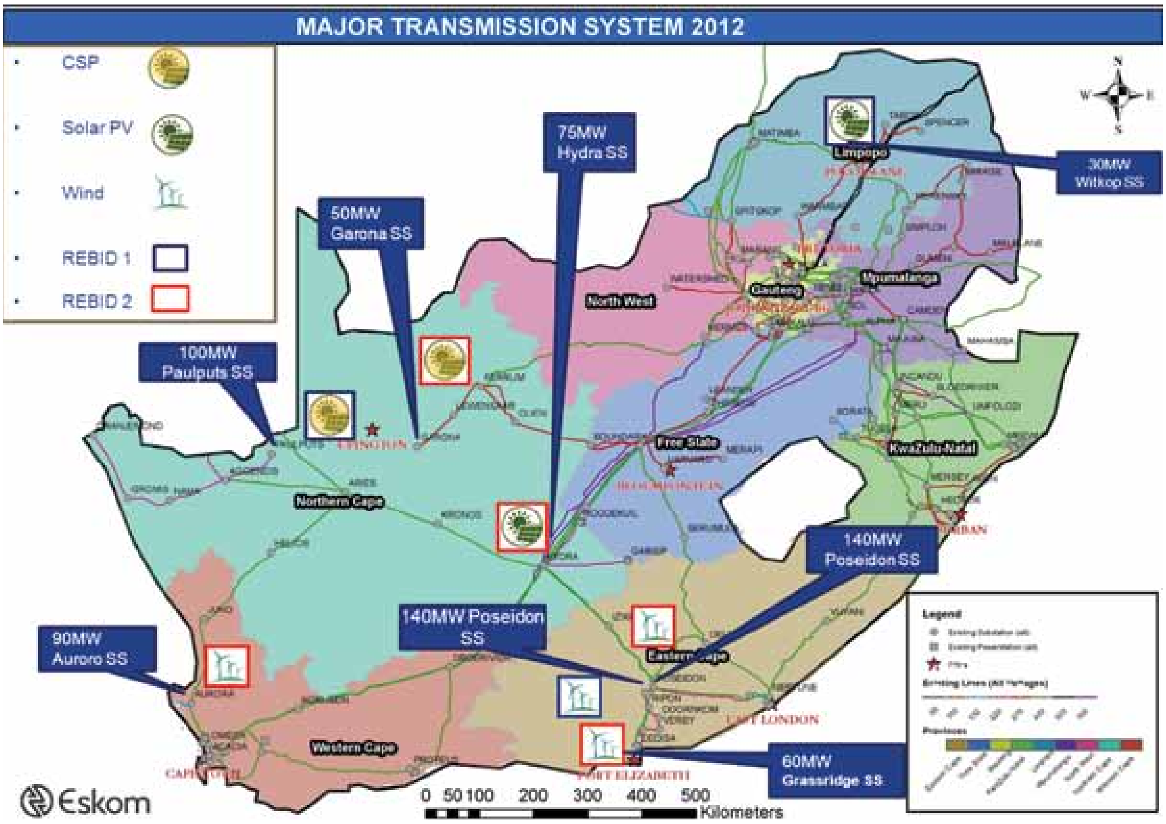


Figure 6.19: Round 1 and 2 of DOE Renewable Energy Preferred Bidders – Transmission Connections

A plan is also contained in this TDP update (similar to last year's TDP) to include the integration of wind and solar generation based on the assumptions of the location and size made in Section 2.2 above of the generation assumptions. The plan is included in the provincial network sections above. It should be noted that this is merely an assumption at this stage, especially as regards the locations selected for the wind farms which are next to existing Transmission substations. The Upington Solar Park can be assumed to be more accurate, considering that the area represents some of the highest sources of solar radiation in the country. The main reason for producing this plan was to compile a financial budget for this type of generation integration for the Transmission Ten-Year Supply Plan.

This plan resulted in a lot of simple feeder-bay requirements at most of the selected Transmission stations initially, as there is spare capacity. As this capacity runs out, new transformers will have to be added to ensure that Grid Code Criteria are met. Two SVCs have been placed on the system in order to ensure the voltage requirements are met. One was placed at the Gromis substation and the other at the Delphi substation.

The TDP will be updated annually with more accurate information on the location and size of new wind and solar generation facilities, based on the Connection Quotation applications received.

6.11 STRATEGIC SERVITUDES UNDER INVESTIGATION

All the line projects and new substation projects that are proposed in the document need to go through a full environmental impact assessment (EIA) process before implementation. This process includes public participation meetings, which are advertised in the media. The concerns of the public and affected parties are addressed at the public participation meetings. Eskom Holdings will not commence the construction of any line or substation unless the EIA process (Record of Decision signed and servitudes acquired) has been concluded.

The proposed lines shown in various schematics in this document give an estimation of where the various proposed lines will run. The outcome of the EIA process will determine the exact position of the lines. The projects in this document are at various stages of the EIA and Land Acquisition processes.

7. CAPITAL EXPENDITURE PLAN

The total capital expenditure for Transmission including expansion, refurbishment, spares, production equipment, and land acquisition project costs amount to R174 billion (excluding IDC). This summary is shown in Table 7.1. It is clear that the majority of the cost will be related to expansion because this relates directly to the strengthening of the network to accommodate new customers as well as new generation.

Capital expenditure (R'mil)	FY 13-22
Capacity expansion	149,259
Refurbishment	12,194
Strategic	1,729
EIA and servitudes	4,696
Capital spares	2,349
Production equipment	4,537
Total	174,763

Table 7.1: Capital Expenditure (10 Year Plan) for different categories of projects

Refurbishment and land acquisition projects are the second and third-most expensive items in the capital expenditure, respectively. Refurbishment is required to prolong the life of assets and land acquisition projects are required to purchase the land in which to build the expansion assets.

The summary of expansion capital expenditure per project type required to realise this ten-year plan is shown in Table 7.2. The total expenditure is expected to be approximately of R149 billion.

Type	Total (R'mil)
Customer Connections (Load)	2,752
Generation	25,665
Reliability	120,842
Grand Total	149,259

Table 7.2: Capital expenditure per project type

Please note that the amounts in the tables represents cash flows in the Ten-year plan periods, any cash flows not falling within this period have not been added, consequently the total cost of the plan may be higher than reflected here.

The details of costing per Province and Project type are shown in Appendix B. For purposes of confidentiality the planned or exact costs per project of Customer Projects have been excluded from the table, however the total sum of all customer projects are indicated in Table 7.2 above.

8. CONCLUDING REMARKS

The most visible difference between this TDP and the previous year's TDP is the increase in the amount of transformation (MVA) by approx. 11000MVA. This is mainly due to new substations being added in the latter part of the planning period.

There is a marginal change in the net amount of lines (km) required. More kilometres of line have however been added in the new planning period.

There has been re-phasing of the existing projects using more realistic completion dates. The acquisition of servitudes for lines and new substations continues to be a challenge for Eskom Transmission resulting in the re-phasing in most cases.

Projects required for the DOE Renewable Energy (RE) IPP program that are in Budget quote phase have been added. There still remains an assumed plan for Renewable Energy integration.

The result is an improved and more realistic or achievable spread of the transmission line projects and transformer installations. New substations have been included, mainly owing to a better positioning of loads resulting from the spatial load-forecasting techniques applied.

Slower rates of completion of the transmission lines and new transformers has resulted in an increase of the overall risk to the network. However this risk can be managed as the N-1 un-firm refers to the strict deterministic level which assumes that the N-1 event will happen at the time of the loading peak. 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 include higher reliance on the following: utilisation of strategic spares, the use of capacitors in the short term for voltage support, as well as Emergency Preparedness Plans.

The economic slowdown as well as efforts to promote demand side management through the use of solar geysers and compact fluorescent lamps and by encouraging the saving of electricity has greatly assisted in reducing major supply constraints. The economy is, however, showing signs of a recovery, and there should be a return to pre-recession demand levels and forecasts soon. Hence we believe it will be necessary to proceed with the planned infrastructure development.

This Ten-Year Plan has many similarities with the previous one as far as projects are concerned. At the end of the period of this Ten-Year Plan, it is expected that the transmission network will be fully compliant to the reliability requirements of the Grid Code that were amended in 2008.

Robust and efficient planning requires the timely exchange of credible information between stakeholders. In particular, stakeholders are requested to note that spatial data and information are critical for the effective planning and development of the transmission network.

Transmission infrastructure could easily become the critical path in connecting and integrating large new loads and generation, due to the long lead times for securing corridors. We recommend that for planning purposes, developers should allow for at least 7 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 required to implement projects.

The conclusion is that 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. The system will be running at risk in some areas, and careful operational mitigation planning will have to be undertaken until the transmission projects and new generation are in place.

The estimated rand value of the planned projects is approximately R149 billion (excluding IDC) over the next ten years, of which approximately R3 billion is for customer related projects; R25 billion for generation integration projects, and approximately R121 billion is related to reliability projects.

2010 IRP Calender	PSS/E Casefile	Grootvlei		Komati		Medupi		Kusile		Ingula		DoE OCGT 1 Dedisa		Doe OCGT 2 Avon			Co-Gen	Co-Gen
Year	Year	Unit	MW	Unit	MW	Unit	MW	Unit	MW	Unit	MW	Unit	MW	Unit	MW	Unit	Location	MW
2011	2011	5	190	4	101													
		6	190	5	101													
				6	101													
2012	2012			7	101													
				8	101													
	2013																	
2013	2013			9	101	1	738			1	333	1	147	1	147	1	SASOL (Sol)	200
												2	147	2	147	2	SASOL (Sol)	200
														3	147			
														4	147			
														5	147			
2014	2014					2	738			2	333							
										3	333							
	2015									4	333							
2015	2015					3	738											
						4	738											
2016	2016					5	738											
2017	2017					6	738	1	738									
								2	738									
2018	2018							3	738									
2019	2019							4	738									
								5	738									
2020	2020							6	738									
2021	2021																	
2022	2022																	

2010 IRP Calender	PSS/E Casefile		New Coal	New Coal		Wind	Wind		CSP	CSP		O & C CGT	O & C CGT		HYDRO import	HYDRO import
Year	Year	Unit	Location	MW	Unit	Location	MW	Unit	Location	MW	Unit	Location	MW	Unit	Location	MW
2011	2011															
2012	2012															
	2013				1	Juno (Sere)	100									
					1	Poseidon	140									
					1	Delphi	100									
					1	Droerivier	60									
2013	2013				1	Grassridge	140									
					2	Grassridge	80									
					3	Grassridge	30									
					2	Juno (IPP)	70									
					1	Palmiet	30									
					1	Aurora	50									
2014	2014	1	Coal IPP 1	200	2	Aurora	100	1	Upington	100						
		2	Coal IPP 1	200	1	Gromos	100									
		3	Coal IPP 1	200	1	Bacchus	100									
					2	Delphi	100									
	2015															
2015	2015	1	Coal IPP 2	300	1	Hydra	100	1	Paulputs	100						
		2	Coal IPP 2	300	2	Poseidon	100									
					3	Delphi	100									
					2	Droerivier	100									
2016	2016				2	Hydra	100	2	Upington	100						
					3	Poseidon	100									
					4	Delphi	100									
					3	Droerivier	100									
2017	2017				2	Gromos	100	3	Upington	100						
					3	Poseidon	100									
					4	Droerivier	100									
					3	Hydra	100									
2018	2018				4	Hydra	100	4	Upington	100						
					5	Delphi	100									
					1	Nama	100									
					3	Gromis	100									
2019	2019	1	Coal IPP 3	250	4	Droerivier	100	5	Upington	100	3	Dedisa	237			
					6	Delphi	100									
					4	Grassridge	100									
					2	Bacchus	100									
2020	2020	2	Coal IPP 3	250	2	Nama	100	6	Upington	100	4	Dedisa	237			
					3	Bacchus	100									
					5	Droerivier	100									
					1	Neptune	100									
2021	2021	3	Coal IPP 3	250	3	Nama	100	7	Upington	100	5	Dedisa	237			
					4	Bacchus	100									
					6	Droerivier	100									
					2	Neptune	100									
2022	2022	4	Coal IPP 3	250	5	Hydra	100	8	Upington	100	6	Dedisa	269	1	Maputo	570
					6	Droerivier	100				7	Dedisa	269	2	Maputo	570
					5	Grassridge	100				8	Dedisa	269			
					4	Nama	100									

Generation Plant used for the TDP studies

> APPENDIX B: COSTING DETAILS

APPENDIX B1: COSTING PER PROJECT TYPE

Type	Total (R'mil)
Customer Connections (Load)	2,752
Generation	25,665
Reliability	120,842
Grand Total	149,259

Please note that the amounts in the tables represents cash flows in the Ten-year plan periods, any cash flows not falling within this period have not been added, consequently the total cost of the plan may be higher than reflected here.

APPENDIX B2A: COSTING FOR GAUTENG PROVINCE PROJECTS

Province	Project	Cost (R)	Grand Total
GP	Benburg Ext 3rd 250MVA 275/132kV	91,280,731	13,499,147,238
GP	JHB Reactive Power Project	17,301,301	
GP	Johannesburg CLN Fault Level Management	40,000,000	
GP	Johannesburg East Strengthening - Phase 3 A-D - Apollo-Esselen 1st 400kV (energised @ 275kV)	125,695,806	
GP	Johannesburg North - Phase 2a (Lepini Ext 275kV 2x 150Mvar capacitors)	125,695,806	
GP	Johannesburg North - Phase 2b (Apollo-Lepini 1st 275kV line)	297,467,850	
GP	Pelly 132/22kV transformation upgrade	30,148,222	
GP	Tshwane Reinforcement - Phoebus Phase 1 - 3 & Verwoerdburg Phase 1 - 2	1,834,000,000	
GP	Johannesburg East Strengthening - Phase 1B	437,669,700	
GP	Johannesburg East Strengthening - Phase 2	328,366,954	
GP	Johannesburg East Strengthening - Phase 3 A-D - Prospect-Sebenza 1st 275kV line	244,065,056	
GP	Johannesburg East Strengthening - Phase 3 A-D - Matla-Jupiter B 1st 400kV line (operated @ 275kV)	1,954,972,921	
GP	Johannesburg East Strengthening - Phase 3 A-D - Jupiter B 275kV Loop-ins	15,760,075	
GP	Johannesburg East Strengthening - Phase 3 E-F	577,379,766	
GP	Soweto Strengthening Phase 1 - 275kV	496,999,919	
GP	Tshwane Reinforcement - Wildebees Phase 1	125,000,000	
GP	Vaal Strengthening Phase 2	393,338,988	
GP	Johannesburg East Strengthening - Phase 2	328,366,954	
GP	Kookfontein Phase 2	211,083,468	
GP	Simmerpan 275/88kV substation	524,033,470	
GP	Soweto Strengthening Phase 1 - 275kV	496,999,919	
GP	Soweto Strengthening Phase 2 - 275/132kV	424,435,512	
GP	Demeter 400kV Integration	911,473,670	
GP	Kyalami Integration	1,365,153,157	
GP	Tshwane Reinforcement - Anderson Phase 1	107,728,184	
GP	West Rand Strengthening - Phase: Westgate and Taunus 400kV - Westgate 400/132kV substation	928,529,774	
GP	West Rand Strengthening - Phase: Westgate and Taunus 400kV	903,299,265	
GP	West Rand Strengthening - Phase: Etna 400kV	162,900,769	

Please note that the amounts in the tables represent cash flows as a total scheme cost that may fall outside of the Ten-year plan periods.

APPENDIX B2B: COSTING FOR KZN PROVINCE PROJECTS

Province	Project	Cost (R)	Grand Total
KZN	Ariadne-Venus 2nd 400kV Line	897,853,599	22,086,284,606
KZN	Avon Ext 3rd 250MVA 275/132kV transformer	71,623,313	
KZN	DME OCGT Integration at Avon 275kV (Pinetown)	55,727,089	
KZN	eThekwini Electricity Network Strengthening	2,111,600,262	
KZN	Incandu Ext 3rd 500MVA 400/132kV transformer	91,925,010	
KZN	Ingula Pumped Storage P/S Integration	1,271,000	
KZN	KZN 765kV Strengthening - Empangeni Integration - Theta (Mbewu) Substation	2,839,737,090	
KZN	KZN 765kV Strengthening - Empangeni Integration - Umfolozi-Theta (Mbewu) 765kV line	1,130,567,008	
KZN	KZN 765kV Strengthening - Empangeni Integration - Theta (Mbewu) 400kV loop-ins	155,819,955	
KZN	KZN 765kV Strengthening - Empangeni Integration - Invubu-Theta (Mbewu) 2nd 400kV line	851,933,734	
KZN	KZN 765kV Strengthening - Lambda Substation and Majuba - Lambda 1st & 2nd 400kV lines	3,255,430,546	
KZN	KZN 765kV Strengthening - Pinetown Integration - Sigma (Isundu) Substation	3,381,256,423	
KZN	KZN 765kV Strengthening - Pinetown Integration - Lambda - Sigma (Isundu) 1st 765kV line	2,845,987,673	
KZN	KZN 765kV Strengthening - Pinetown Integration - Loop in Ariadne - Hector 2 400kV line	843,554,683	
KZN	KZN 765kV Strengthening Isundu - Mbewu 1st & 2nd 400kV lines	1,603,835,612	
KZN	Mersey Ext 3rd 250MVA 275/132kV transformer	93,224,469	
KZN	Normandie Ext 2nd 250MVA 400/132kV transformer	60,000,000	
KZN	South Coast Strengthening	925,791,713	
KZN	Transnet Coal - Line Upgrade	869,145,429	

Please note that the amounts in the tables represent cash flows as a total scheme cost that may fall outside of the Ten-year plan periods.

APPENDIX B2C: COSTING FOR LIMPOPO PROVINCE PROJECTS

Province	Project	Cost (R)	Grand Total
Lim	Medupi Integration (Charlie) Phase 2B: Mokopane	647,000,000	30,189,125,936
Lim	Medupi Phase 3 (Masa - Selemo 765kV lines; Masa & Selemo Substations). Selemo falls in the NW Province, however costs are included in this scheme	12,897,146,491	
Lim	Nzhelele 400kV reinforcement	1,970,518,927	
Lim	Spitskop Transformation Upgrade	81,129,122	
Lim	Tabor and Spencer Reinforcement - Phase 2	622,000,000	
Lim	Medupi Integration (Alpha) Phase 1A & Phase 1B: Marang, Spitskop and Dinaledi	11,100,000,000	
Lim	Tubatse Strengthening Scheme Phase 3	900,812,469	
Lim	Nzhelele 400kV reinforcement	1,970,518,927	

Please note that the amounts in the tables represent cash flows as a total scheme cost that may fall outside of the Ten-year plan periods.

APPENDIX B2D: COSTING FOR NORTH WESTERN PROVINCE PROJECTS

Province	Project	Cost (R)	Grand Total
NW	Dinaledi 3rd 500MVA 400/132kV Transformer	82,697,462	6,722,413,531
NW	Medupi Integration (Charlie) Phase 2A: Mogwase	647,000,000	
NW	Kimberley 400kV Strengthening Phase 2	1,900,000,000	
NW	Watershed Strenghtening	152,134,281	
NW	Dwaalboom 132kV switching station	142,209,852	
NW	Rustenburg Strengthening Phase 1	292,047,670	
NW	Lomond MTS transformation upgrade	81,434,444	
NW	Rustenburg Strengthening Phase 2	910,469,461	
NW	Kimberley Strengthening Phase 3 (Hermes-Mookodi (Vryburg) 1st 400kV line)	2,514,420,362	

Please note that the amounts in the tables represent cash flows as a total scheme cost that may fall outside of the Ten-year plan periods.

APPENDIX B2E: COSTING FOR MPUMALANGA PROVINCE PROJECTS

Province	Project	Cost (R)	Grand Total
MP	Foskor & Acornhoek 275/132kV transformation upgrades	343,202,392	11,221,012,602
MP	Highveld North-West and Lowveld North Reinforcement - Phase 1	681,613,169	
MP	Highveld North-West and Lowveld North Reinforcement - Phase 2	2,163,004,034	
MP	Highveld North-West and Lowveld North Reinforcement - Phase 3	127,260,665	
MP	Highveld South Reinforcement	699,975,197	
MP	Khanyisa PS integration	378,920,203	
MP	Kruispunt Reinforcement	19,418,665	
MP	Kusile Integration Phase 1 - 4	2,438,000,000	
MP	Lowveld 400kV Strengthening - Phase 1: Gumeni	400,000,000	
MP	Lowveld 400kV Strengthening - Phase 2: Marathon B	898,579,656	
MP	Lowveld 400kV Strengthening - Phase 3a	413,085,122	
MP	Lowveld 400kV Strengthening - Phase 3b	859,382,430	
MP	Malelane 275kV Reinforcement - Phase 2	8,457,433	
Lim	Tubatse Strengthening Scheme Phase 1. This project falls in the Limpopo Province	900,812,469	
Lim	Tubatse Strengthening Scheme Phase 2. This project falls in the Limpopo Province	877,026,015	
MP	Xstrata Phase 2 customer project - Transmission Reinforcement	12,275,153	

Please note that the amounts in the tables represent cash flows as a total scheme cost that may fall outside of the Ten-year plan periods.

APPENDIX B2F: COSTING FOR FREE STATE PROVINCE PROJECTS

Province	Project	Cost (R)	Grand Total
FS	Bloemfontien Strengthening - Everest - Merapi 275kV (built at 400kV standards)	545,421,176	1,643,929,562
FS	Bloemfontien Strengthening - Merapi Ext 3rd 250MVA 275/132kV transformer	75,126,259	
FS	Bloemfontien Strengthening Phase 2	633,879,863	
FS	Harrismith Strengthening Phase 1	218,277,073	
FS	Kimberley Strengthening Phase 3	152,353,545	
FS	Merapi Wind Phase 1	18,871,647	

Please note that the amounts in the tables represent cash flows as a total scheme cost that may fall outside of the Ten-year plan periods.

APPENDIX B2G: COSTING FOR NORTHERN CAPE PROVINCE PROJECTS

Province	Project	Cost (R)	Grand Total
NC	Gariep Network Strengthening	35,328,849	9,784,456,801
NC	Garona Strengthening	213,052,514	
NC	Gromis Wind Phase 1	93,445,075	
NC	Hydra 400 & 132kV equipment upgrade (Fault level requirements)	32,200,000	
NC	Juno Wind Phase 2	84,012,507	
NC	Kappa Wind Phase 1	131,833,137	
NC	Kimberley Strengthening Phase 3 - Hotazel 400kV loop-in (Ferrum-Mookodi(Vryburg) 2nd 400kV line)	683,295,591	
NC	Kimberley Strengthening Phase 3C	152,353,545	
NC	N Cape reinforcement: Aggenuis-Paulputs 2nd 220kV	508,000,000	
NC	N Cape reinforcement: Aries SVC	417,417,335	
NC	N Cape reinforcement: Ferrum -Nieuwehoop - Aries 400kV (Aries - Nuwehoop)	730,834,703	
NC	N Cape reinforcement: Ferrum -Nieuwehoop - Aries 400kV (Ferrum - Nuwehoop)	1,217,320,234	
NC	Paulputs Ext 2nd 125MVA 220/132kV transformer	74,000,000	
NC	Sishen-Saldanha Full Solution (Supply for New Spoornet Traction)	1,583,178,235	
NC	Upington Strengthening Phase 1	3,819,185,077	
NC	Ferrum 132kV Feeder extention	9,000,000	

Please note that the amounts in the tables represent cash flows as a total scheme cost that may fall outside of the Ten-year plan periods.

APPENDIX B2H: COSTING FOR EASTERN CAPE PROVICE PROJECTS

Province	Project	Cost (R)	Grand Total
EC	Delphi 3rd 120MVA 400/132kV transformer	64,100,942	11,944,945,117
EC	Delphi Wind Phase 1	13,066,214	
EC	Delphi Wind Phase 2 - Delphi Ext 1st 400kV SVC	307,065,614	
EC	Delphi Wind Phase 2 - Delphi Ext 400/132kV substation	86,962,661	
EC	DME OCGT Integration at Dedisa 400kV	24,432,543	
EC	Grassridge 132kV equipment upgrade (Fault level requirements)	32,200,000	
EC	Grassridge-Dedisa Strengthening	117,489,051	
EC	Greater East London Strengthening - Phase 1 & Phase 2: Eros-Mthatha, Neptune-Mthata & SS	1,550,000,000	
EC	Greater East London Strengthening - Phase 3 - Pembroke B loop-in and out Poseidon-Neptune 1st 400kV line	366,914,869	
EC	Greater East London Strengthening - Phase 3 - Poseidon-Neptune 1st 400kV Line	889,522,887	
EC	Hydra Wind Phase 1	12,738,589	
EC	PE Phase 3: Poseidon, Delphi, Grassridge and Dedisa Shunt compensation	146,752,920	
EC	Pembroke Transformer Upgrade	83,279,029	
EC	Southern Grid - Phase 3 : 1st Gamma Grassridge 765kV Line	4,419,831,881	
EC	Southern Grid - Phase 4: 2nd Gamma Grassridge 765kV Line	3,779,875,472	
EC	Southern Grid - Transmission Transformer Normalisation	50,712,446	

Please note that the amounts in the tables represent cash flows as a total scheme cost that may fall outside of the Ten-year plan periods.

APPENDIX B2I: COSTING FOR WESTERN CAPE PROVICE PROJECTS

Province	Project	Cost (R)	Grand Total
WC	Aurora Wind Phase 1	9,785,980	32,040,088,437
WC	Aurora Wind Phase 2	35,671,909	
WC	Bacchus Wind Phase 1	21,503,516	
WC	Bacchus Wind Phase 2	38,783,807	
WC	Blanco Substation Establishment (2x 500MVA 400/132kV TRFR's)	684,109,719	
WC	Cape Corridor Phase 2: Gamma-Omega 765kV Integration	5,525,000,000	
WC	Cape Corridor Phase 2: Kappa 765kV Integration	1,077,192,198	
WC	Cape Corridor Phase 4: 2nd Zeus-Per-Gam-Ome 765kV Line	17,653,048,675	
WC	Droerivier Wind Phase 1	11,871,184	
WC	Droerivier Wind Phase 2	79,570,640	
WC	Droerivier Wind Phase 3	39,511,645	
WC	Droerivier-Proteus 2nd 400kV line	1,349,445,856	
WC	Firgrove Substation Establishment (2x 500MVA 400/132kV TRFR's)	432,842,774	
WC	Gas 1 off-site relocation to Ankerlig	471,000,000	
WC	Howhoek Substation Establishment (2x 500MVA 400/132kV TRFR's)	498,004,701	
WC	Juno MTS transformers upgrade project	81,128,422	
WC	Koeberg 400kV busbar reconfiguration and transformers upgrade project Transformation upgrade)	128,640,905	
WC	Koeberg 400kV busbar reconfiguration and transformers upgrade project (Busbar reconfig)	598,544,154	
WC	Mitchells Plain 400kV Substation	1,439,706,858	
WC	Muldersvlei Ext 3rd 500MVA 400/132kV transformer & 132kV Series Reactors	117,587,765	
WC	Nama MTS Transformers Upgrade	31,343,731	
WC	Nama Wind Phase 1 (Nama Ext 220kV feeder bay (Wind))	18,396,353	
WC	Nama Wind Phase 1 (Gromis Ext 220kV SVC)	304,894,130	
WC	Philippi Ext 3rd 500MVA 400/132kV transformer	119,225,968	
WC	Stikland Ext 3rd 500MVA 400/132kV transformer	119,225,968	
WC	Vryheid Substation Establishment (2x 250MVA 400/132kV TRFR's) - Vryheid 400kV line loop-in (Bacchus - Proteus 400kV line)	203,875,273	
WC	Vryheid Substation Establishment (2x 250MVA 400/132kV TRFR's) - Vryheid 400/132kV Substation (1st and 2nd 250MVA transformers)	422,391,045	
WC	Windmill Substation Establishment (2x 500MVA 400/132kV TRFR's) - Windmill 400kV line loop-in (Bacchus - Muldersvlei 400kV line)	69,216,313	
WC	Windmill Substation Establishment (2x 500MVA 400/132kV TRFR's) - Windmill 400/132kV Substation (1st and 2nd 500MVA transformers)	458,568,950	

Please note that the amounts in the tables represent cash flows as a total scheme cost that may fall outside of the Ten-year plan periods.

> APPENDIX C: PUBLICATION TEAM

Although the publication of the document was not undertaken by a formal team, the following people were instrumental in bringing the document to life. Credit is also given to all the Grid Planning staff, who are responsible for formulating the Strategic Grid Plan as well as the Provincial Grid Plans. The formulation of the plan also includes work from the Eskom Group Capital Division, the Eskom Finance Division as well as the Transmission Project Development Department.

Team Members	Role
Nishan Rathanlall	Compiler 1
Ziyaad Jina	Compiler 2
Roy Estment	Compiler 3
Camille Shah and Nomfi Nomjana	Printing and Communication
Juan La Grange	Legal/Regulations

> APPENDIX D: CONTACT DETAILS

This document will be available via the Eskom website (www.eskom.co.za), but should you have any queries please contact the following people.

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