Transmission Development Plan 2016 – 2025

Public Forum

16 October 2015

Eskom Transmission Development Plan 2016 - 2025

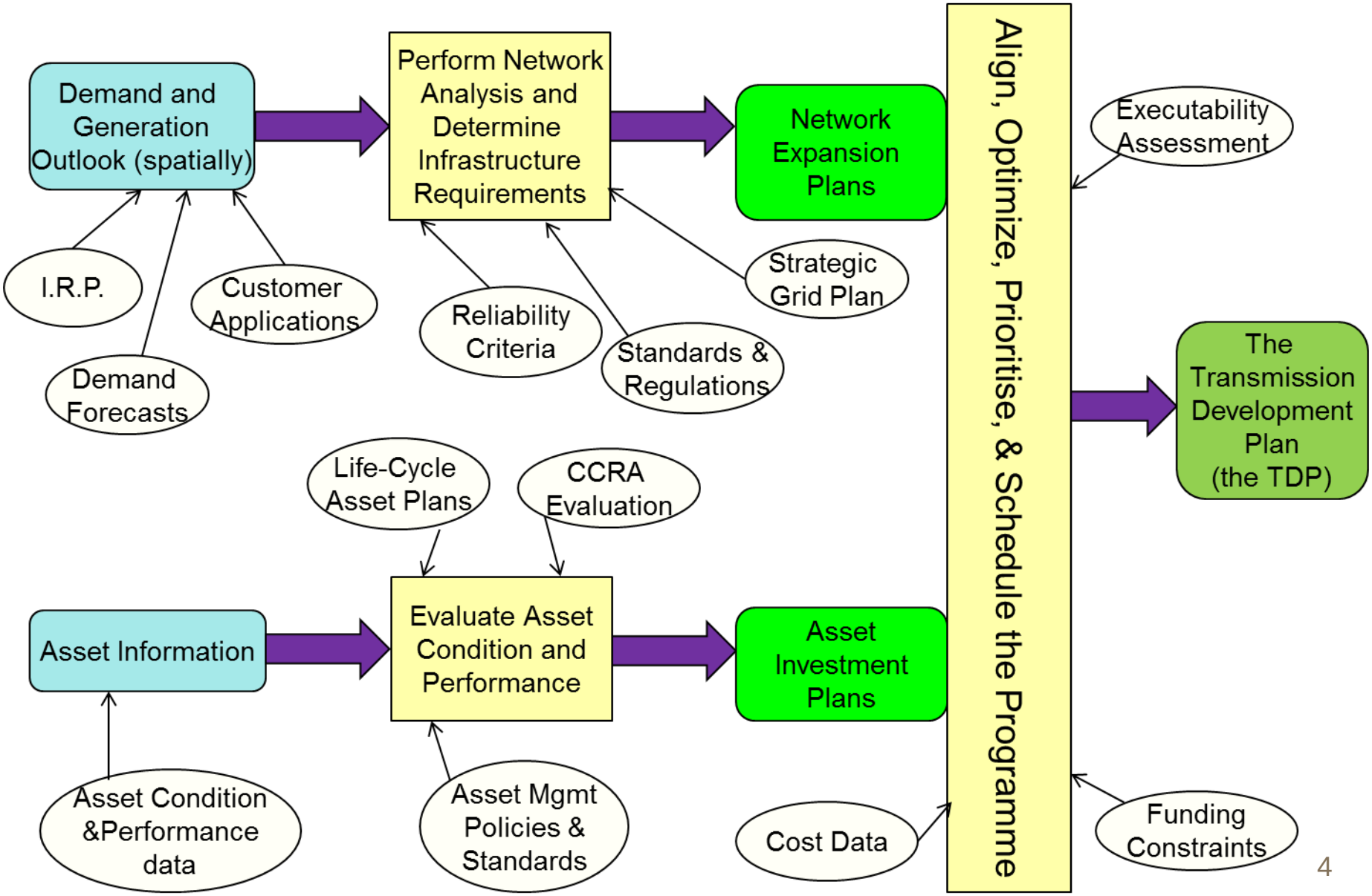
Planning for the South African Integrated Power System

Presented by: Mbulelo Kibido

Desired Outcomes for this Public Forum

- Information on the transmission infrastructure investment plans for the TDP period 2016 to 2025
- Insight into the assumptions and inputs on which these plans are based.
- Appreciation of the rigour that goes into the process of planning infrastructure investments in Transmission.
- An understanding of the generation and load growth that has been catered for in these plans
- The plans to create grid capacity to integrate the generation envisaged in the 2010 IRP.
- Information on the capital budget requirements to execute these plans.
- More importantly, to solicit comments and further inputs to improve these plans

Our Infrastructure Investment Planning Model



The Key Plans

Integrated Resource Plan (IRP)

- The Department of Energy (Energy Planner) is accountable for the Country Electricity Plan, which is called the Integrated Resource Plan For Electricity (IRP 2010-2030).
- The Integrated Resource Plan (IRP) is intended to drive all new generation capacity development.
- Nersa licences new generators according to this determination.

Strategic Grid Plan (SGP)

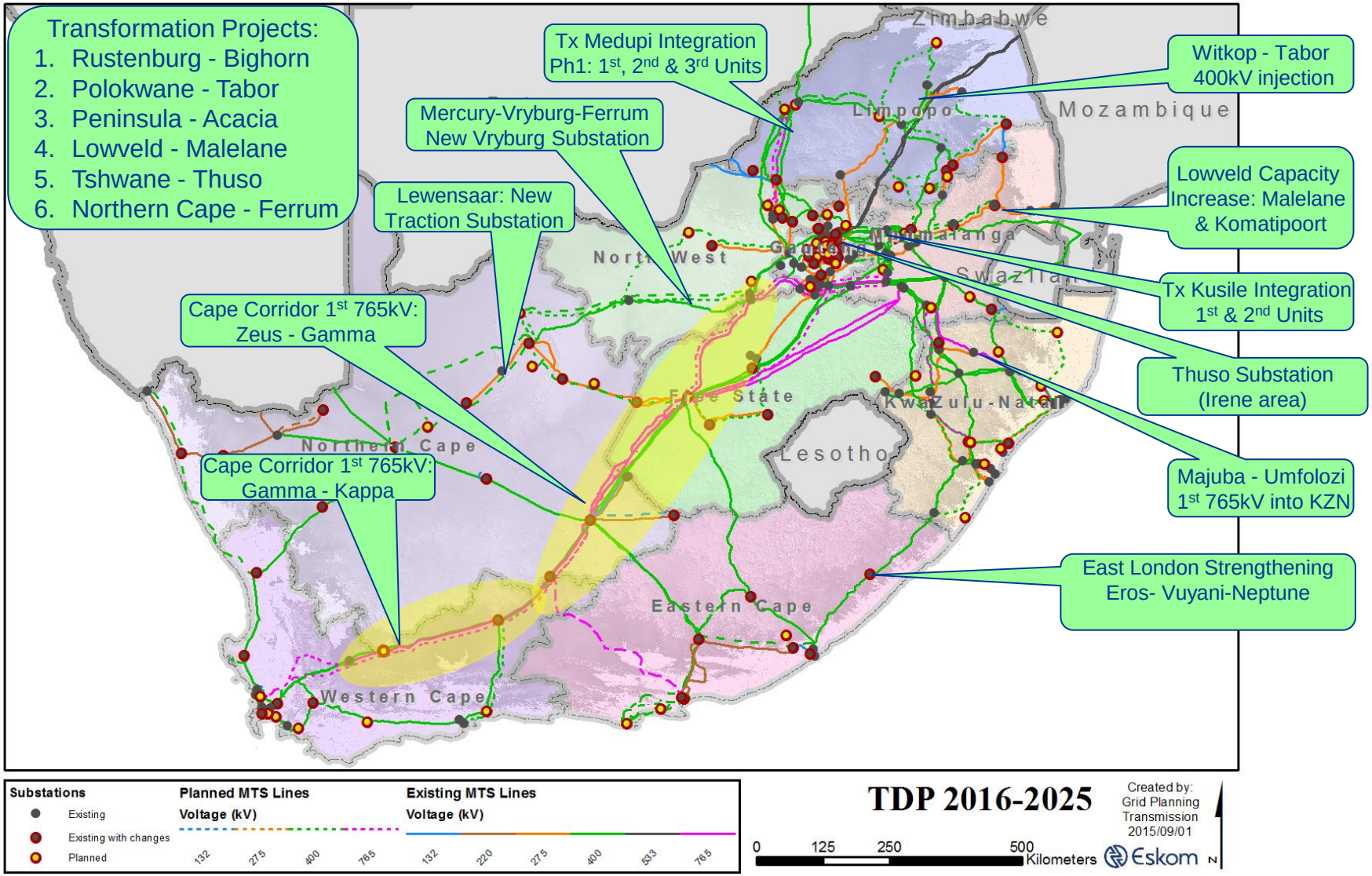
- The Strategic Grid Plan formulates long term strategic transmission corridor requirements
- The Plan is based on a range of generation scenarios and associated strategic network analysis
- Horizon date is 20 years
- Updated every 2 - 3 years

Transmission Development Plan (TDP)

- The Transmission Development Plan (TDP) represents the transmission network infrastructure investment requirements
- The TDP covers a 10 year window
- Updated annually
- Indicates financial commitments required in the short to medium term

Recently Completed Projects

Major Projects Completed Recently



Since 2011, 42 projects (2142 MW) of RE IPPs were connected, ~88% (1865 MW) of which are in operation

Status of Current DOE IPP Programme – end August 2015

Name of programme	MW contribution	Current status
Bid Window 1 (28 projects)	1436	All 28 projects connected
Bid Window 2 (19 projects)	1054	14 projects connected (706MW) 5 projects in execution
Bid Window 3 (19 projects)	1656	All projects in execution

2142 MW of RE IPPs have been connected to the grid underpinned by a R2.4 billion Eskom network investment

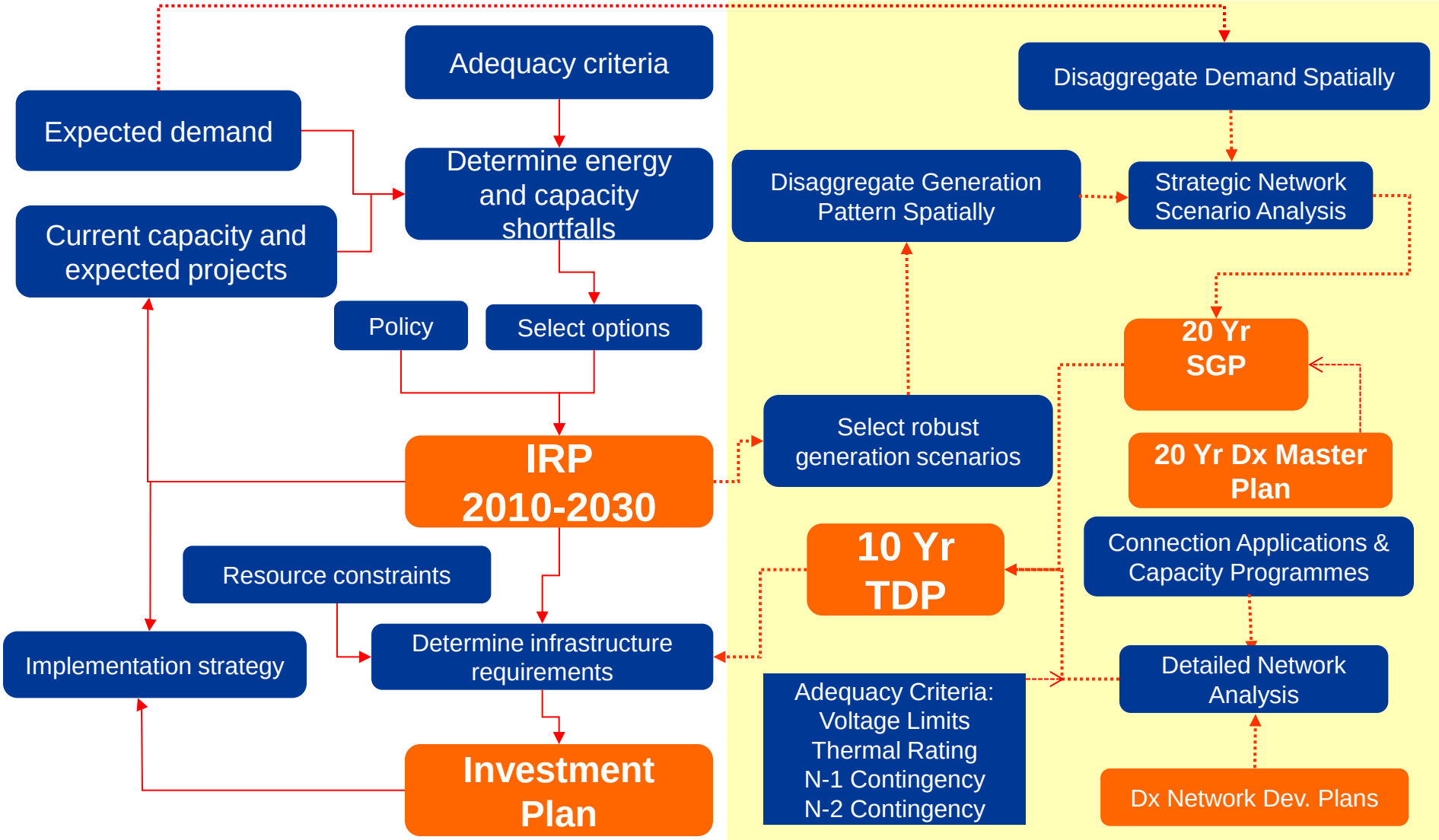
Thank you

TDP 2016 – 2025

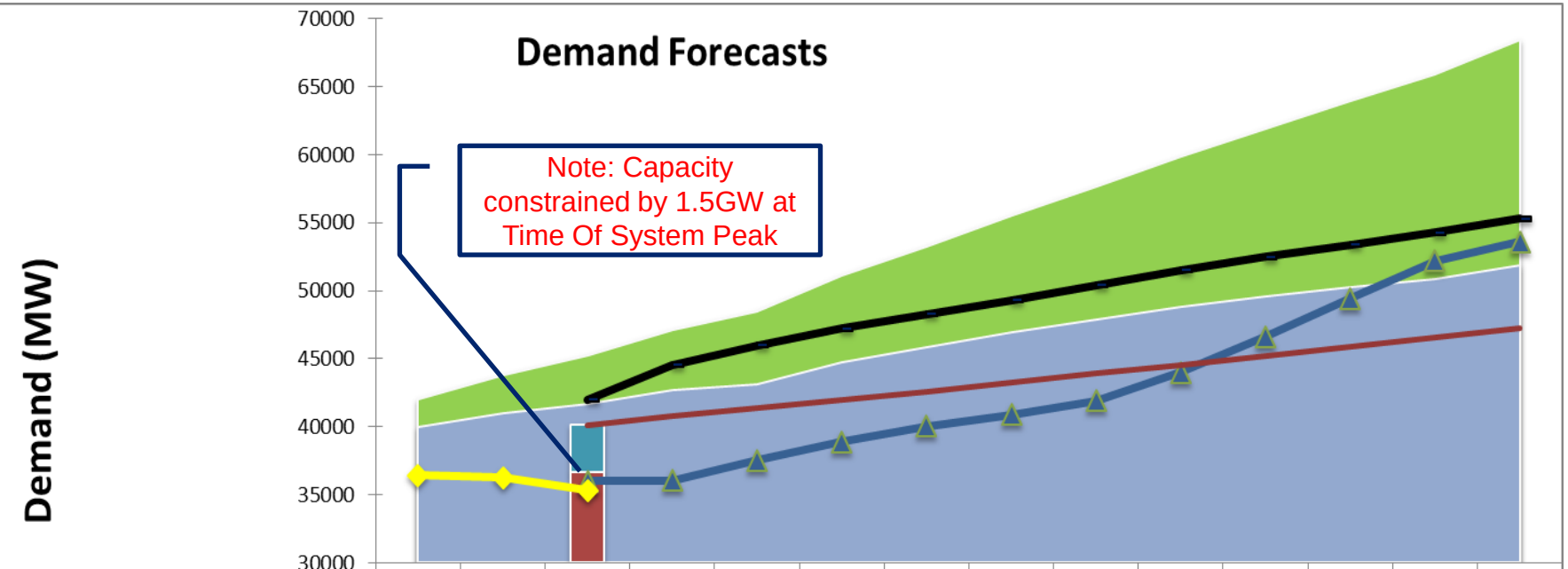
Overview

Presented by: Leslie Naidoo

Linkages between the various plans

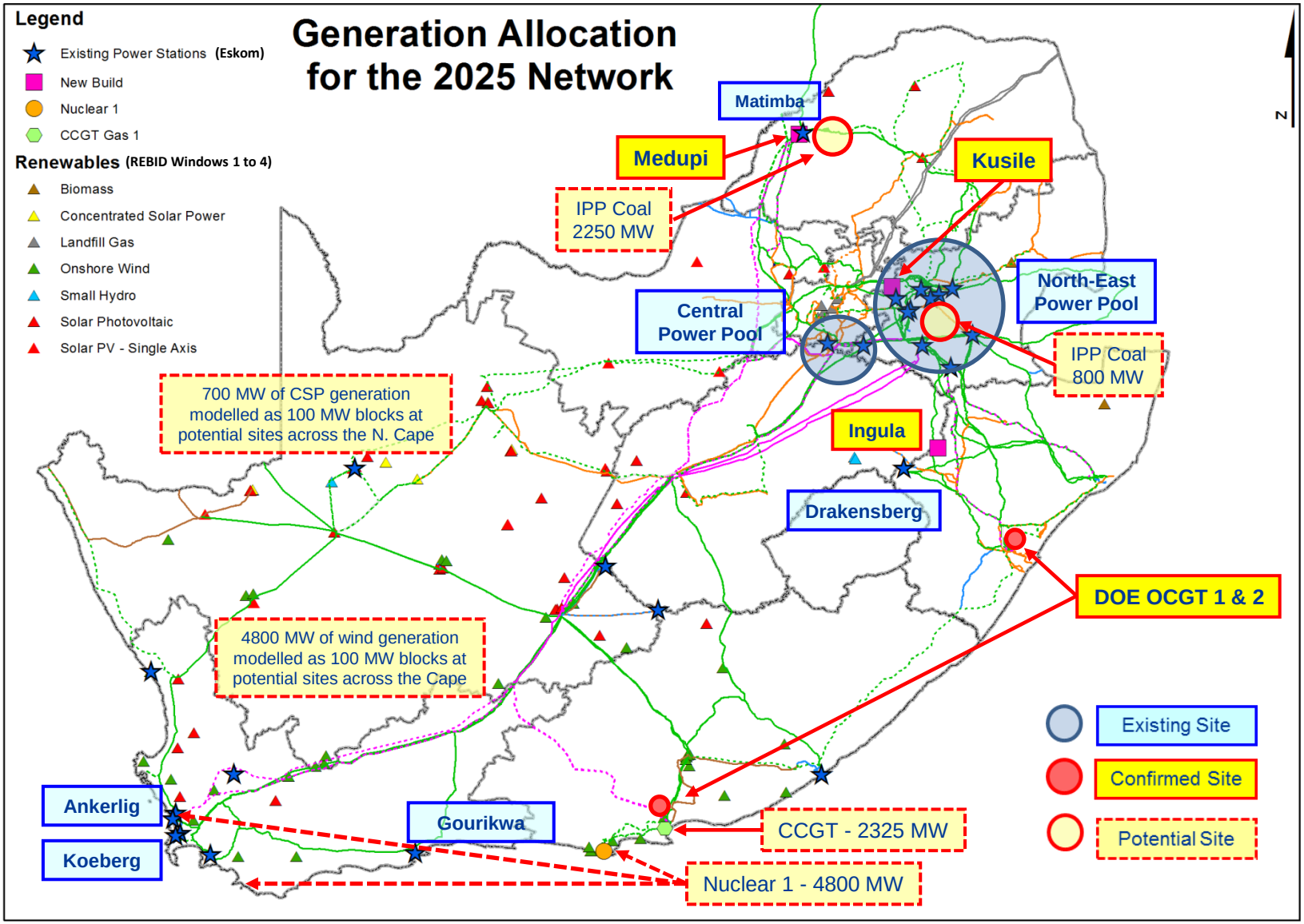


Assumed transmission capacity forecast and comparisons



	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
2010 IRP High Demand (MW)	42027	43839	45255	47124	48479	51090	53276	55573	57649	59885	61932	63955	65870	68458
2010 IRP Low Demand (MW)	40002	41040	41669	42666	43157	44710	45815	46952	47848	48828	49596	50299	50872	51903
Mid Size Customer NMD (MW)			3472											
Top Customer NMD (MW)			36676											
2015 TDP Demand (MW) - Constrained			36000	36065	37536	38885	40036	40904	41921	43990	46629	49427	52193	53600
2015 TDP Demand (MW) - Unconstrained			42000	44536	45998	47220	48271	49328	50398	51528	52501	53403	54296	55310
Actual Peak Demand (MW)	36437	36276	35343											
NMD growth at 1.5%			40148	40750	41361	41982	42612	43251	43900	44558	45226	45905	46593	47292

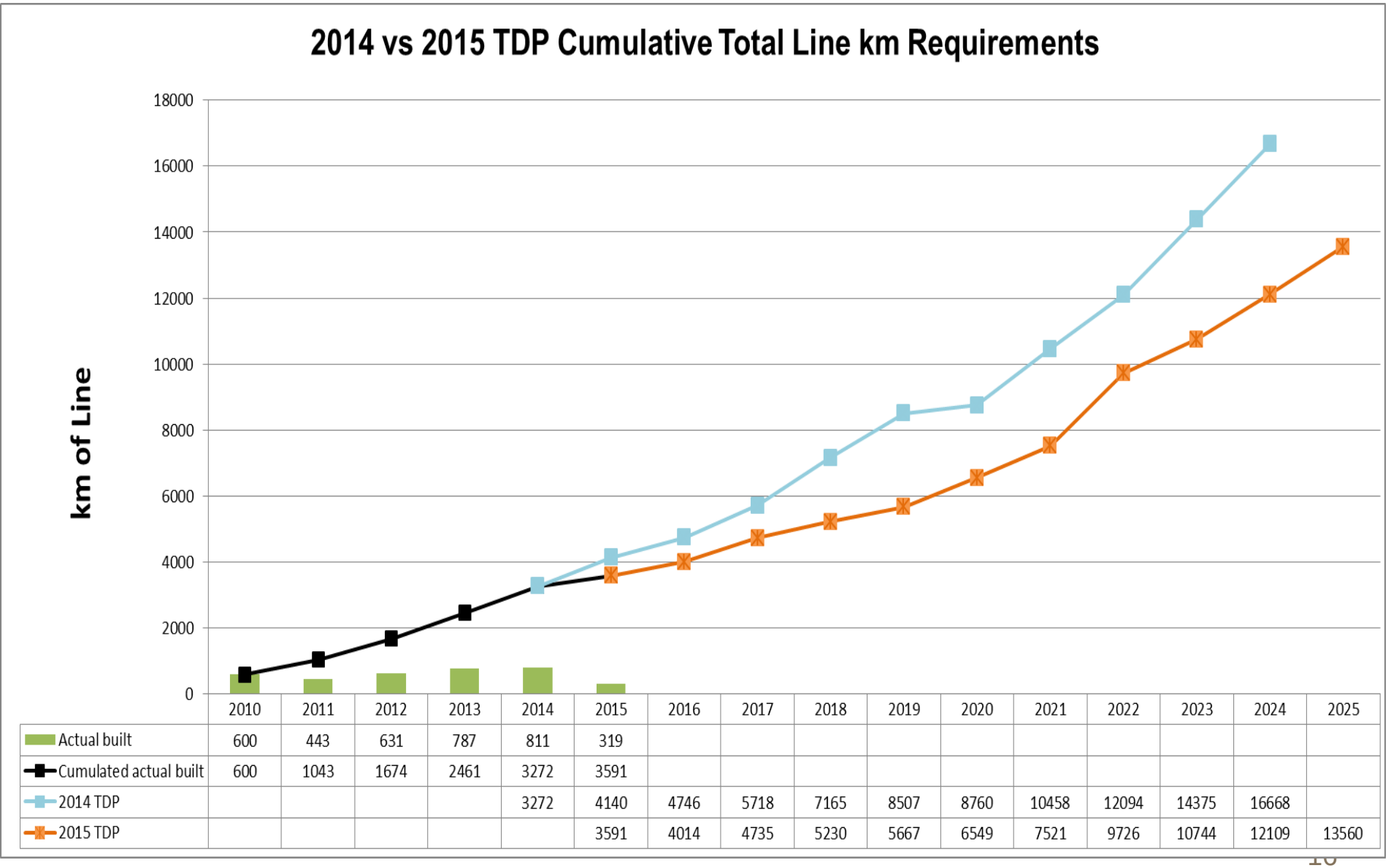
Assumed generation pattern based on IRP 2010



Summary of Transmission Infrastructure Requirements over the TDP Period

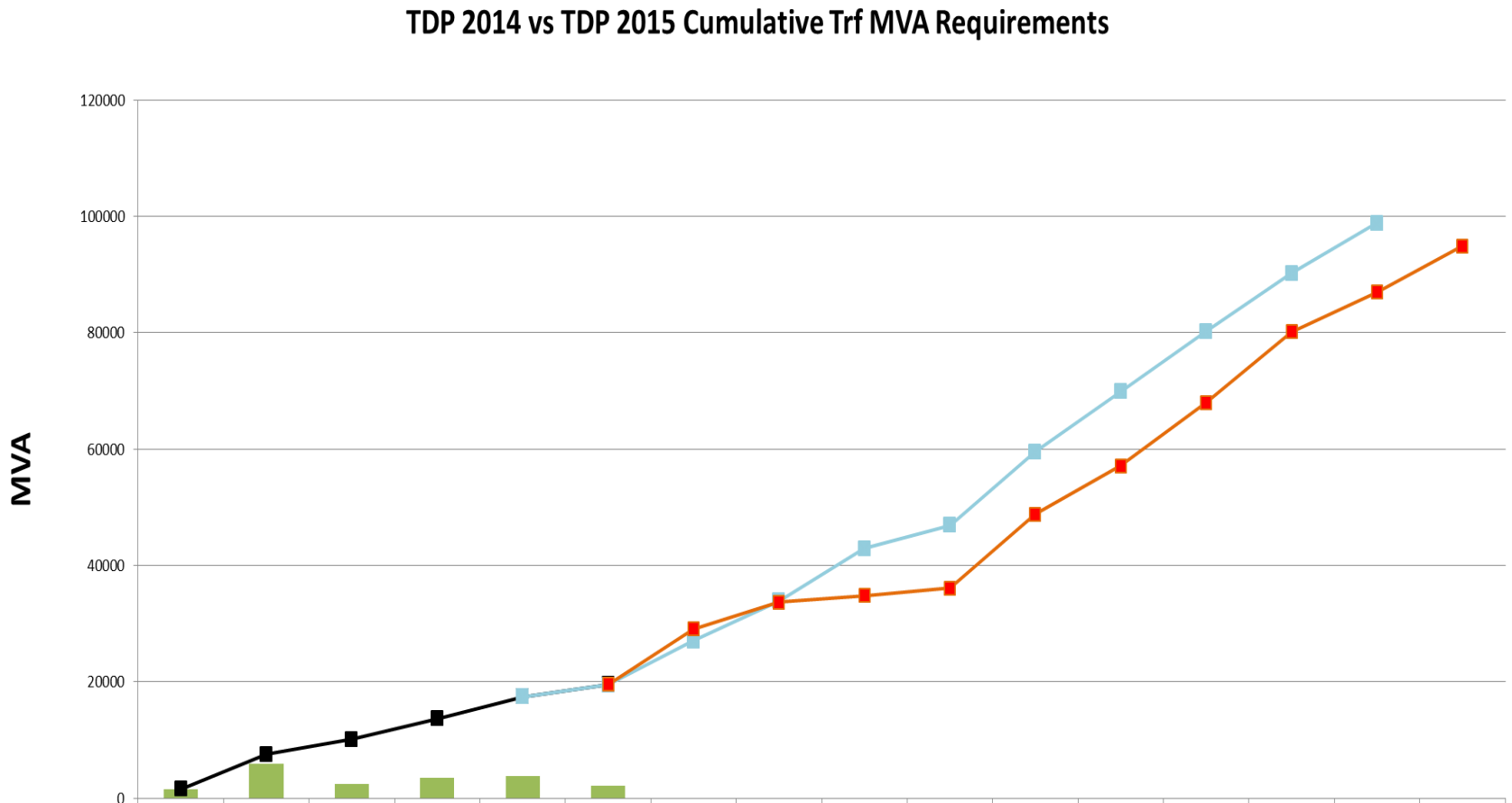
Transmission Assets	New assets expected in 2016 - 2020	New assets expected in 2021 - 2025	Total new assets
Total Kms of lines	**2958**	**7011**	**9969**
765kV lines (km)	350	1760	**2110**
400kV lines (km)	2589	4915	**7504**
275kV lines (km)	19	336	**355**
Total Transformer MVA	**29240**	**46155**	**75395**
Transformers (no)	71	94	165
Capacitors (no)	15	6	21
Reactors (no)	6	15	21

Cumulative line requirements



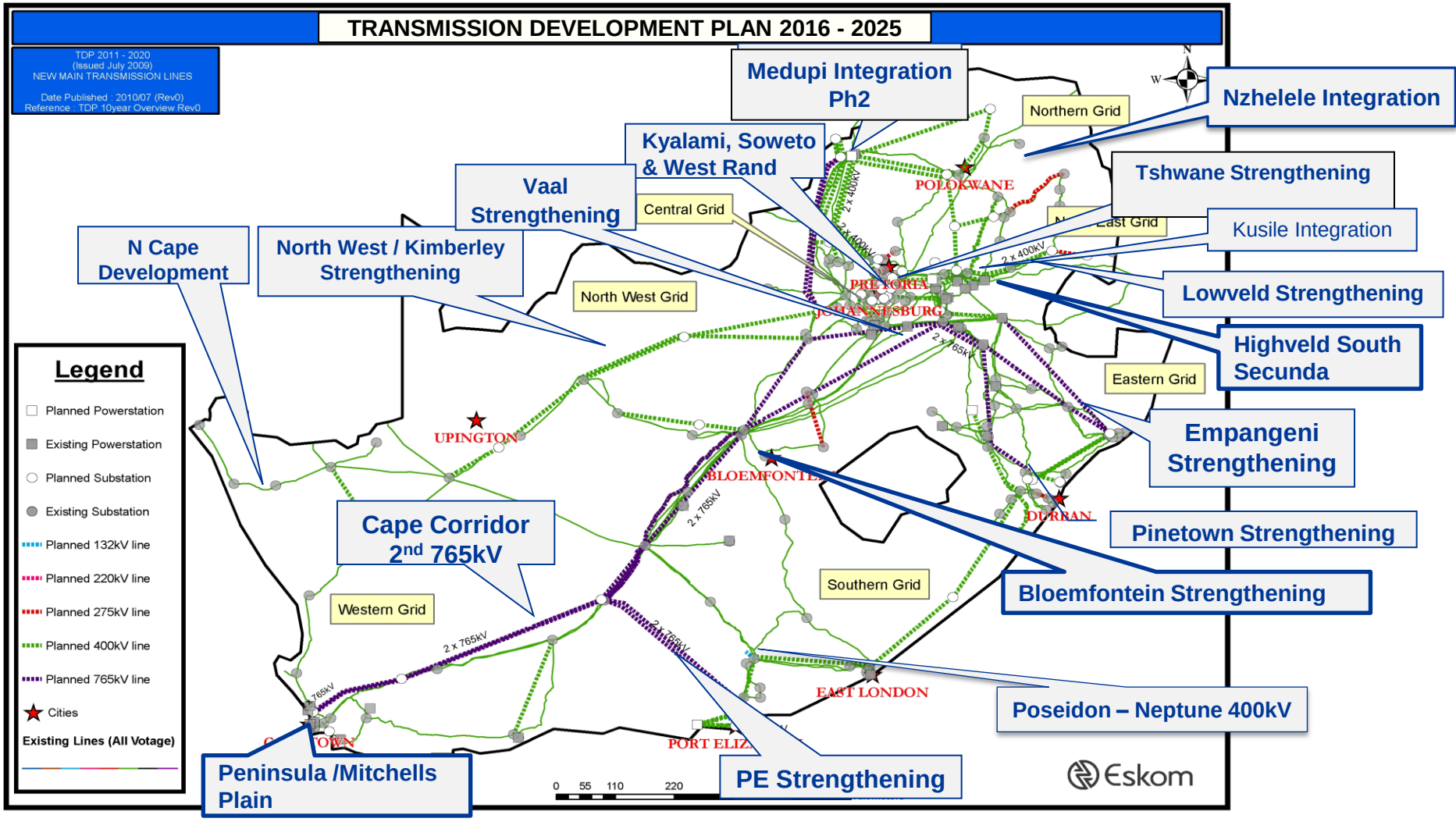
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Actual built	600	443	631	787	811	319										
Cumulated actual built	600	1043	1674	2461	3272	3591										
2014 TDP					3272	4140	4746	5718	7165	8507	8760	10458	12094	14375	16668	
2015 TDP						3591	4014	4735	5230	5667	6549	7521	9726	10744	12109	13560

Cumulative transformer requirements

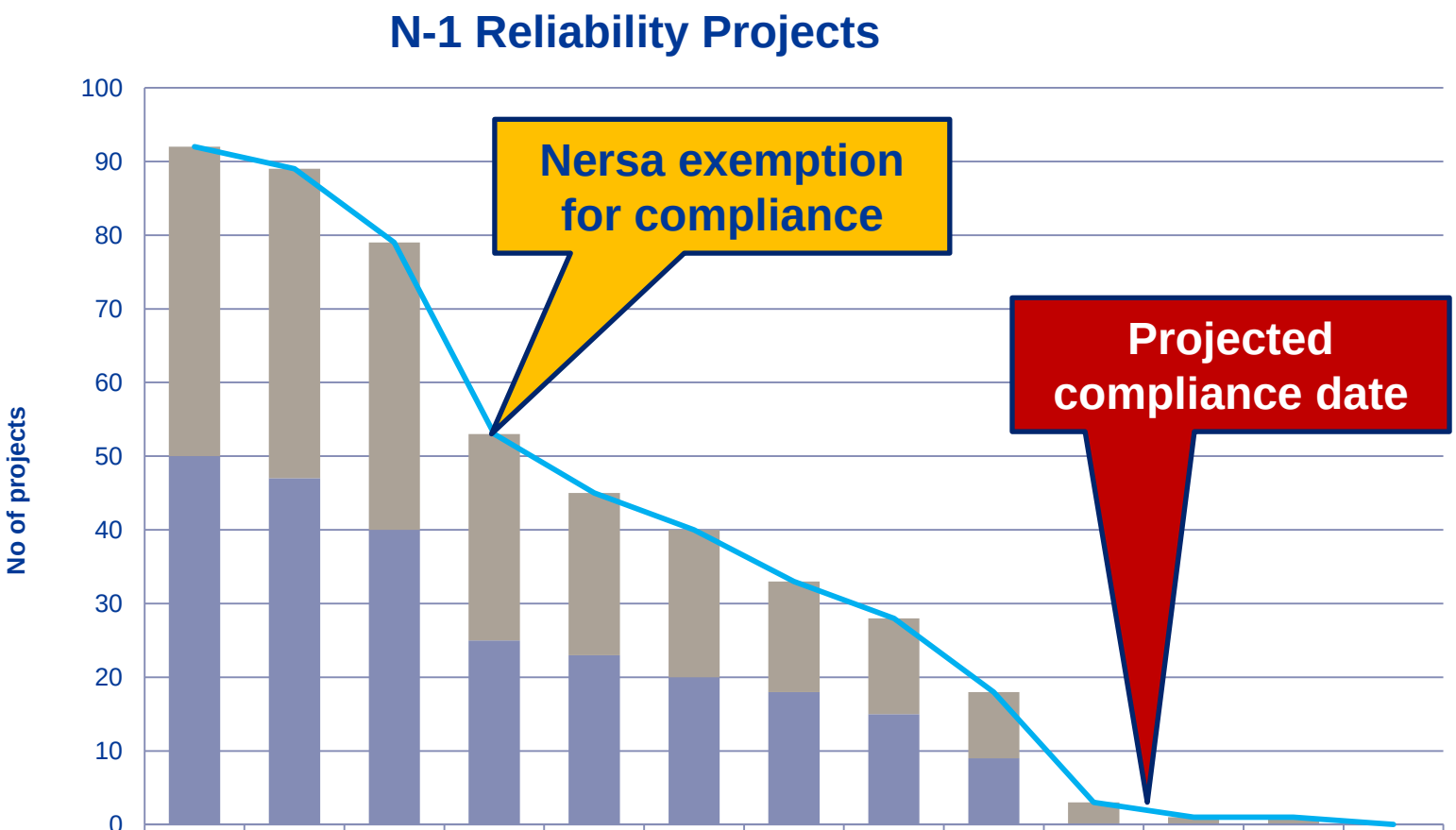


	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Actual Installed	1630	5940	2525	3580	3790	2090										
Actual Installed Cumulated	1630	7570	10095	13675	17465	19555										
2014 TDP					17465	19485	27065	33920	42955	46955	59575	69875	80290	90235	98850	
2015 TDP						19555	29100	33730	34855	36125	48795	57115	68010	80205	86950	94950

Major projects planned for in the TDP period



N-1 Compliance outlook with the reprioritised plan



	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Substation Violations	42	42	39	28	22	20	15	13	9	3	1	1	0
Corridor Violations	50	47	40	25	23	20	18	15	9	0	0	0	0
Total Violations	92	89	79	53	45	40	33	28	18	3	1	1	0

Note. The 2022 date is based on the assumption that the Transmission Capital Plan for the N-1 projects will be adequately resourced from the MYPD4 period and beyond

TDP 2016 - 2025

Provincial Plans

North-West Province

TDP 2016 - 2025

Presented by: Queen Melato

North-West Province Profile

Generation:

- Matimba Power Station in Limpopo Province
- Medupi Power Station

Economic activity:

- Mining , Industrial , Re-distributors
- Commercial, Agricultural and Residential

Load drivers (Rustenburg CLN):

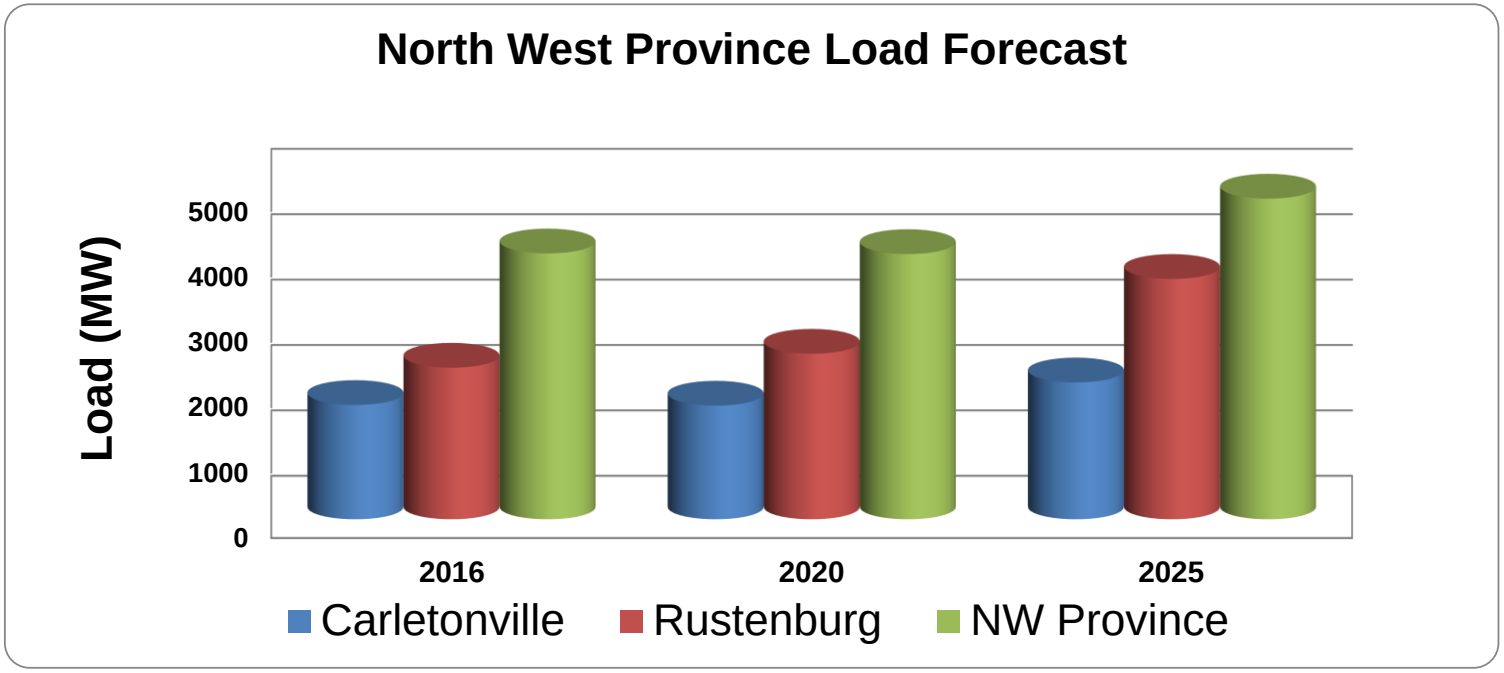
- Platinum mining and smelting operations
- Home to the largest platinum refinery; and two largest platinum mines
- The 4th largest integrated ferrochrome producer

  is based in the North West Province

Load drivers (Carletonville CLN):

- Richest gold-producing hub
- Supplies predominantly gold mines
- One of South Africa's largest Game Reserves

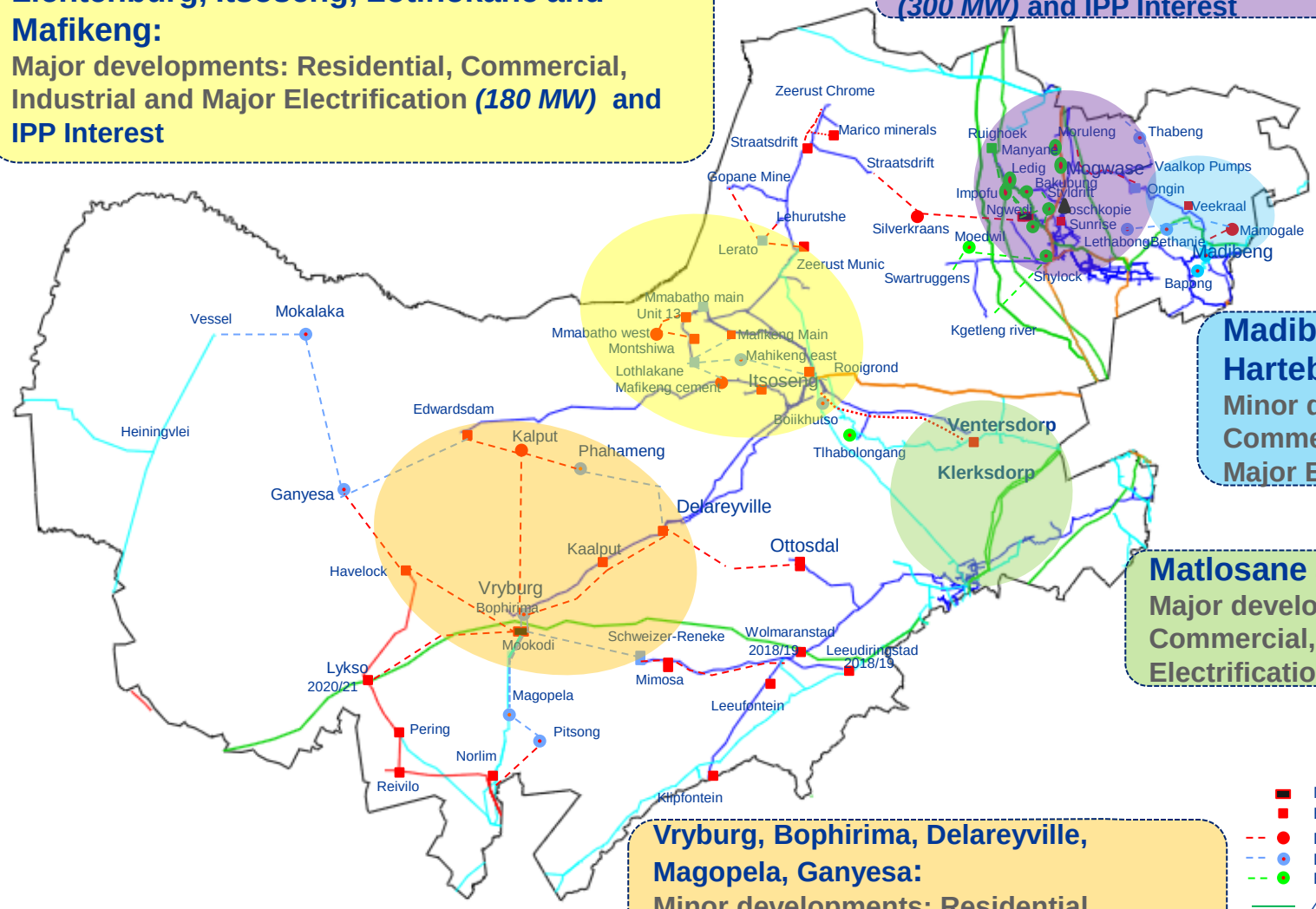
Electricity Demand Forecast



NWOU NDP's Major Projects

Lichtenburg, Itsoseng, Lotlhokane and Mafikeng:
Major developments: Residential, Commercial, Industrial and Major Electrification *(180 MW)* and IPP Interest

Ruighoek, Manyane, Mogwase and Sun City:
Major developments: Mining, Commercial, Industrial *(300 MW)* and IPP Interest



Madibeng, Brits and Hartebeespoort:
Minor developments: Commercial, Industrial and Major Electrification *(100 MW)*

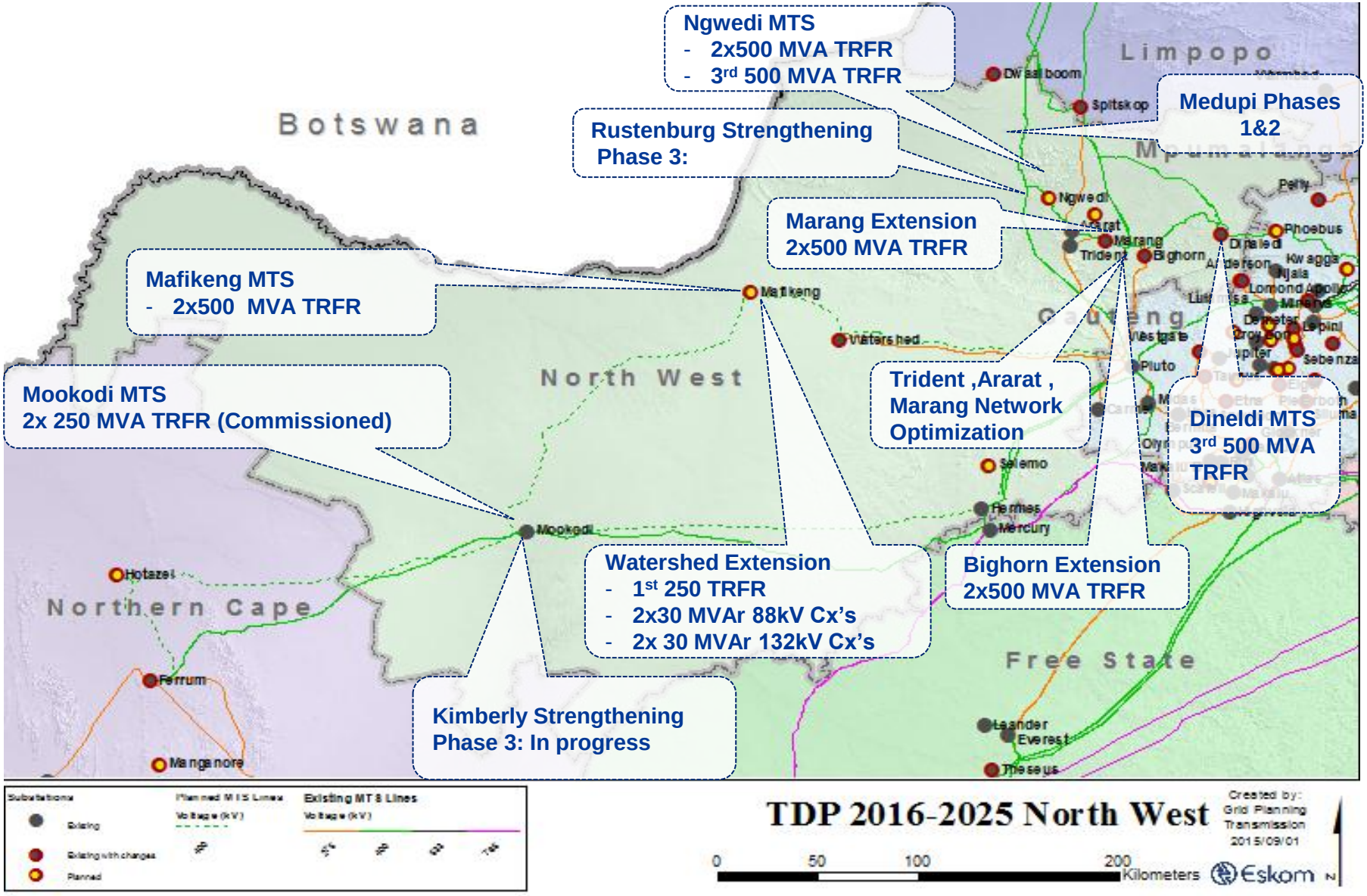
Matlosane and Potchefstroom:
Major developments: Residential, Commercial, Industrial & Major Electrification *(180 MW)*

Vryburg, Bophirima, Delareyville, Magopela, Ganyesa:
Minor developments: Residential, Industrial and Major Electrification – *(250 MW)*

Legend

- New Main Transmission Substation
- Existing HV/MV substations to be upgraded
- DPA/CRA new substation/line projects
- DRA new substation/line projects
- ERA new substation/line projects
- 400kV Line
- 275kV Line
- 132kV Line
- 88kV Line

Provincial TDP Overview



Thank you

Gauteng Province

TDP 2016 - 2025

Presented by: Tonderayi Gumunyu

Gauteng Province Profile

Generation

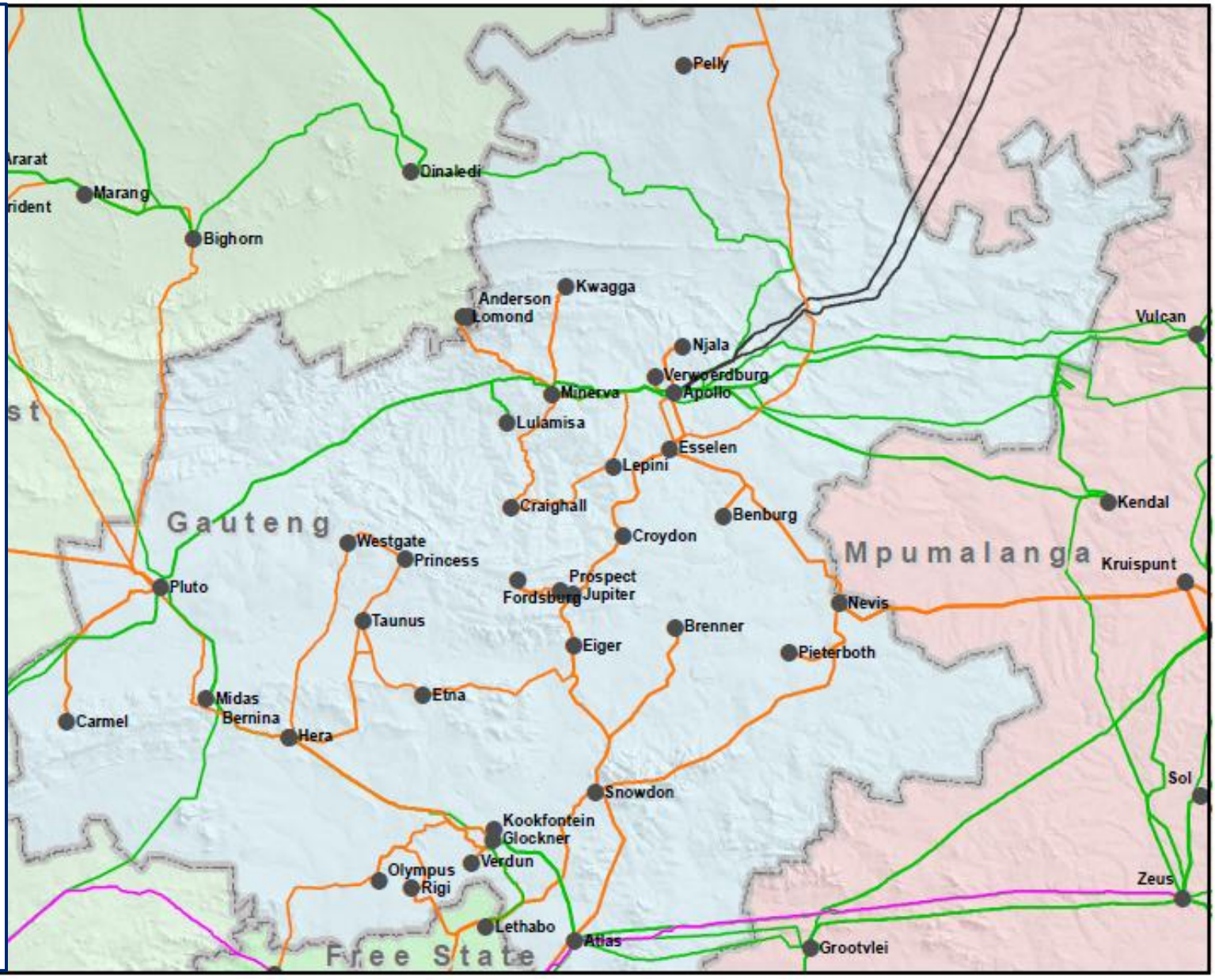
- Bulk supply from Mpumalanga, Free State, Lephalale and Apollo HVDC (from Mozambique)
- Independent Power Producers - Kelvin Power Station (Joburg), Rooiwal Power Station (Tshwane)

Geographical area

- Johannesburg North, Johannesburg South, East Rand, Vaal, West Rand and Tshwane

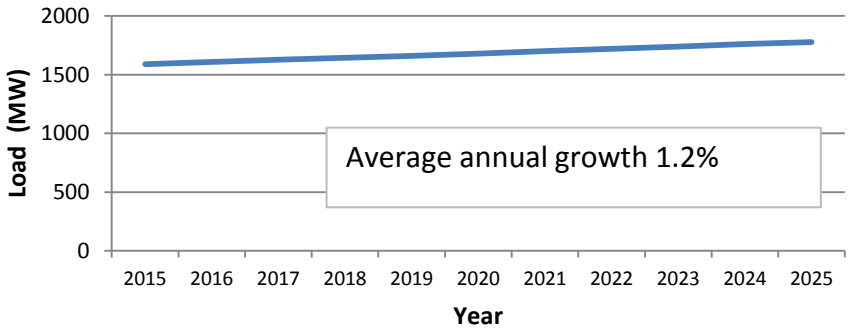
Economic Activity

- Major Customers: Re-distributors, residential and large commercial customers

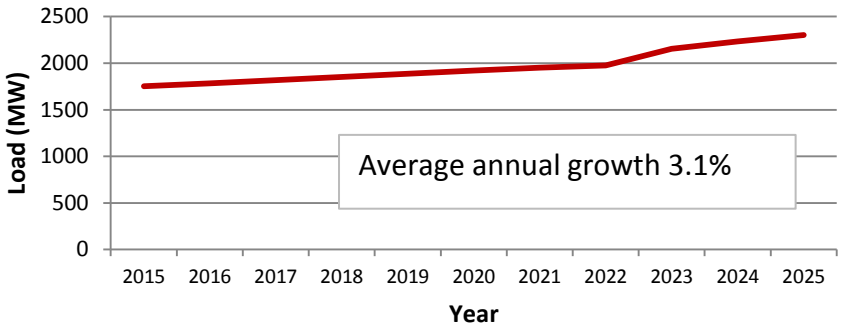


Gauteng growth trend

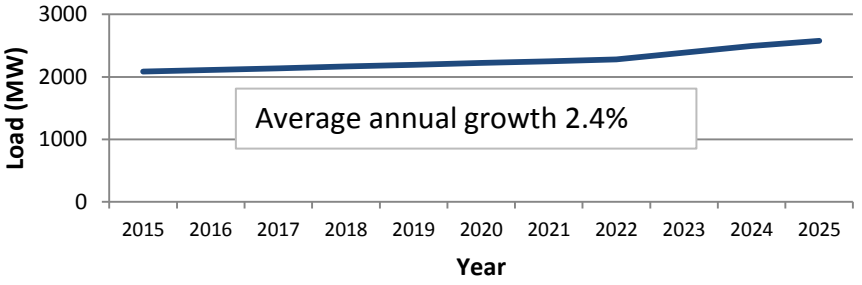
Vaal CLN Load forecast



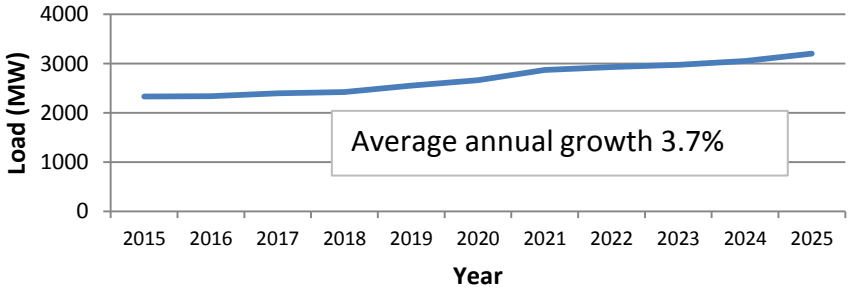
JHB North CLN Load Forecast



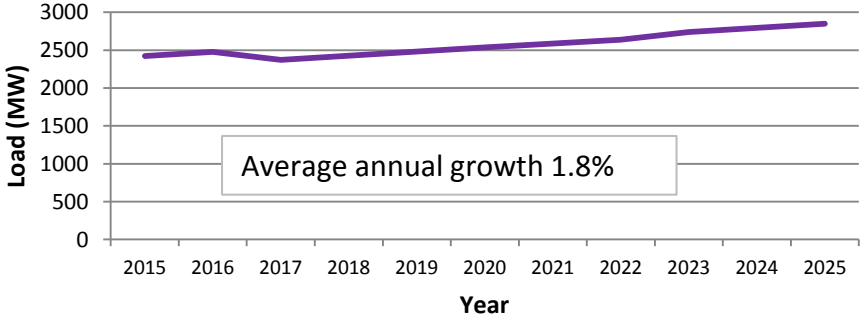
East Rand CLN Load Forecast



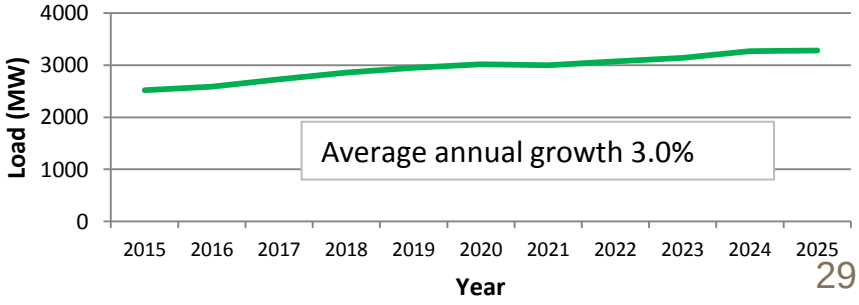
West Rand CLN Load Forecast



Tshwane CLN Load Forecast

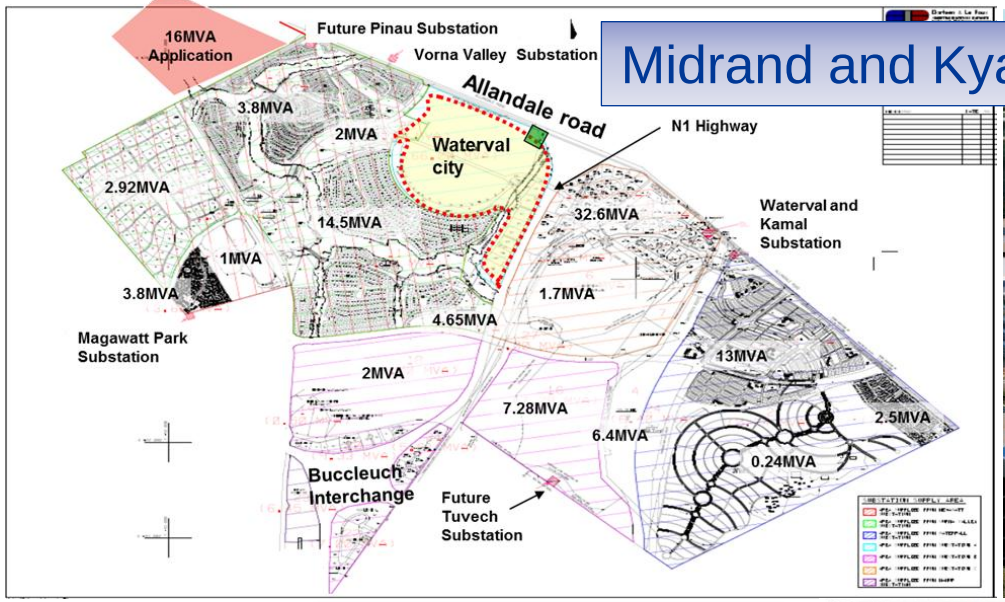


JHB South CLN Load Forecast



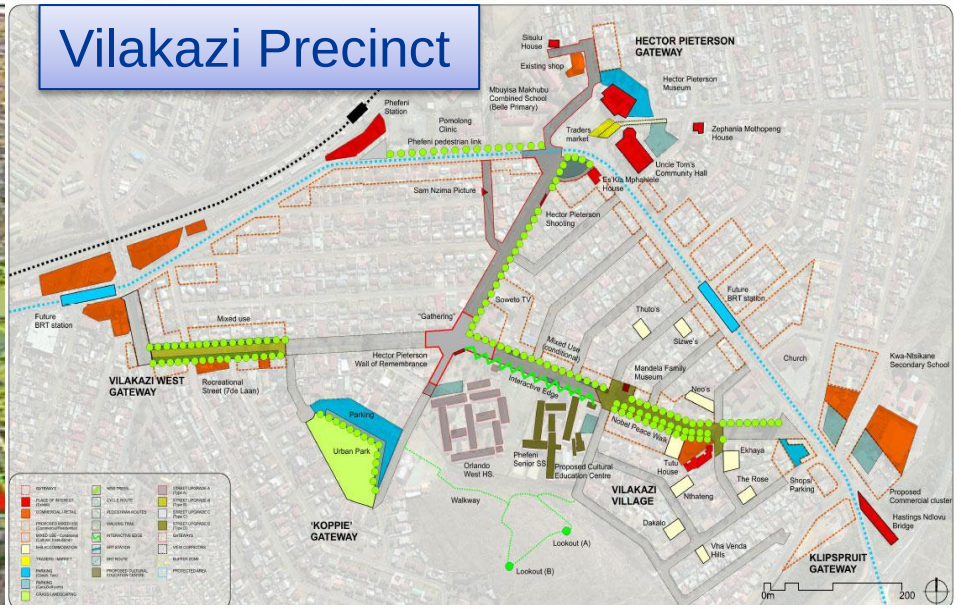
Key developments in Joburg North/West Rand

Midrand and Kyalami

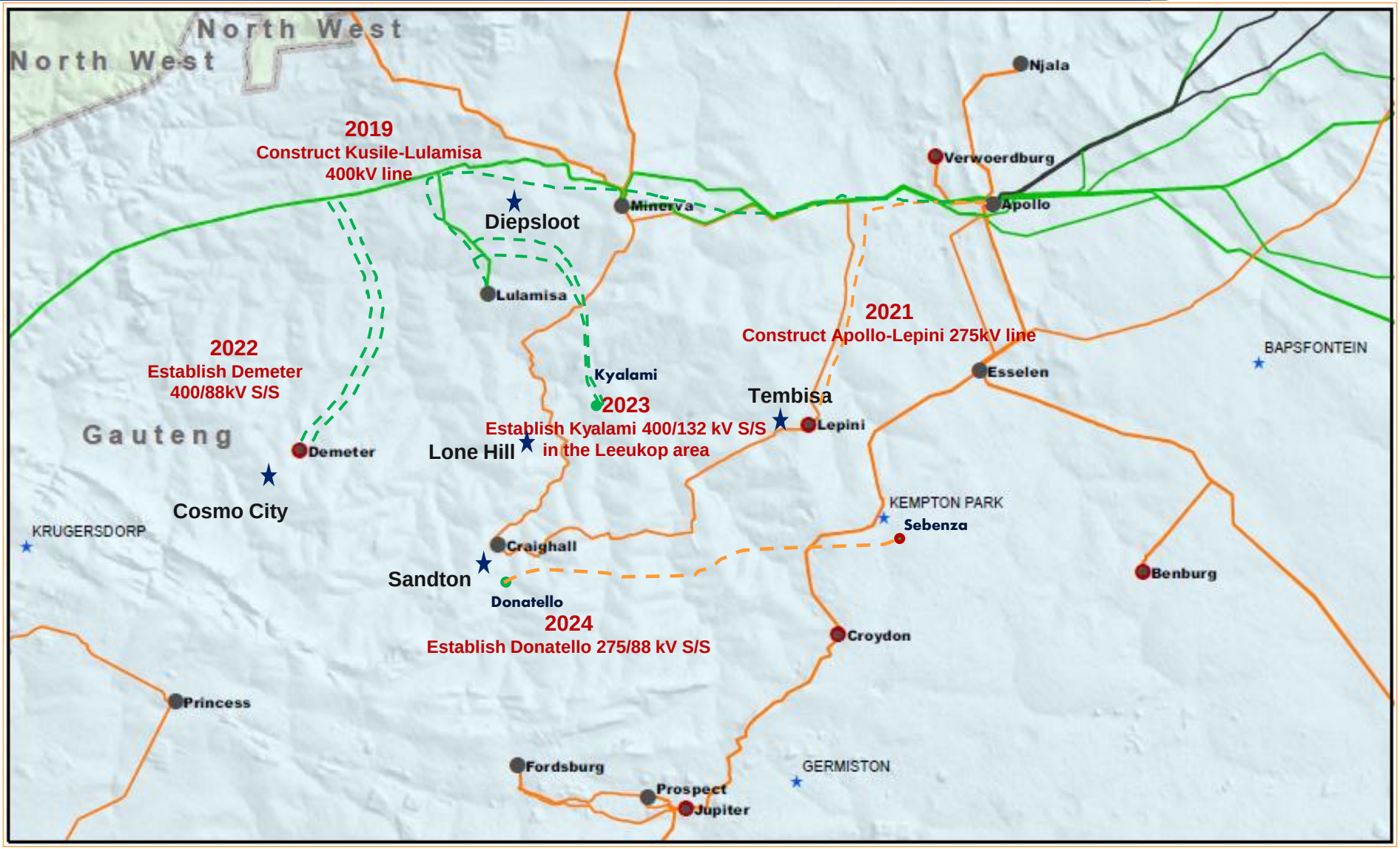


Orlando Precinct

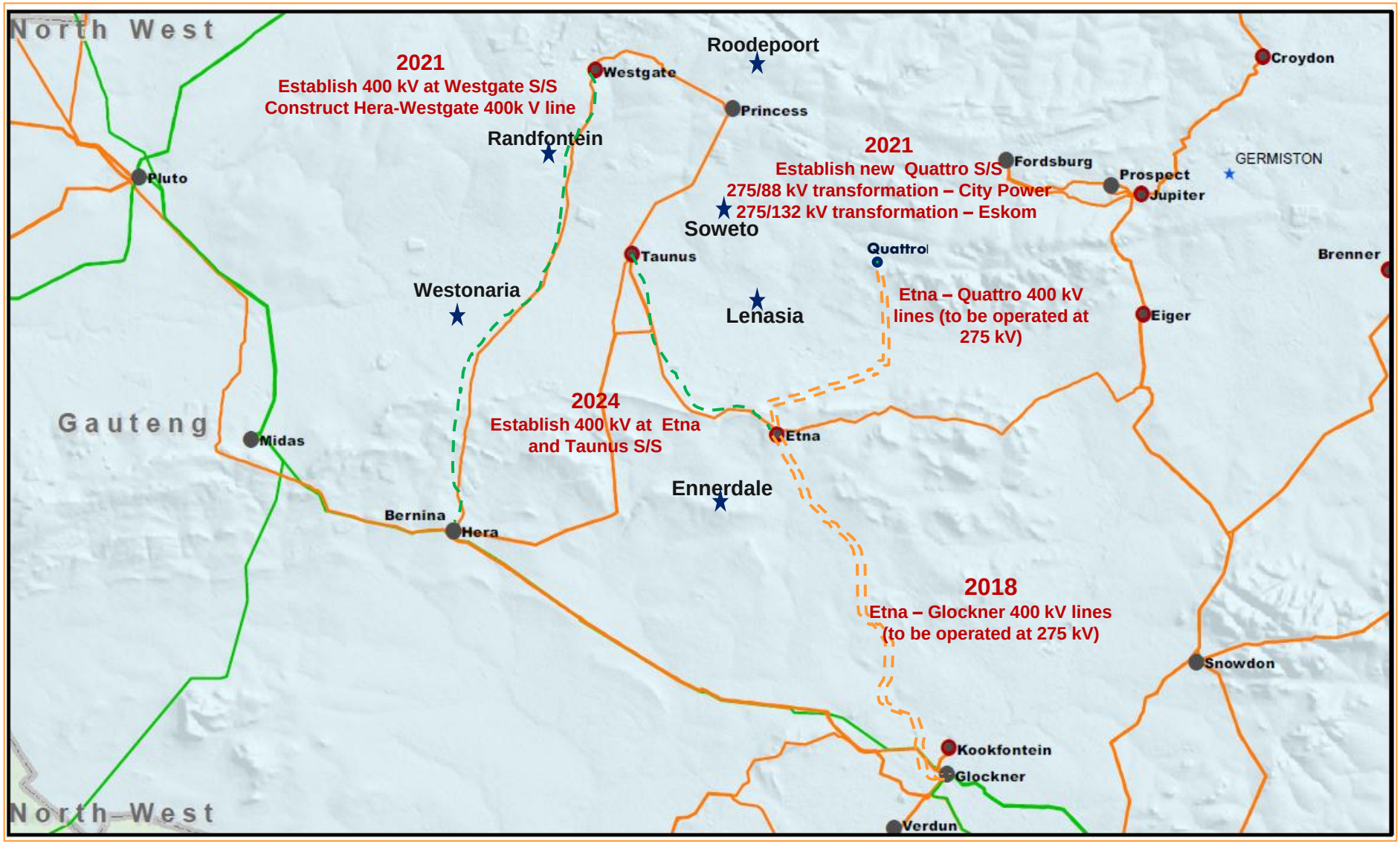
Vilakazi Precinct



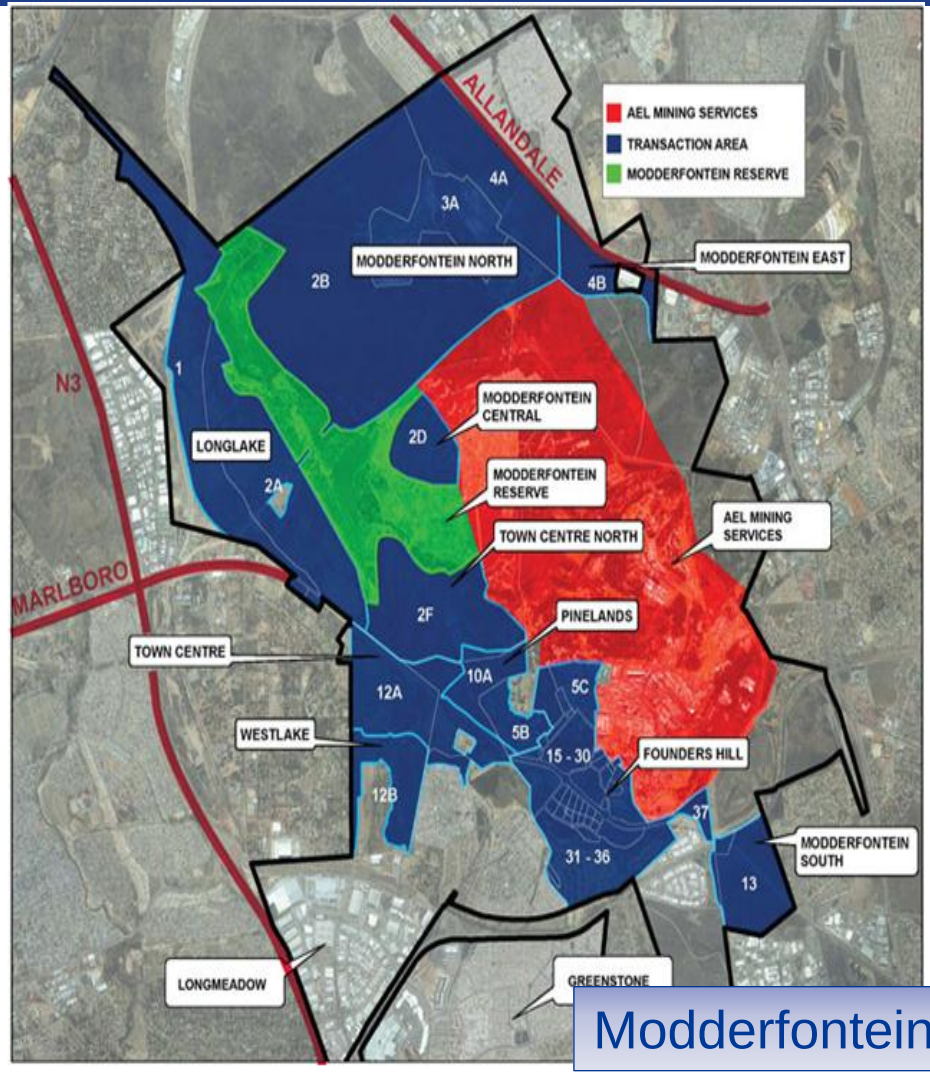
TDP Projects - JHB North Area

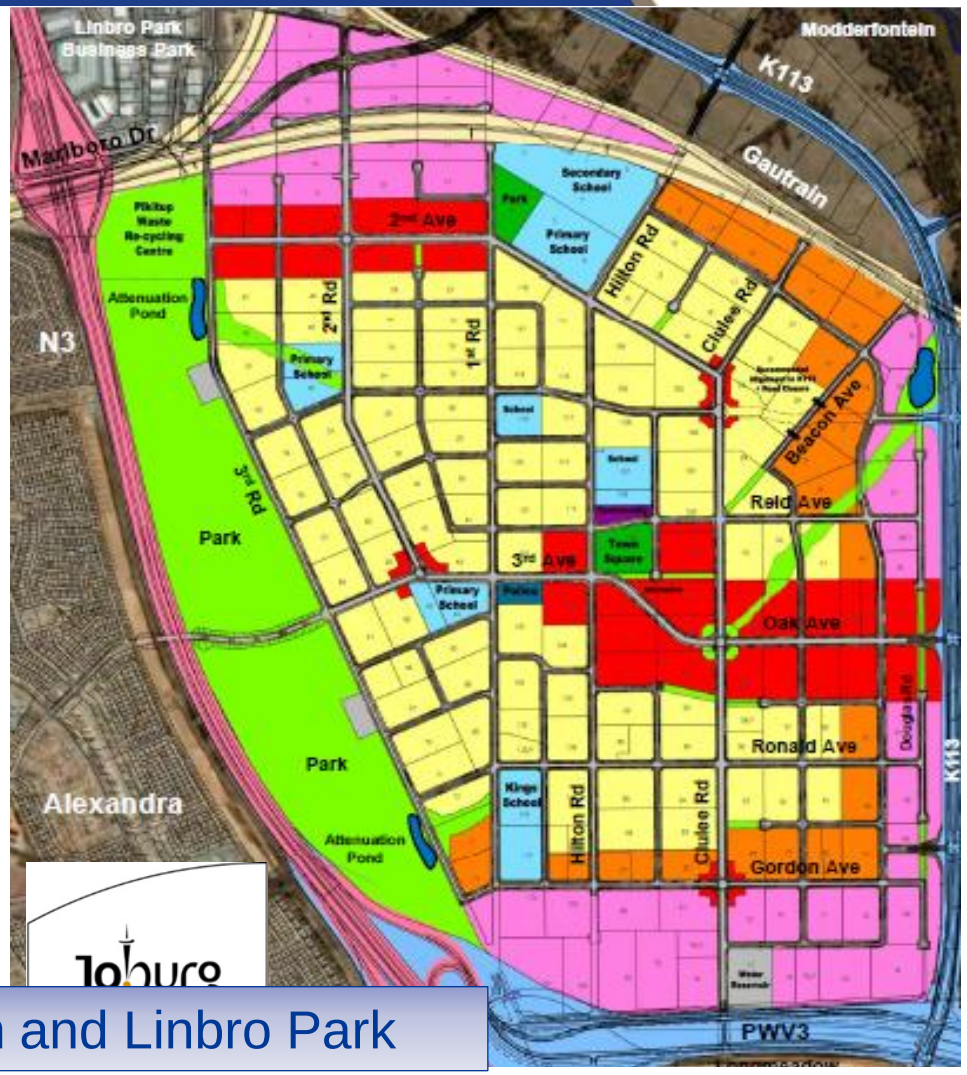


TDP Projects - West Rand and Vaal Areas



Key Developments in Joburg South/East Rand





Modderfontein and Linbro Park

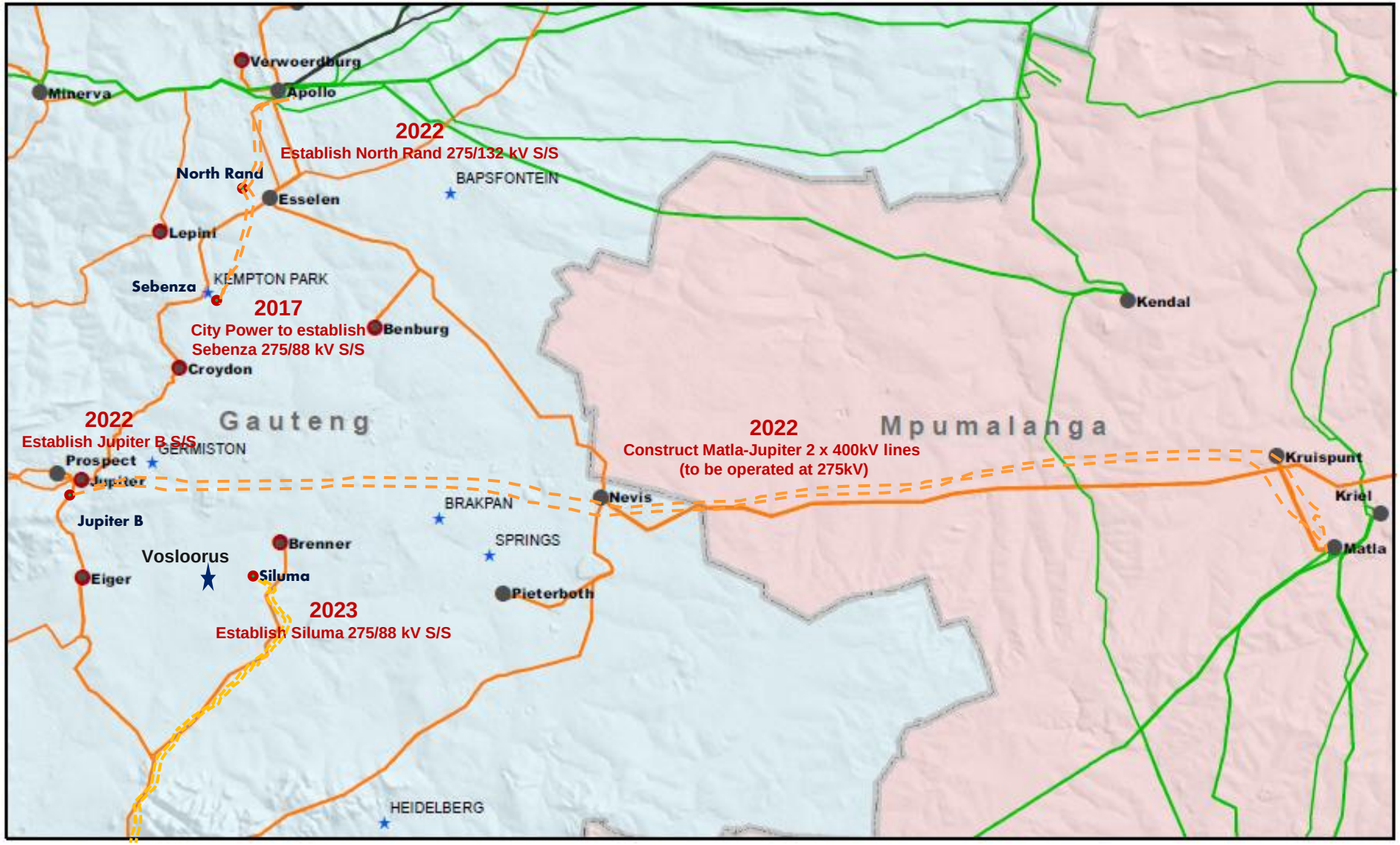
Zendai Modderfontein (Mixed Development)

- 30 000 Housing units, commercial and light industry envisaged
- Potential 200 000 jobs

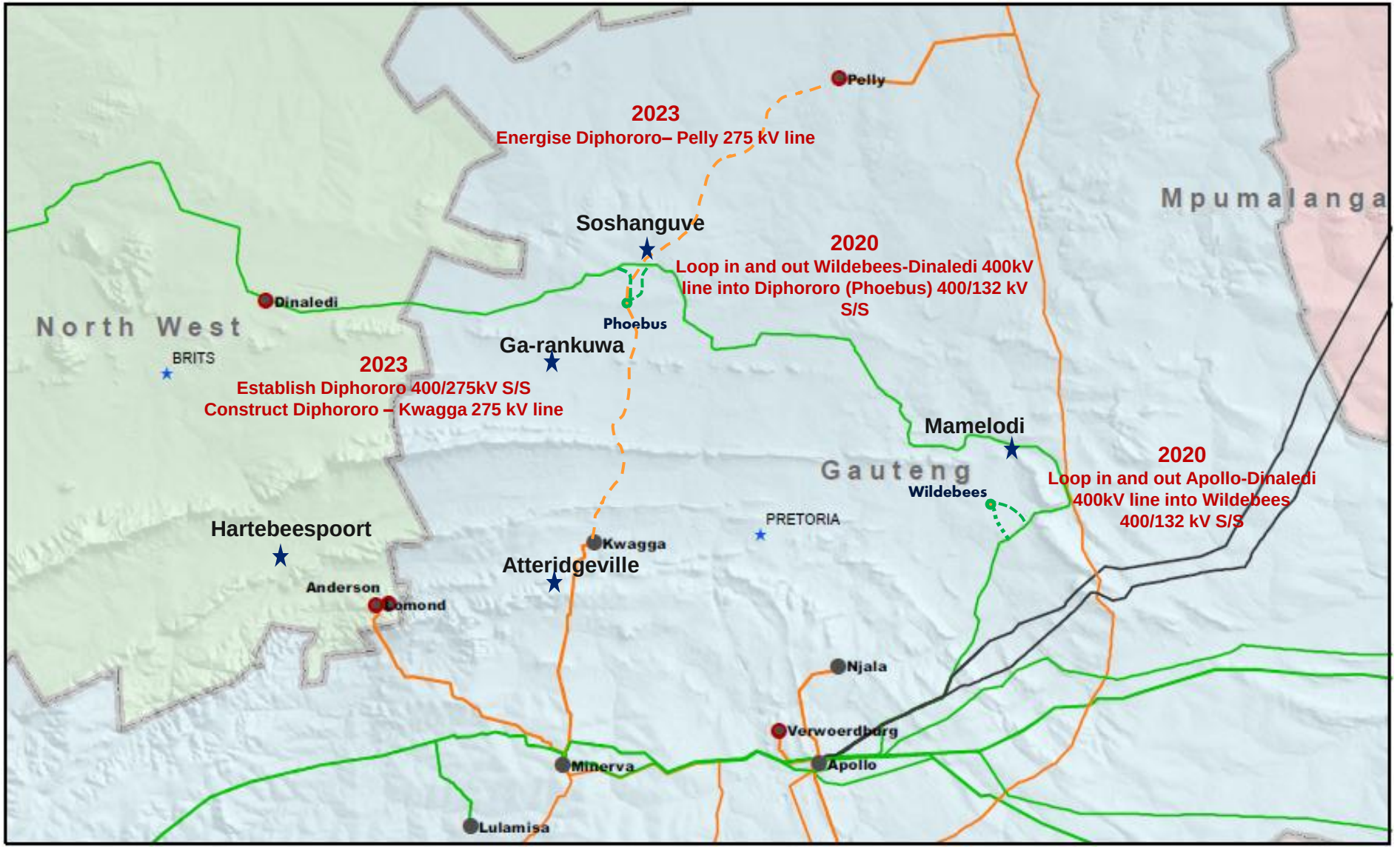
Linbro Park (Mixed Development)

- 20 000 Housing units, commercial and light industry envisaged
- Alexandra Township re-blocking

TDP Projects - JHB East and South Areas



TDP Projects - Tshwane Area



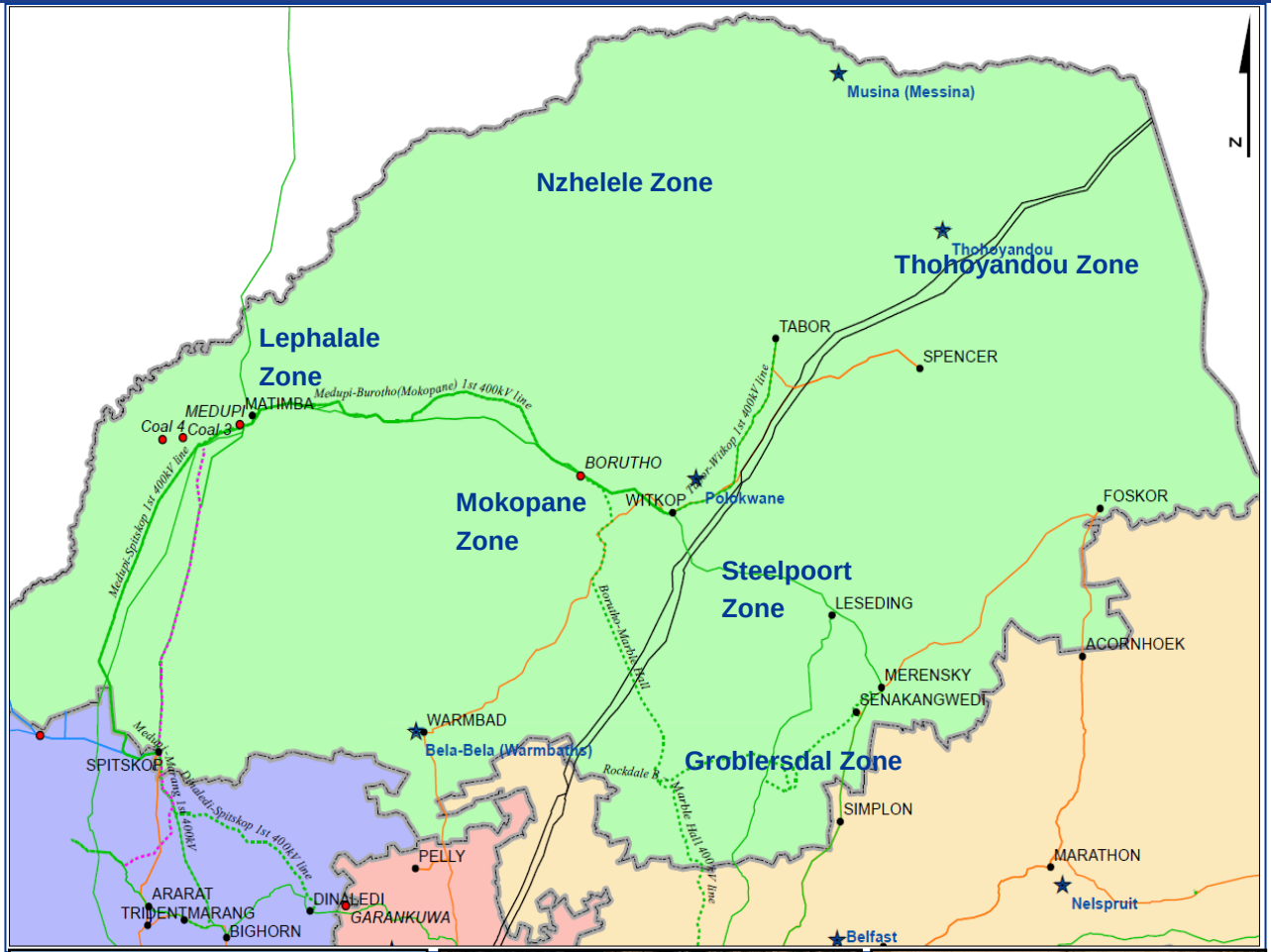
Thank you

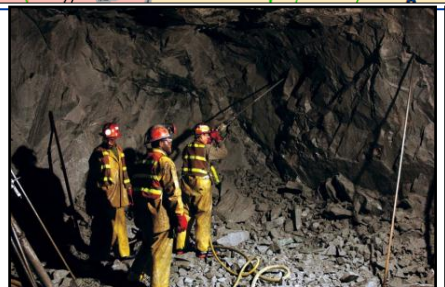
Limpopo Province

TDP 2016 - 2025

Presented by: Dalton Matshidza

Limpopo Province Profile





Generation

- Matimba Power Station = 3805 MW
- Medupi Power Station = 4800 MW (Under Construction)

Transmission

- Load demand = 2807 MW
- Number of Substations = 10
- Customer Load Networks = 3

(Polokwane, Lephalale and Phalaborwa)

General

- Economic mix - Platinum mining, Coal, high concentration of electrification, Game Farms, Industrial, Farming, Residential and Commercial, International Tie Line – Botswana

Key Developmental Areas

- Nzhelele/Thohoyandou Zone
- Mokopane Zone
- Lephalale Zone
- Steelpoort Zone
- Groblersdal Zone

Limpopo Province Network Expansion Drivers

Economic Activity (Growth):

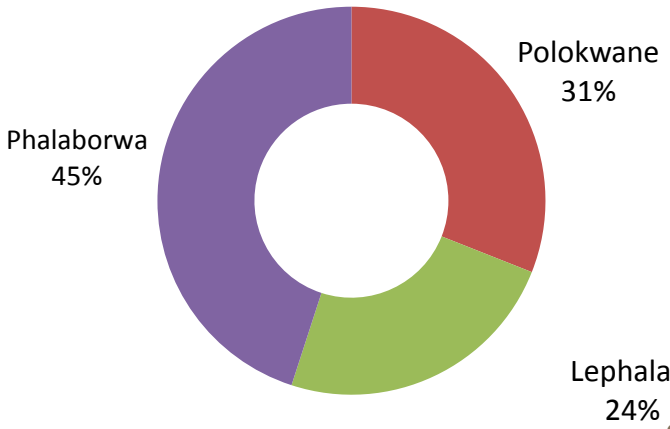
- Industrial 30%
- Mining 30%
- Commercial 5%
- Residential 20%
- Agricultural 5%
- Re-distributors 10%

Transmission Supply Areas (CLN's)	Percentage Growth	2016	2020	2025
Polokwane	3.13%	1 506	1 556	1 871
Lephalale	5.45%	866	1 240	1 383
Phalaborwa	7.61%	1 889	2 543	3390

Major Provincial Development Locations:

- Nzhelele Zone – Electrification, Agriculture, Industrial, Diamond and Coal mining
- Mokopane Zone – Platinum mining
- Lephalale Zone - Integration of Medupi Power Station and Coal mining
- Steelpoort Zone - Chrome and Platinum mining
- Groblersdal Zone - Electrification, Agriculture and Platinum mining

Limpopo CLN % Contribution to 2025 Load



Limpopo Province Network Expansion Drivers

Major Developments / Main Load Drivers

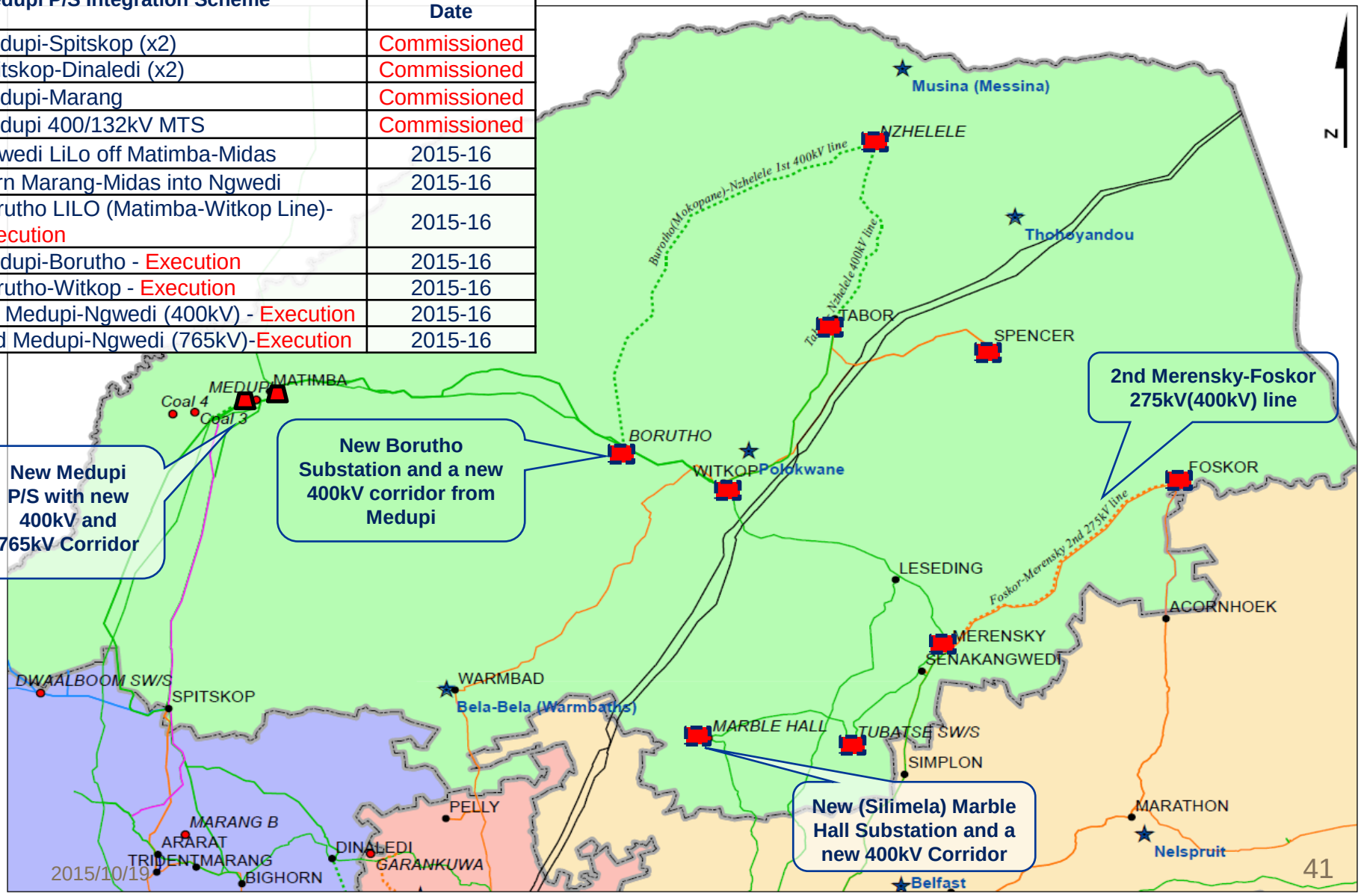
Nzhelele Substation Integration will supply Nzhelele/Thohoyandou – Electrification, Agriculture, Industrial, Diamond and Coal mining

Medupi Power Station – Coal mining in the Waterberg area (Lephalale) and the new 400kV and 765kV Corridor

Marble Hall and Steelpoort new Substations – Electrification, Chrome and Platinum mining in the Groblersdal and Steelpoort areas

Provincial overview of Limpopo Province
Key Corridor Projects & Medupi P/S Integration (2015 – 2019)

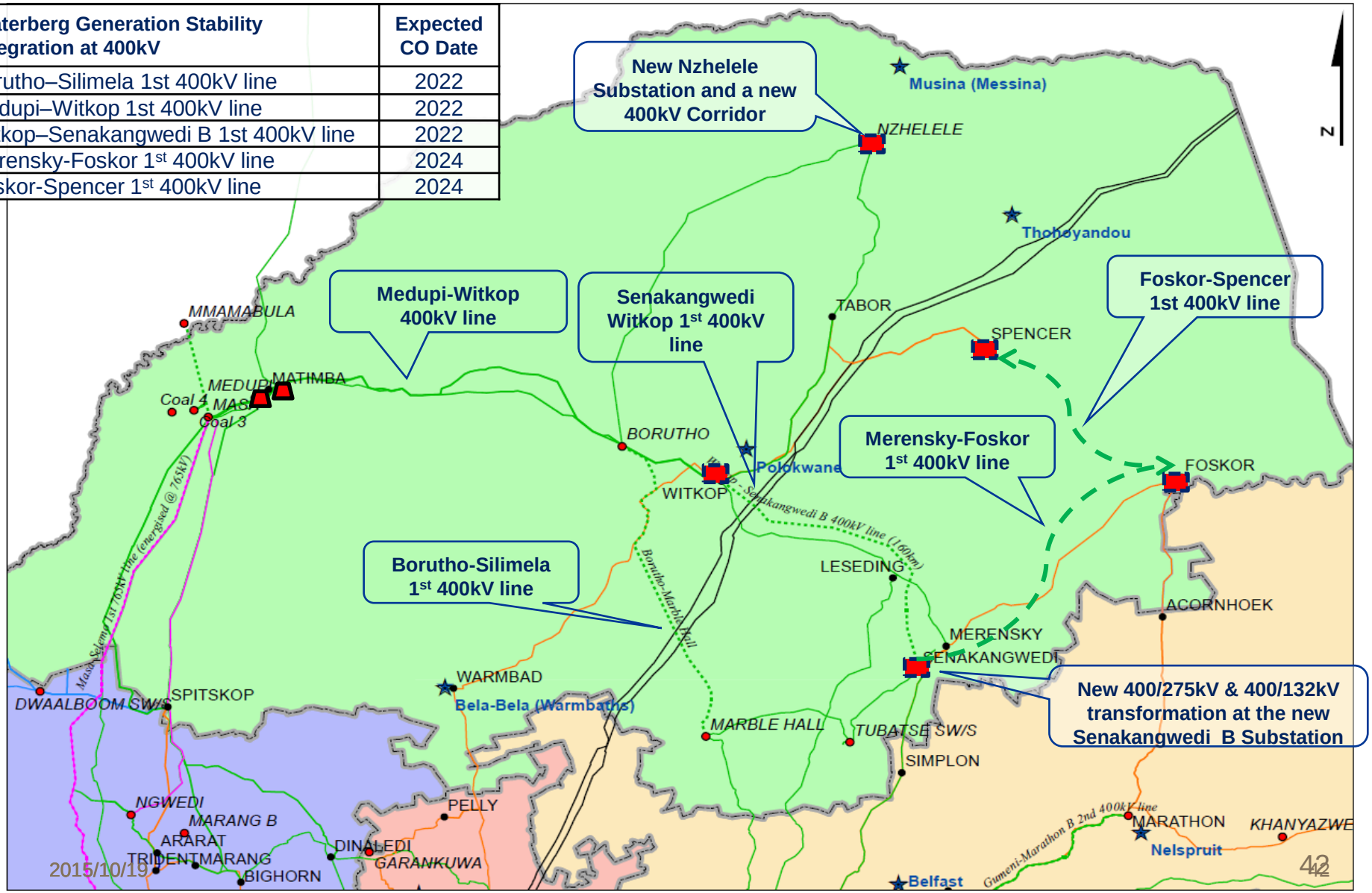
Medupi P/S Integration Scheme	Expected CO Date
Medupi-Spitskop (x2)	Commissioned
Spitskop-Dinaledi (x2)	Commissioned
Medupi-Marang	Commissioned
Medupi 400/132kV MTS	Commissioned
Ngwedi LiLo off Matimba-Midas	2015-16
Turn Marang-Midas into Ngwedi	2015-16
Borutho LILO (Matimba-Witkop Line)-Execution	2015-16
Medupi-Borutho - Execution	2015-16
Borutho-Witkop - Execution	2015-16
1st Medupi-Ngwedi (400kV) - Execution	2015-16
2nd Medupi-Ngwedi (765kV)-Execution	2015-16



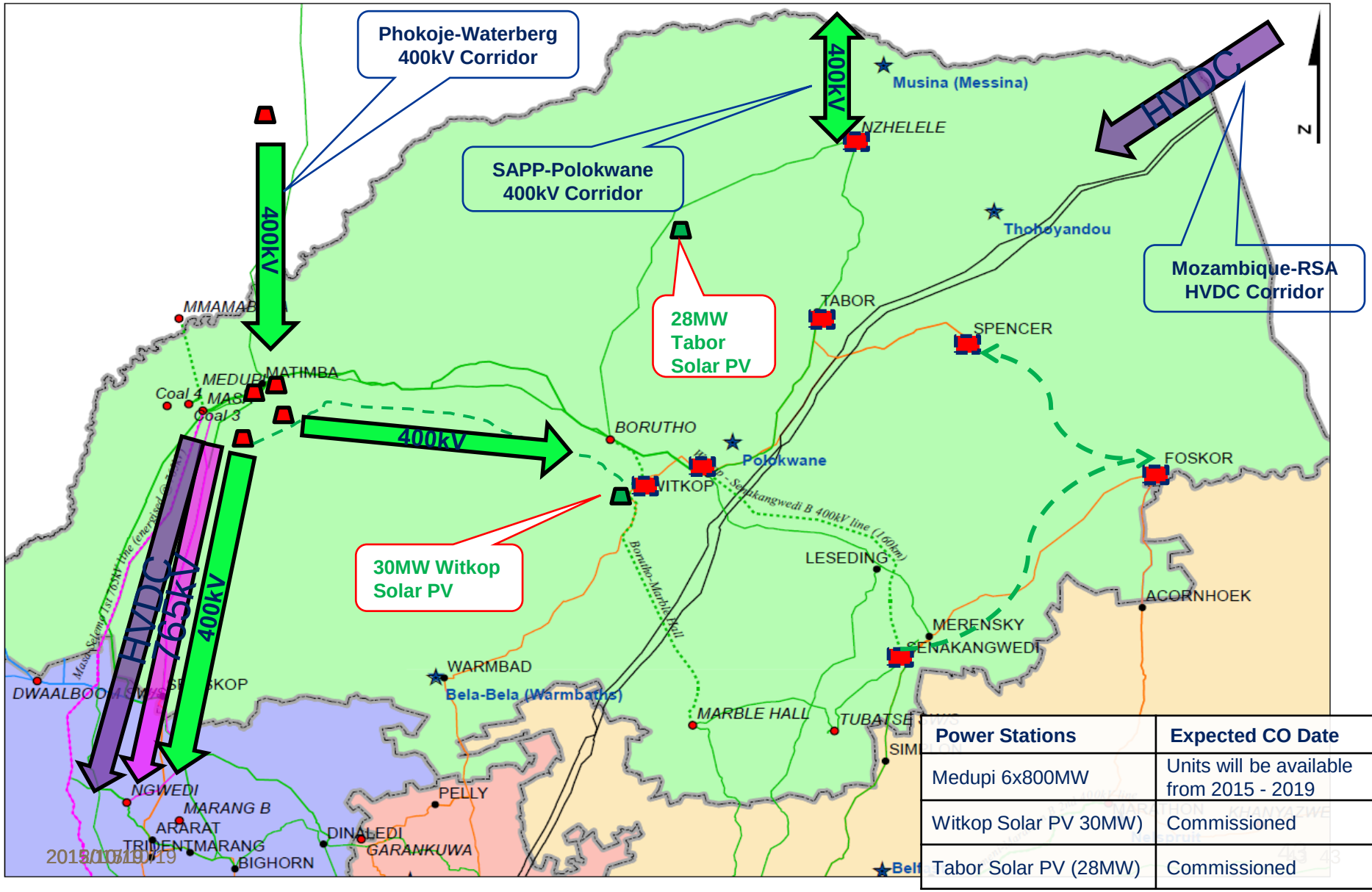
Provincial overview of Limpopo Province

Key Corridor Projects & Waterberg Generation Integration (2019 – 2025)

Waterberg Generation Stability Integration at 400kV	Expected CO Date
Borutho–Silimela 1st 400kV line	2022
Medupi–Witkop 1st 400kV line	2022
Witkop–Senakangwedi B 1st 400kV line	2022
Merensky-Foskor 1st 400kV line	2024
Foskor-Spencer 1st 400kV line	2024



Integration of Future Power Stations and Renewable Projects (Tx & Dx Projects)



Power Stations	Expected CO Date
Medupi 6x800MW	Units will be available from 2015 - 2019
Witkop Solar PV 30MW)	Commissioned
Tabor Solar PV (28MW)	Commissioned

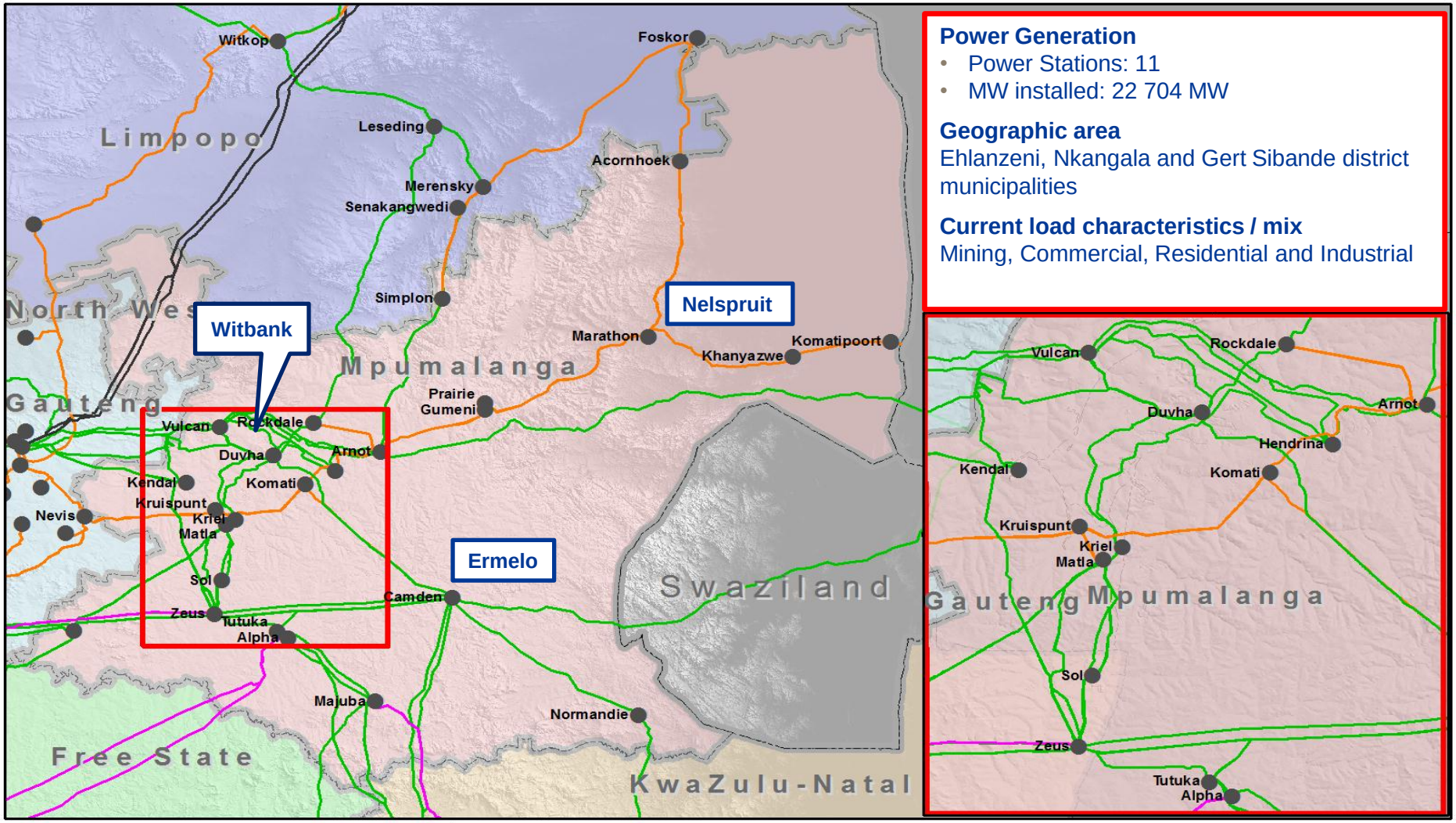
Thank you

Mpumalanga Province

TDP 2016 - 2025

Presented by: Makoanyane Theku

Mpumalanga Province Profile



Power Generation

- Power Stations: 11
- MW installed: 22 704 MW

Geographic area

Ehlanzeni, Nkangala and Gert Sibande district municipalities

Current load characteristics / mix

Mining, Commercial, Residential and Industrial

Substations

Existing MTS Lines Voltage (kV)

275 400 533 765

Exisitng Tx Grid Mpumalanga

Created by: Grid Planning Transmission 2015/09/01

0 50 100 200 Kilometers

Background - TDP Execution

Major provincial developments

- Integration of Kusile Power Station
- Electrification connections
- Integration of Baseload IPPs

North-East TDP execution successes (Project expected in 2015)

Transmission Project	Associated Distribution Projects	Connection Capacity enabled
Gumeni Substation integration	• Gumeni - Machadodorp feeder • Gumeni – Witkloof feeder	500 MVA
Kruispunt substation reinforcement	None, required to resolve transmission line constraints	661 MVA
Normandie transformation upgrade • 2nd 250MVA 400/132kV transformer	None, required to resolve transmission transformation constraints	250 MVA

Challenges in developing and maintaining transmission infrastructure

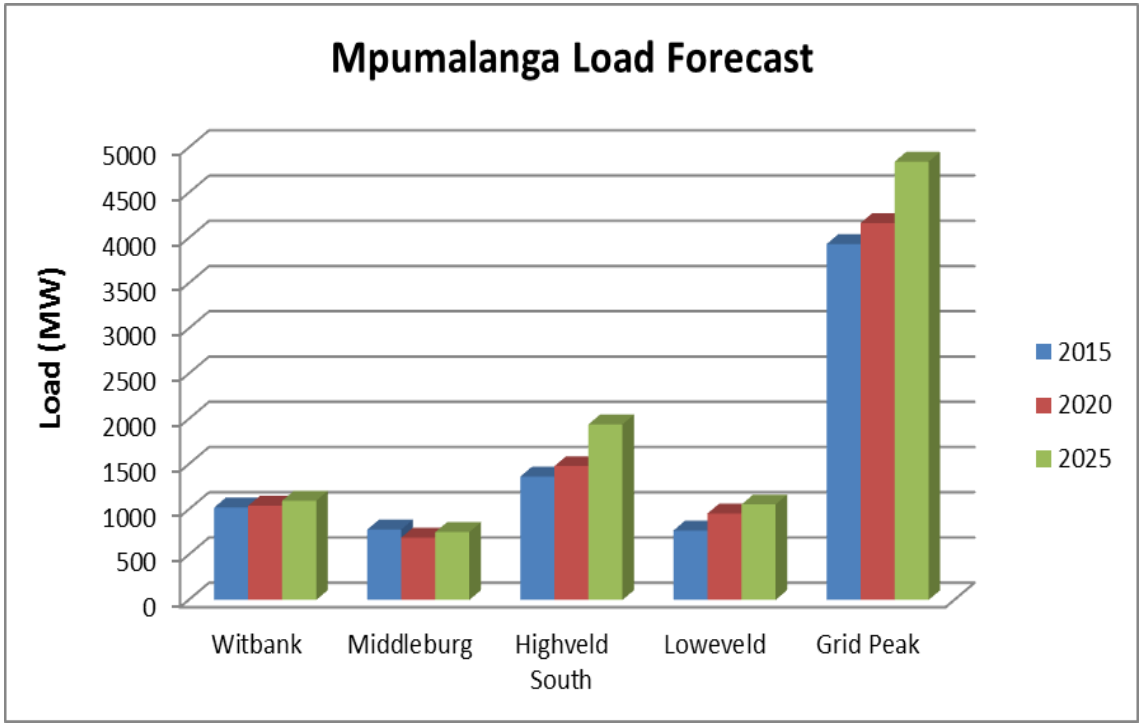
- Delays in servitude acquisition
- Theft and vandalism of transmission and distribution infrastructure
- Subsidence risk – Under-mined land instability and underground mine fires

Mpumalanga Province - Expansion Drivers

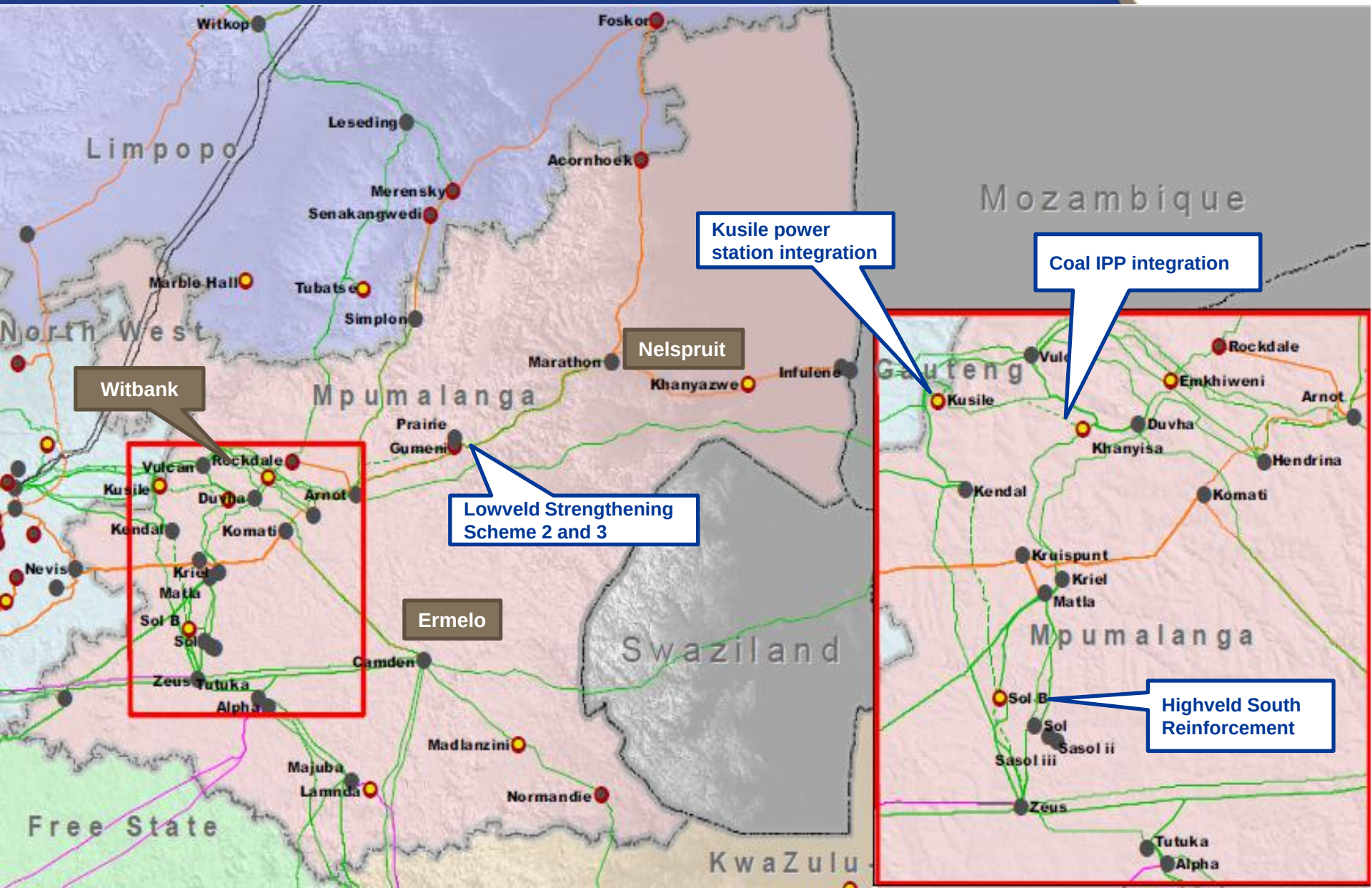
Geographic area

Key drivers (load growth): Mining, Tourism, Commercial developments, electrification, and the establishment of the Industrial Development Zone (IDZ) near Middelburg.

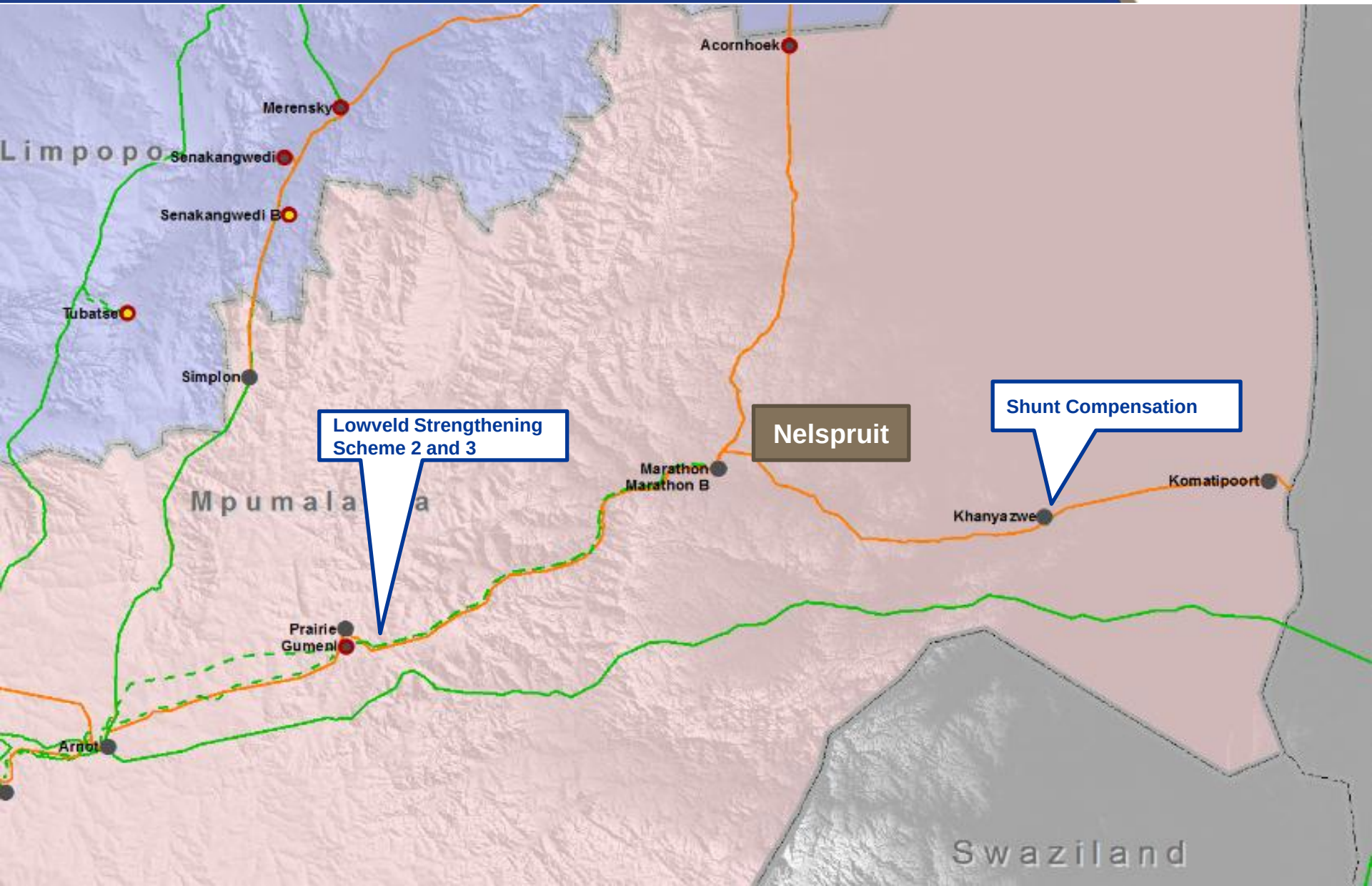
Load growth: 2.3 % per annum



Mpumalanga Province: Development Plan



Mpumalanga Province: Development Plan



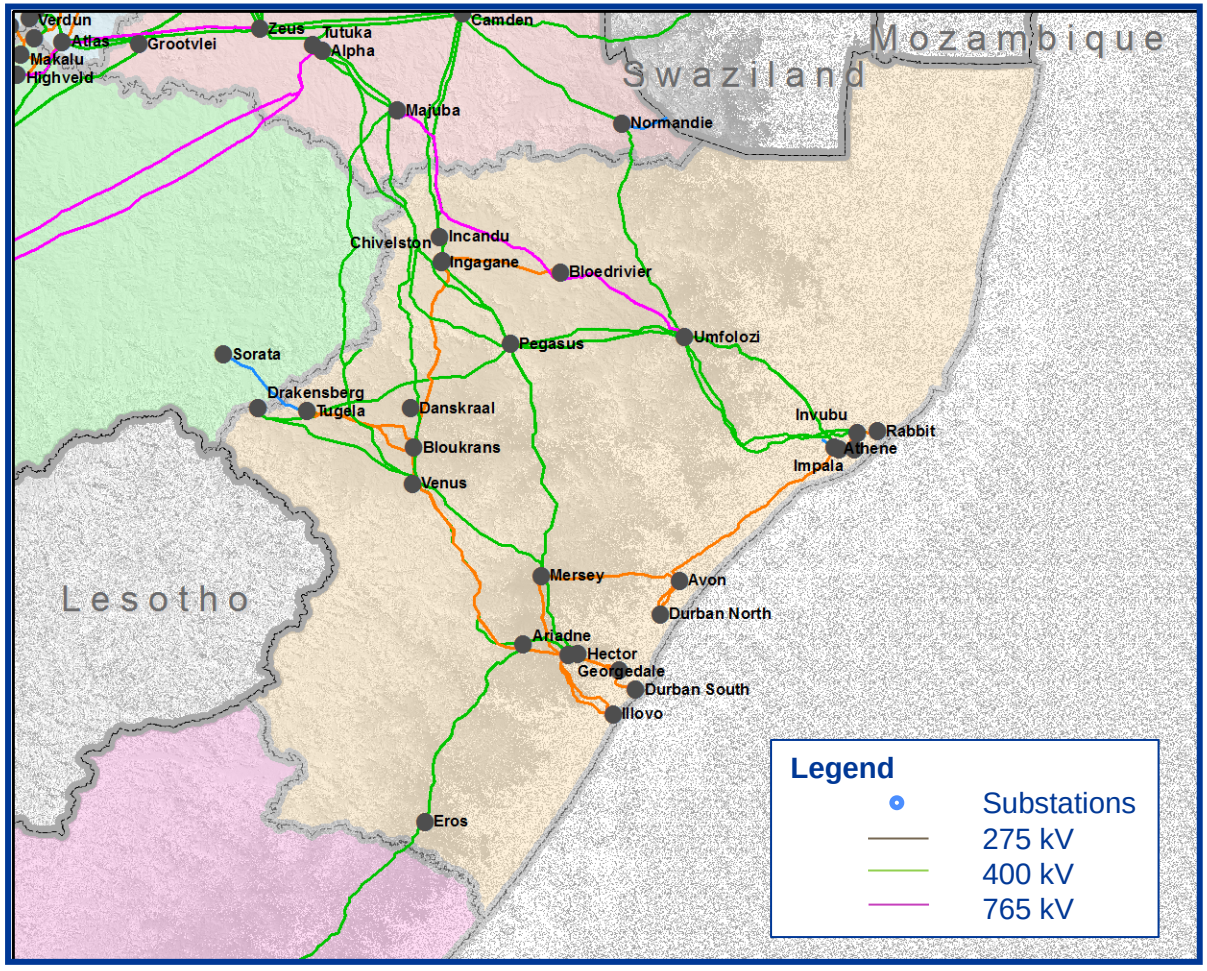
Thank you

KwaZulu-Natal Province

TDP 2016 - 2025

Presented by: Thokozani Bengani

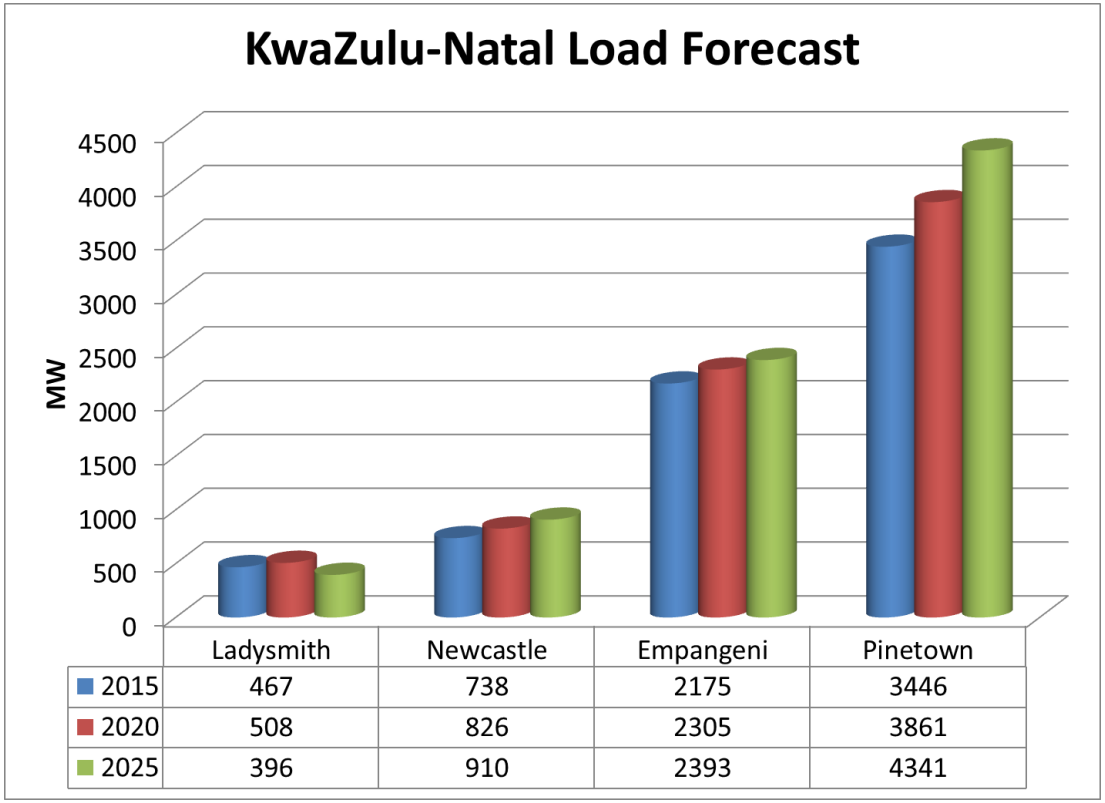
KwaZulu-Natal Province



- **Generation**
  - Power supply into the province is mainly from the Mpumalanga Province power pool
  - Drakensberg Pumped Storage with 1000 MW installed capacity
  - Ingula Pumped Storage under construction - planned capacity 1330 MW
  - Avon OCGT under construction – planned capacity 680 MW
- **Electricity Demand**
  - Load demand in 2014 was 6799 MW
  - Expected demand in 2025 is 8045 MW
- **Load Distribution**
  - Redistributors, Commercial, Mining, Industrial, Residential, Agricultural, Traction

Expansion Drivers

- Concentration of economic activities
  - Port of Durban and Pietermaritzburg
- Other significant contributors
  - Richards Bay, Ladysmith and Newcastle
- Development proposals
  - Dube trade port at La Mercy
  - Bolstering of the Ermelo-Richards Bay coal link
  - Richards Bay IDZ
  - Tourism (iSimangaliso Wetland Park)
  - Public infrastructure delivery (universal access to basic services)



Key developments in Northern KwaZulu-Natal

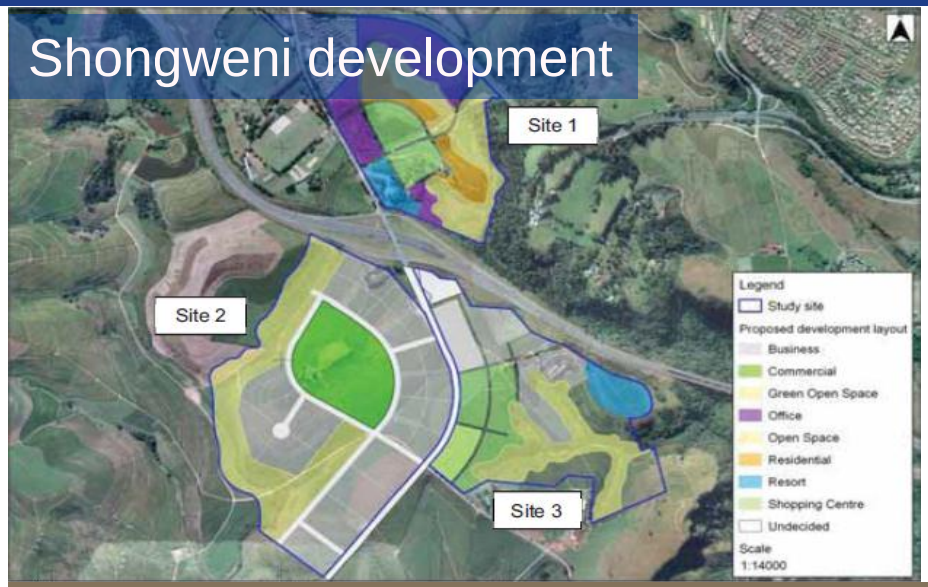
iSimangaliso wetland park: Tourism

Integration of Candover Substation near Mkuze

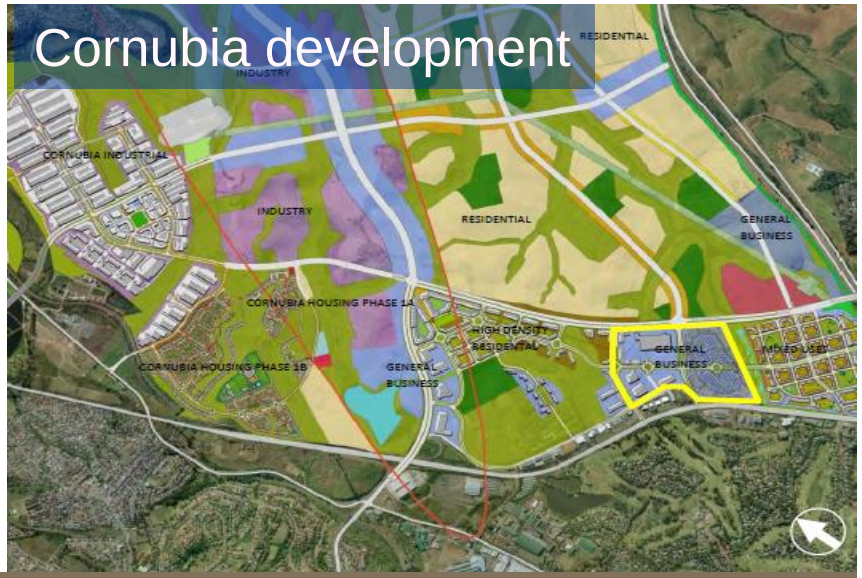
Universal access to basic services

Key developments in eThekwini Metropolitan

Shongweni development

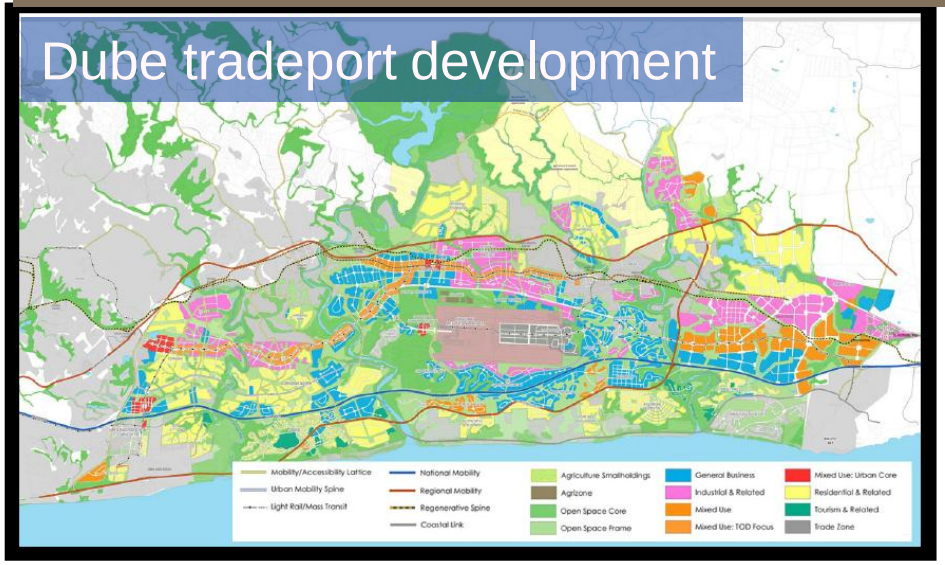


Cornubia development



Integration of Shongweni and Inyaninga Substations

Dube tradeport development



Old airport dig-out

Key developments in the South Coast

South coast: commercial & tourism

New Multi Product Pipeline

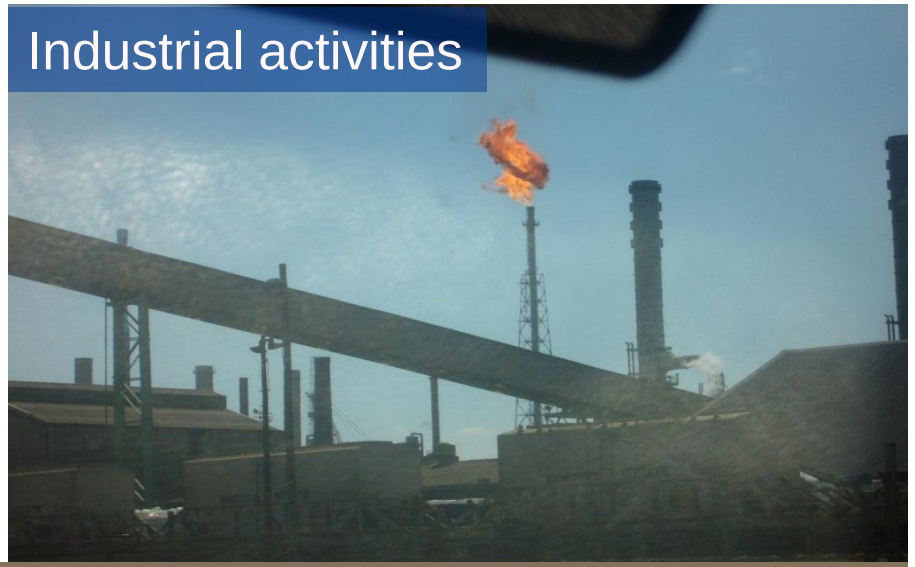
2nd Ariadne-Eros 400kV line and Integration of St Faiths Substation

Universal access to basic services

Key developments in Empangeni, Ulundi, Vryheid and Newcastle

Coal Mining and Ermelo-Richards Bay Coal line

Industrial activities



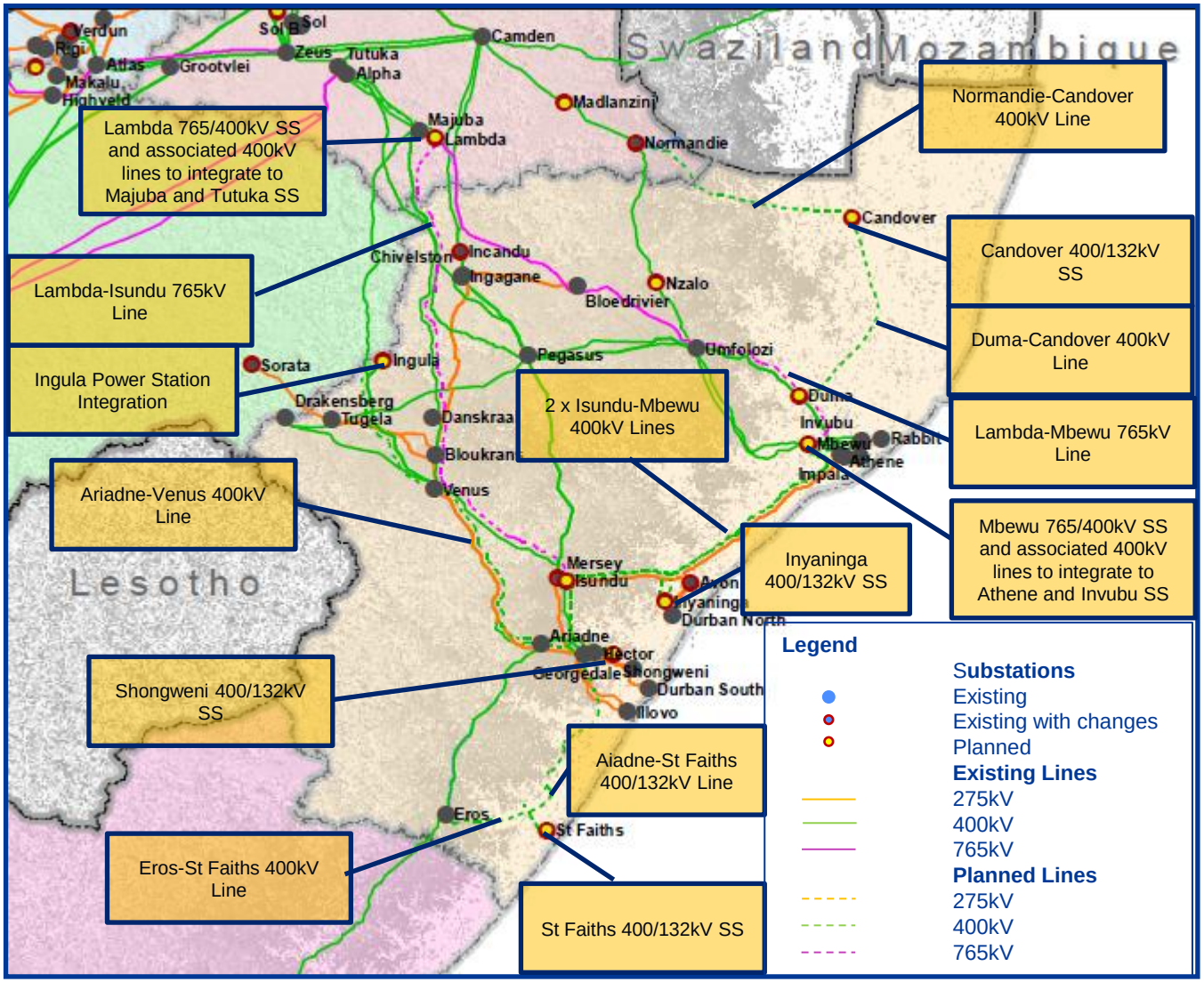
Integration of Nzalo, Duma Substations to reinforce the Ermelo-Richards Bay coal link

Universal access to basic services

KZN 765kV Strengthening

Purpose: To increase power transfer from the power pool into KZN to cater for load growth in the province

Transmission Development Plan: 2016-2025 KwaZulu-Natal Province



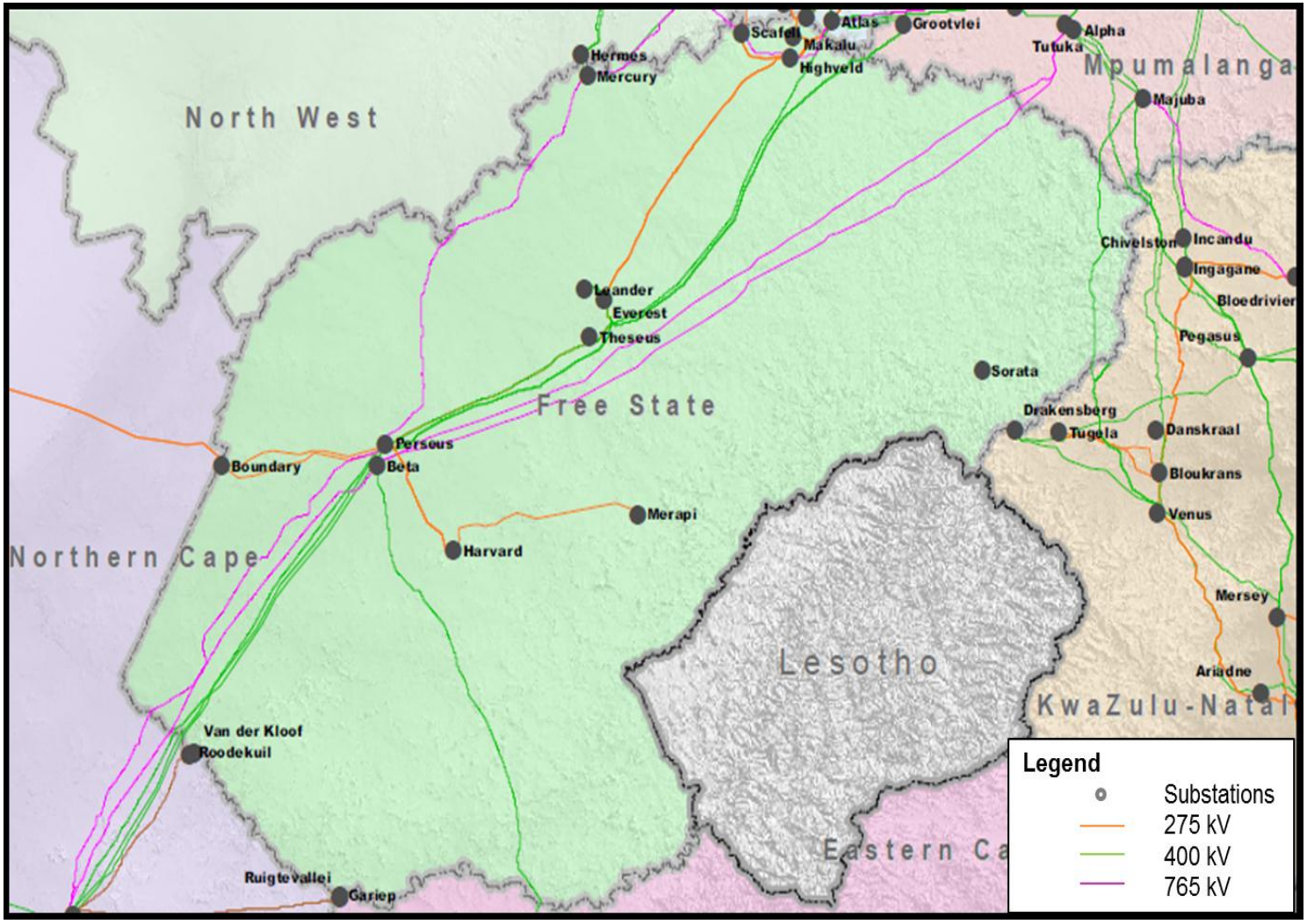
Thank you

Free State Province

TDP 2016 - 2025

Presented by: Caroleen Naidoo

Free State Province



Electricity demand

Load demand in 2014 was 2357 MW

Expected demand in 2025 is 2706 MW

Generation

Power supply into the province is mainly from Mpumalanga Province power pool

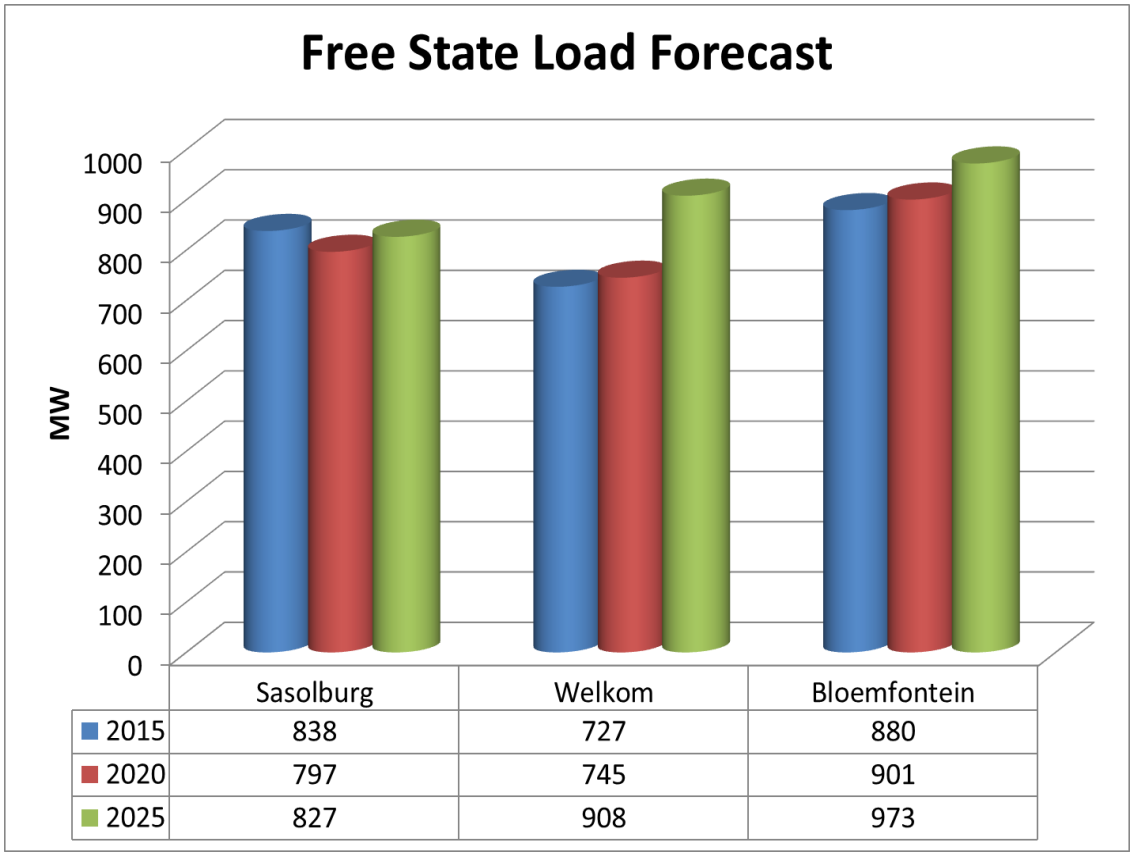
Lethabo Power Station 3558 MW

Load distribution

Redistributors, Mining, Commercial, Industrial, Residential, Agriculture Traction and International

Expansion Drivers

- Important road and rail links traverse the province including:
  - N1 (Cape Town-Johannesburg)
  - N3 (Durban-Johannesburg)
- The province plans to leverage the advantage of its transport infrastructure and its locality:
  - Harrismith Logistics Hub
  - Industrial developments in the Harrismith and Botshabelo
- Public infrastructure delivery (universal access to basic services)
- There is a potential for renewable energy generation
- Solar PV commissioned 124 MW



	Sasolburg	Welkom	Bloemfontein
2015	838	727	880
2020	797	745	901
2025	827	908	973

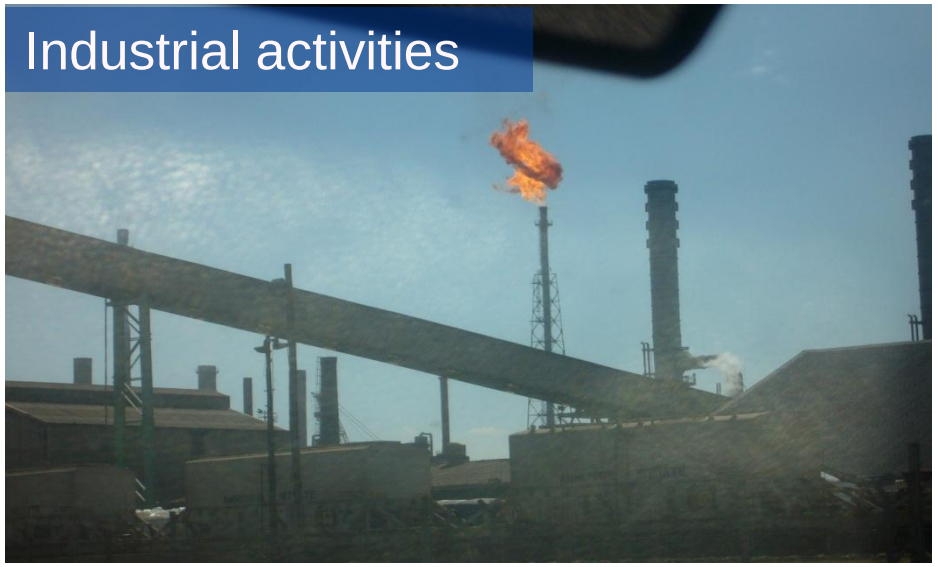
Key developments in Eastern Free State

New Multi Product Pipeline (NMPP)

Extension of Sorata Substation

Universal access to basic services

Key developments in Sasolburg and Vaal Triangle



Integration of Makalu B Substation

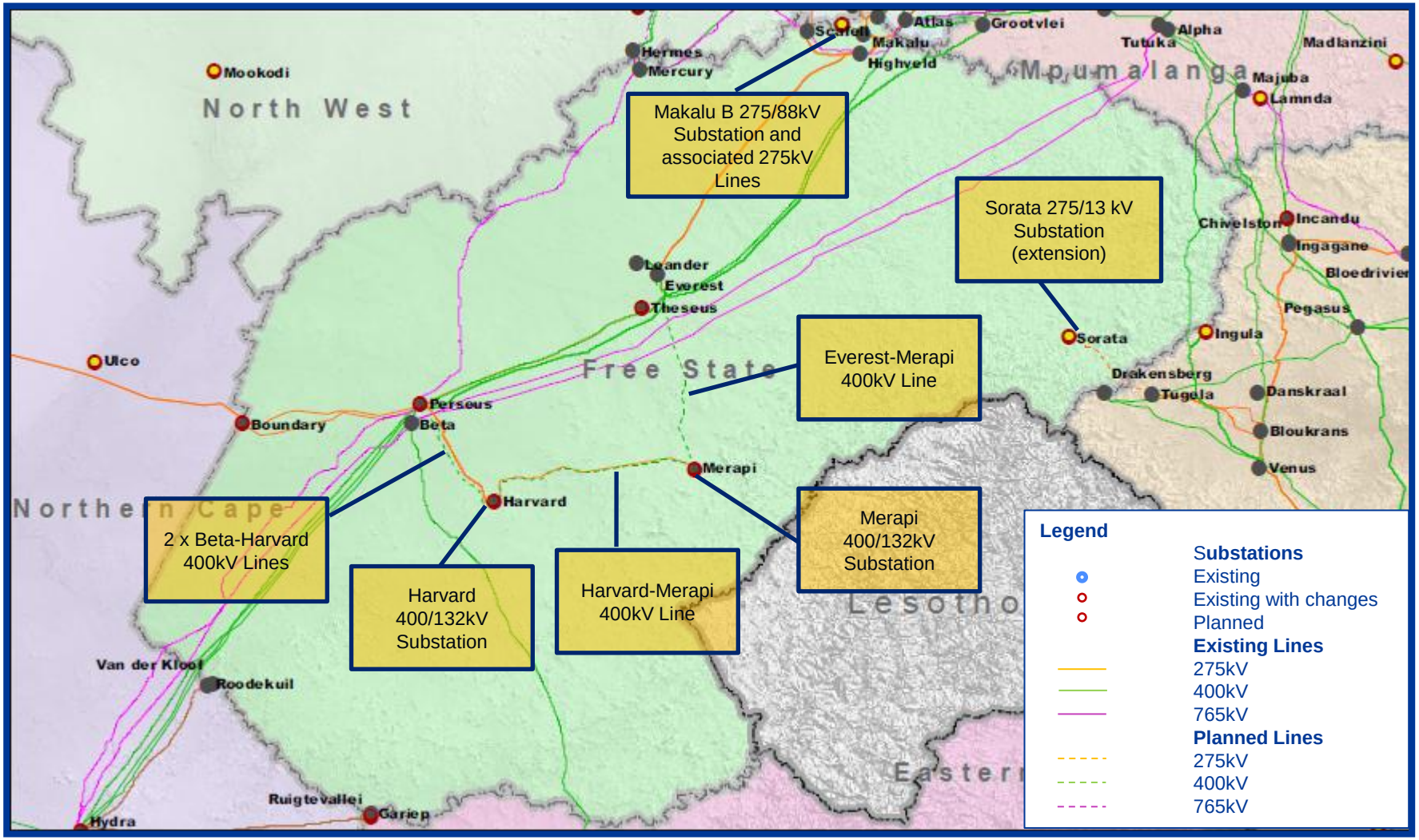
Key developments in Mangaung and surrounding regions

Universal access to basic services

Solar power generation

Bloemfontein Strengthening:
Everest-Merapi 400kV and Beta-Harvard-Merapi 400kV lines and Integration of 400kV at Harvard and Merapi Substations

Transmission Development Plan: 2016 - 2025 Free State Province



Thank you

Western Cape Province

TDP 2016 - 2025

Presented by: Ahmed Hansa

Western Cape Province Profile

Customers

- 334 464 customers:
- Redistributors
- Residential
- Agriculture
- Industrial, mining and commercial
- Prepaid
- 3800 MW of peak load on 11 June 2014
- Forecasted to grow to 4960 MW in 2025

Generation

Eskom Power Stations		
Acacia	19	170 MW
Ankerlig	21	1 350 MW
Gourikwa	22	740 MW
Koeberg	5	1 860 MW
Sere	23	100 MW
Palmiet	18	400 MW
Total		**4 620 MW**

Network Coverage

- Vredendal
- Saldanha
- Cape Town
- Mossel Bay
- George
- Beaufort West

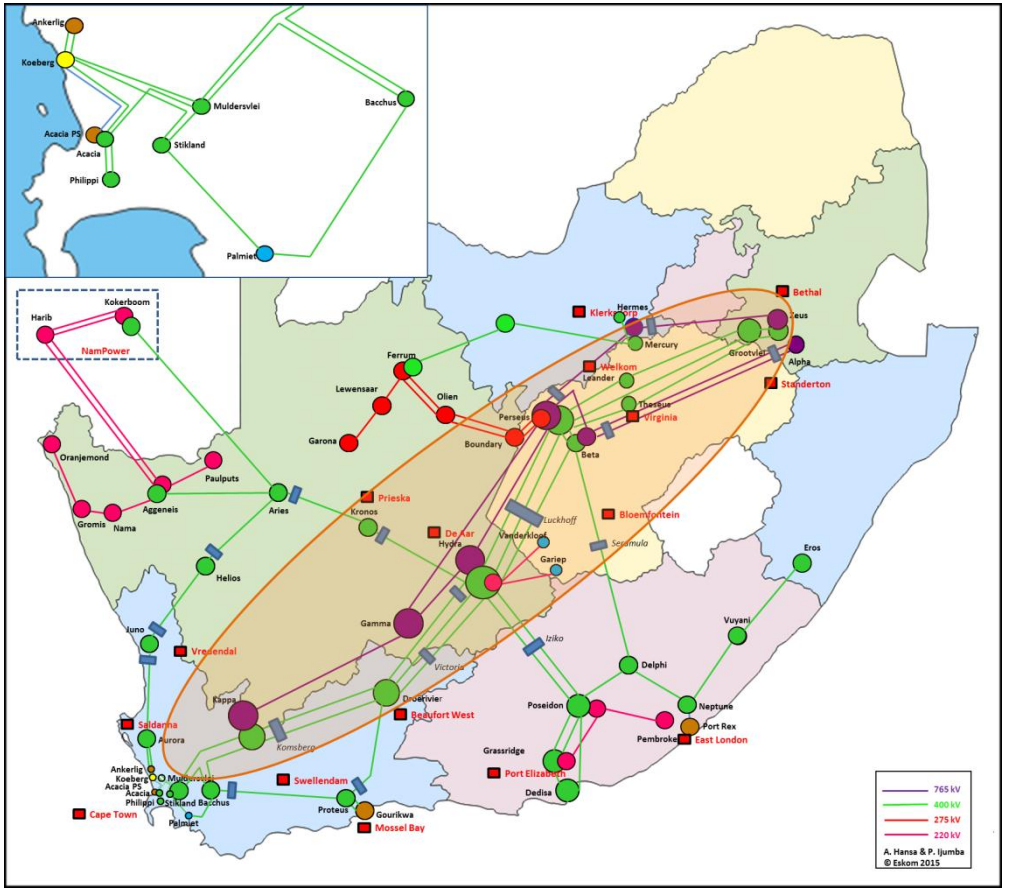
Cape Corridor

- The deficit between Koeberg generation and the Greater Cape load is offset by the generation pool in the Highveld via the Cape Corridor

- Comprises of 400kV and 765kV lines originating ***from Zeus Substation (near Bethal)*** and ***Alpha Substation (near Standerton)*** in the Mpumalanga Province ***to Hydra Substation (near De Aar)*** in the Northern Cape

- It then extends into the Western Cape and ***terminates at Muldersvlei Substation (near Klapmuts)***

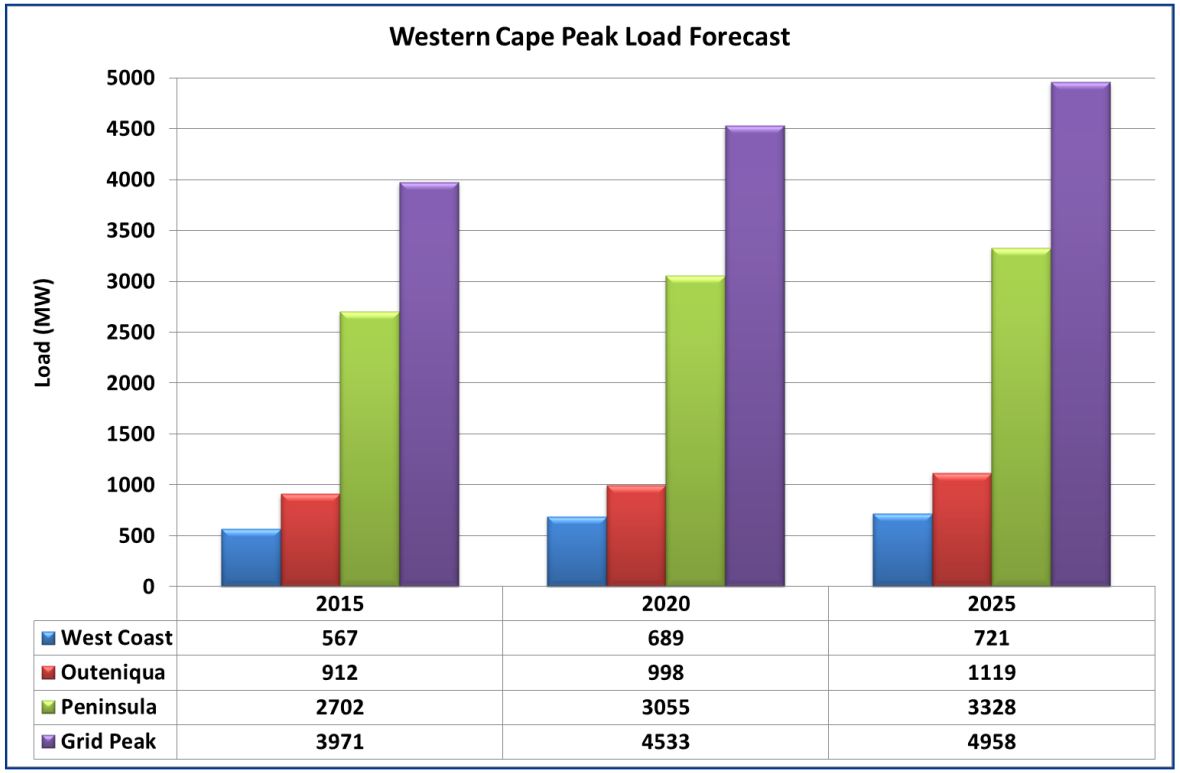
- ***New 765kV lines:***



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

Expansion Drivers

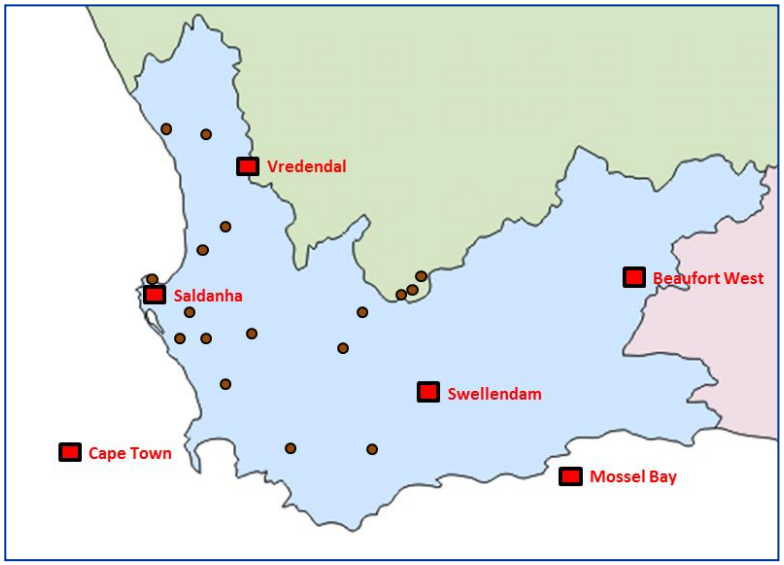
- One of the fastest growing economies in the country
- Financial and business services, manufacturing, tourism, agriculture and fishing
- Economy is dominated by the city of Cape Town
- Huge potential for renewable energy penetration
- Gas and oil imports and gas generation are also major drivers
- 1000 MW of growth forecasted over the next ten years



	2015	2020	2025
West Coast	567	689	721
Outeniqua	912	998	1119
Peninsula	2702	3055	3328
Grid Peak	3971	4533	4958

Renewable Generation

- The Western Cape has huge potential for renewable energy generation due to its climate and proximity to the coastal line.
- Several projects have been approved in the Western Cape under the DoE's Renewable Energy IPP Procurement Programme (REIPPPP)
- **Sere Wind Farm** is an Eskom wind generating facility which was completed in January 2015 and has a capacity of 100 MW. It is located north-west of Vredendal in Skaapvlei, approximately 300 km north of Cape Town

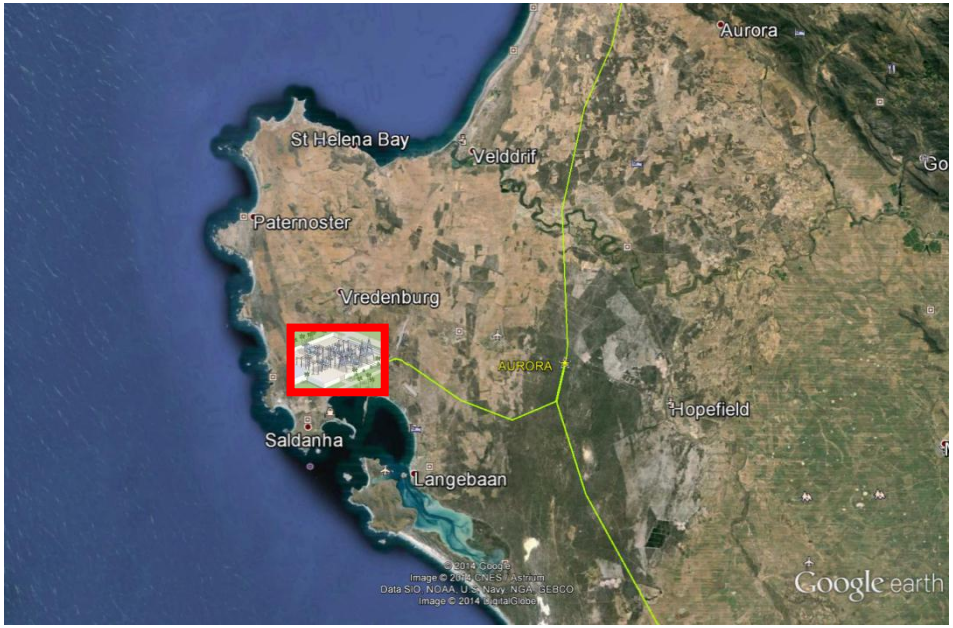


REIPPPP Round	Technology	Capacity (MW)
1	Wind	91
	PV	41
REIPPPP 1 Capacity		**132**
2	Wind	225
	PV	18
REIPPPP 2 Capacity		**243**
3	PV	75
REIPPPP 3 Capacity		**75**
4	Wind	558
REIPPPP 4 Capacity		**558**
Total RE Generation Capacity		**1008**

Substations (West Coast)

Substantial load growth on the West Coast is expected due to the **Saldanha Bay IDZ**

Phased Integration of the new 400/132kV substation: Blouwater



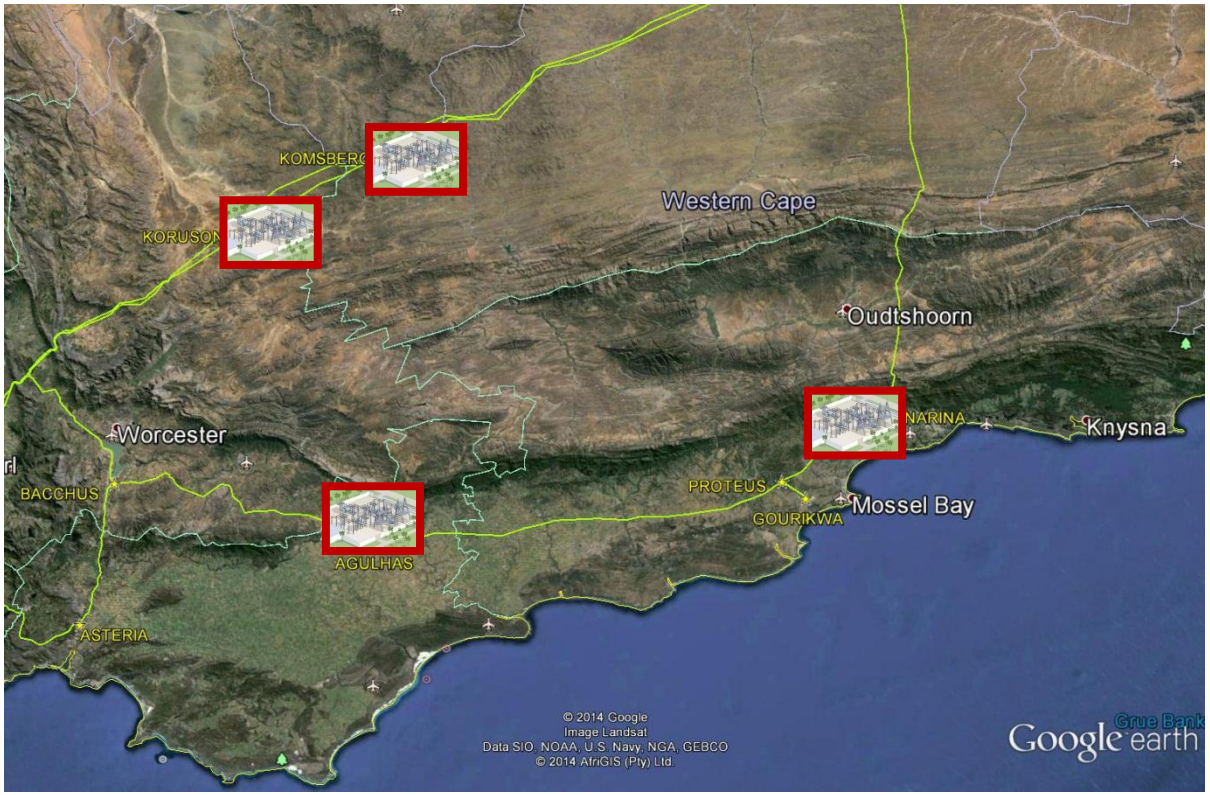
Substations (Peninsula)

Residential, commercial and light industrial load growths in the Peninsula

Integration of new 400/132kV substations: Mitchell's Plain (Erica), Firgrove (Pinotage) and Houhoek (Asteria)

Substations (Outeniqua)

- Area will mainly develop for tourism
- Huge potential and interest for IPP wind generation



Integration of new 400/132 kV substations: Vryheid (Agulhas), Blanco (Narina), Komsberg and Koruson (Kappa)

Transmission Lines

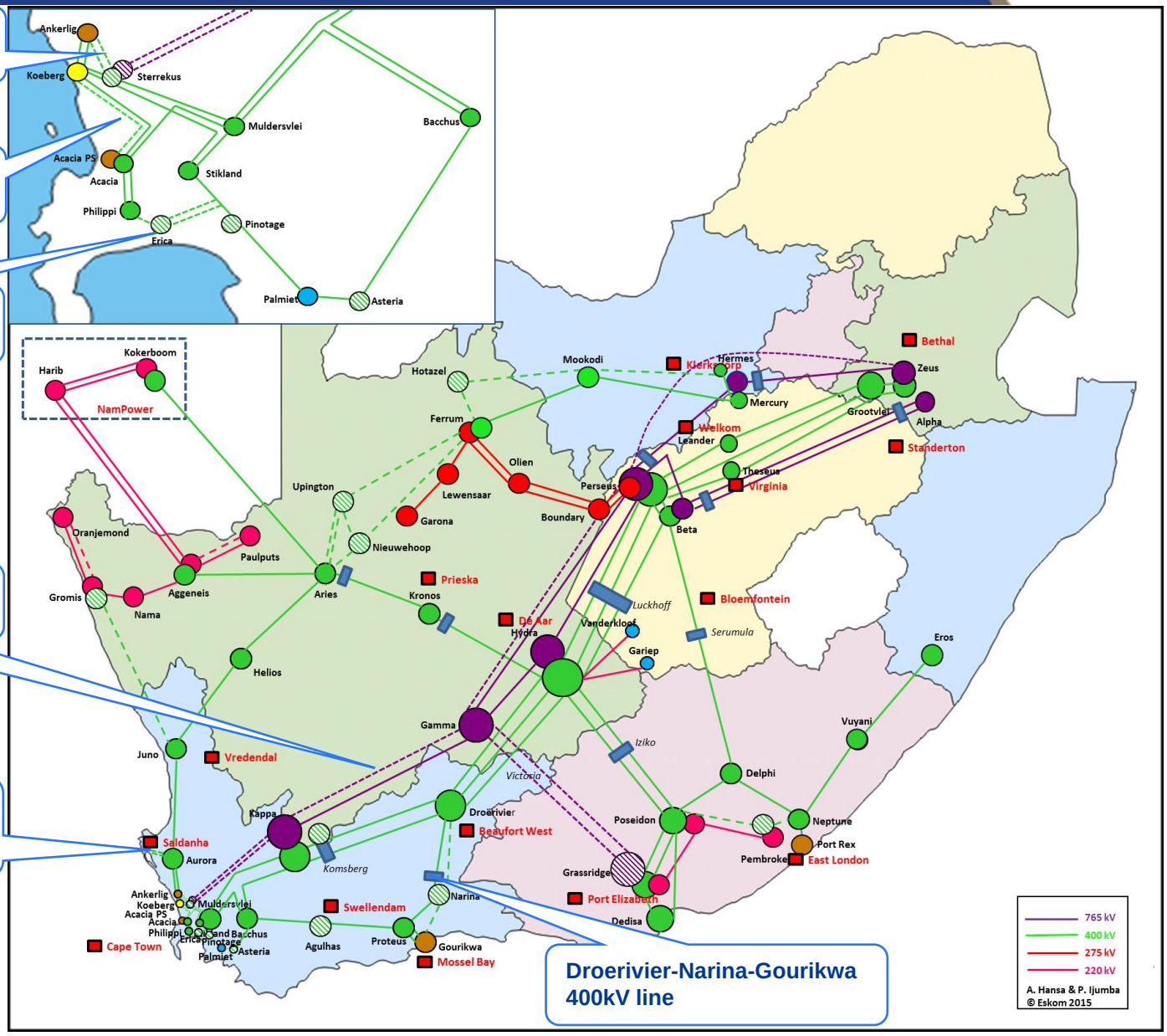
Ankerlig-Sterrekus 1st and 2nd 400 kV lines

Koeberg-Acacia 2nd 400kV line

Erica integration 400kV lines

Cape Corridor 1st and 2nd 765kV lines

Blouwater integration 400 kV lines (operated at 132kV)



Droerivier-Narina-Gourikwa 400kV line

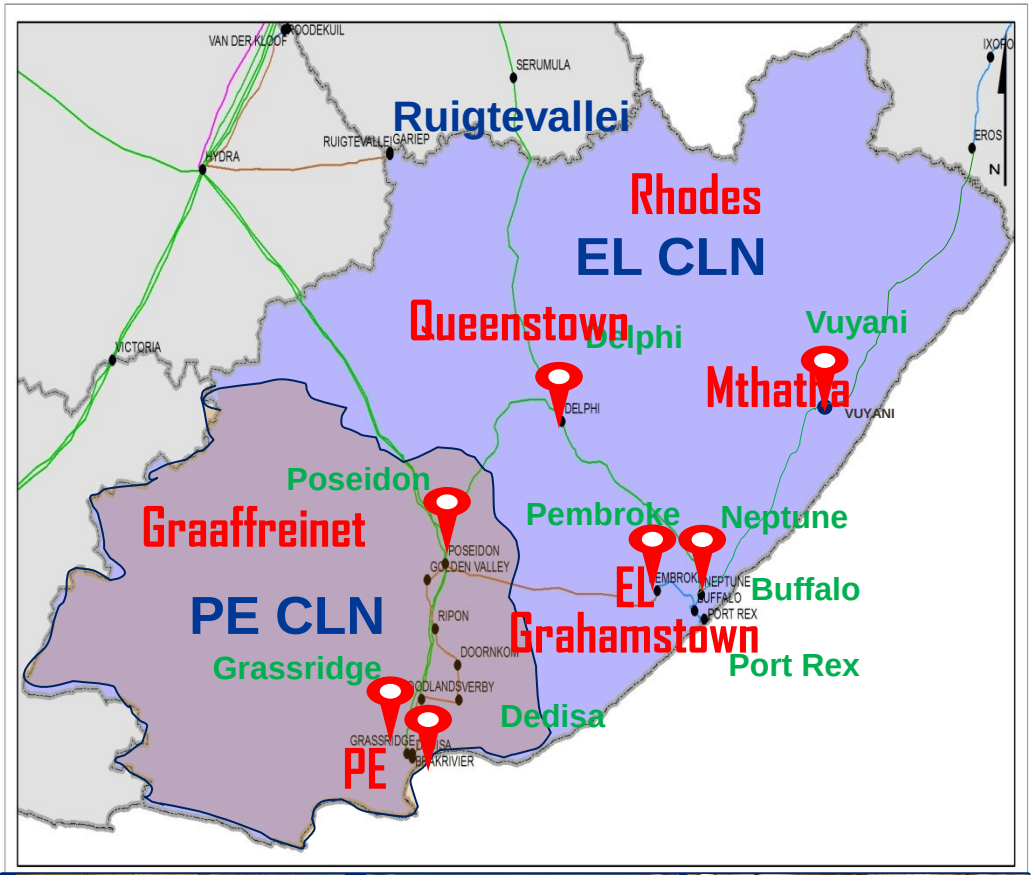
Thank you

Eastern Cape Province

TDP 2016 – 2025

Presented by: Caswell Ndlhovu

Eastern Cape Province Profile



General

- EC Population 6.7 million (0.4% growth)
- 3rd most populous province
- 8.1% of total South African GDP
- 4th largest contributor to GDP
- Major Industries
  - Automotive, tourism, agriculture, agro-processing,

Generation in Eastern Cape

- Port Rex 171MW
- Dedisa OCGT 373MW
- RE IPP (Wind) 800MW

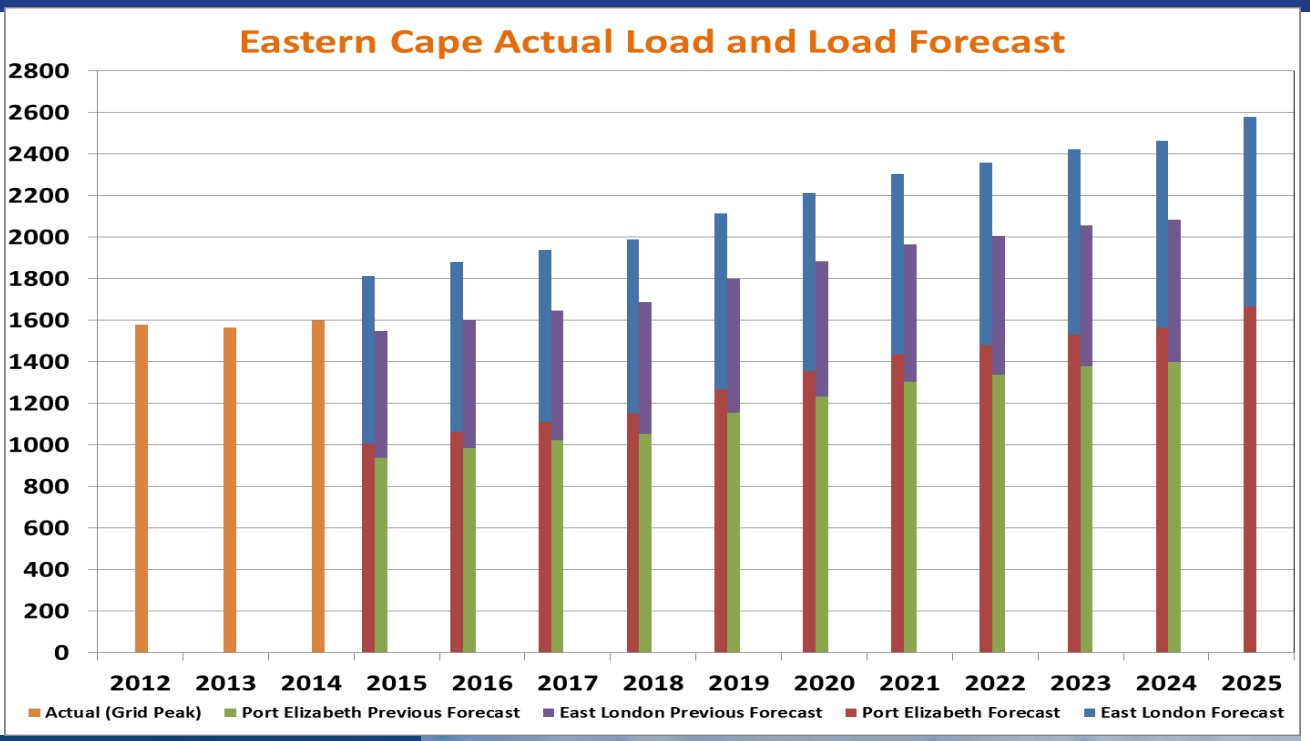
Load Served

- Load demand = 1 445 MW
- No. customers served = 638 187
- Geographic Areas = *Nelson Mandela Metro, Buffalo City Metro, Mthatha

nelson mandela bay

BUFFALO CITY METROPOLITAN MUNICIPALITY

Eastern Cape grid forecast and highlights



Load Drivers

- Coega IDZ -Industrial
- Natural Load Growth
- Electrification
- Agro-Processing

Renewables

- Round 1: 470 MW
- Round 2: 337 MW
- Round 3: 197 MW
- Round 4: 429 MW
- Total : 1432 MW

Constitutes 55% of the 2025 forecasted load and will likely exceed load in future

OCGT and Nuclear

- Possibility Approximately 4500MW of Nuclear by 2023 at Thyspunt
- Appetite for Gas Generation

Completed in 2014/5

- Eros – Vuyani 400kV line
- Vuyani (Mthatha) Substation
- Vuyani-Neptune 400kV line

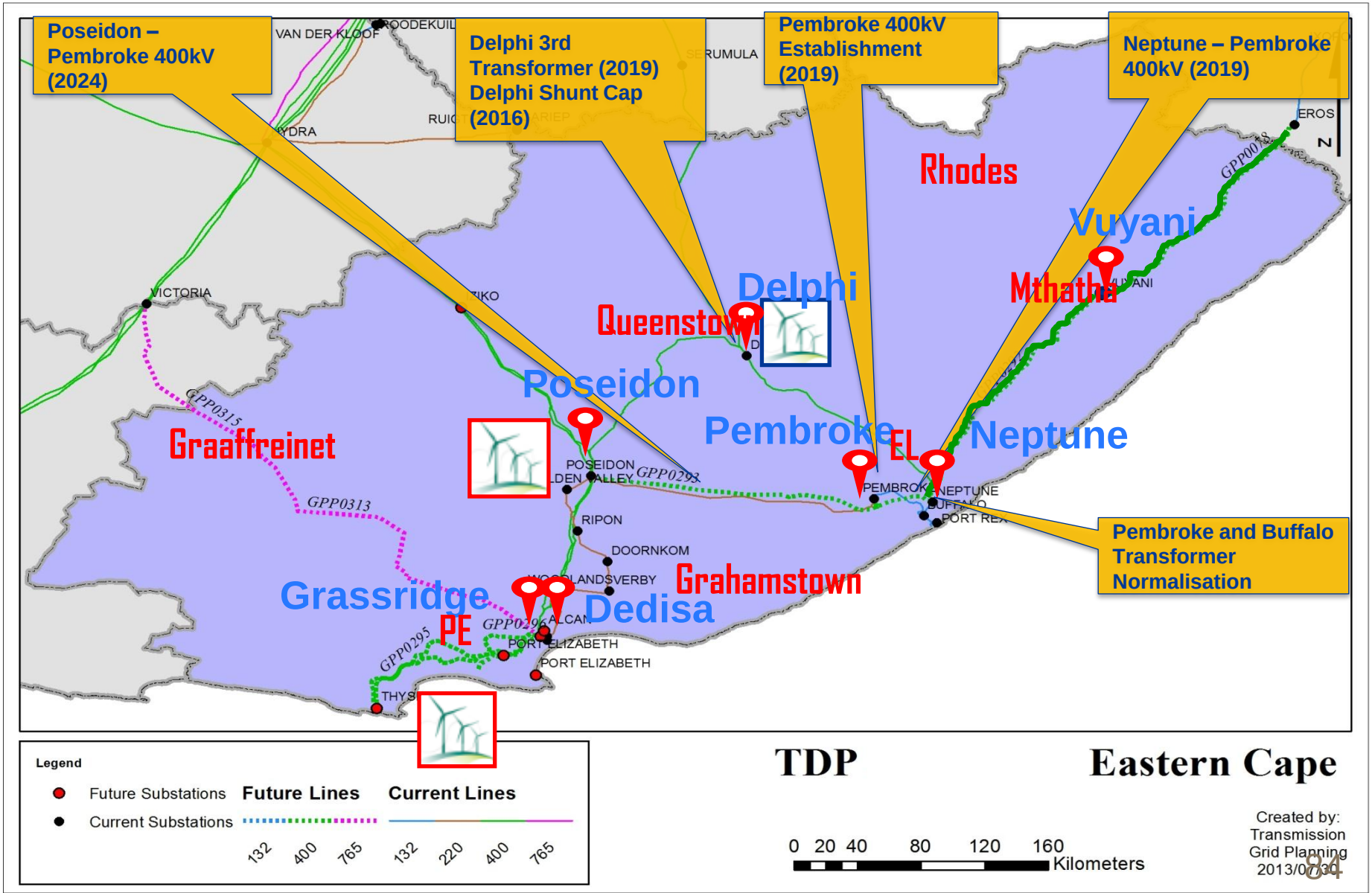
Eastern Cape expansion drivers

- Manufacturing (5%) – Auto Industry - Exports
- Construction (11%) – Commercial Growth
- Agriculture, Forestry and Agro Processing
- Tourism and Sports
- Renewables and possible Nuclear

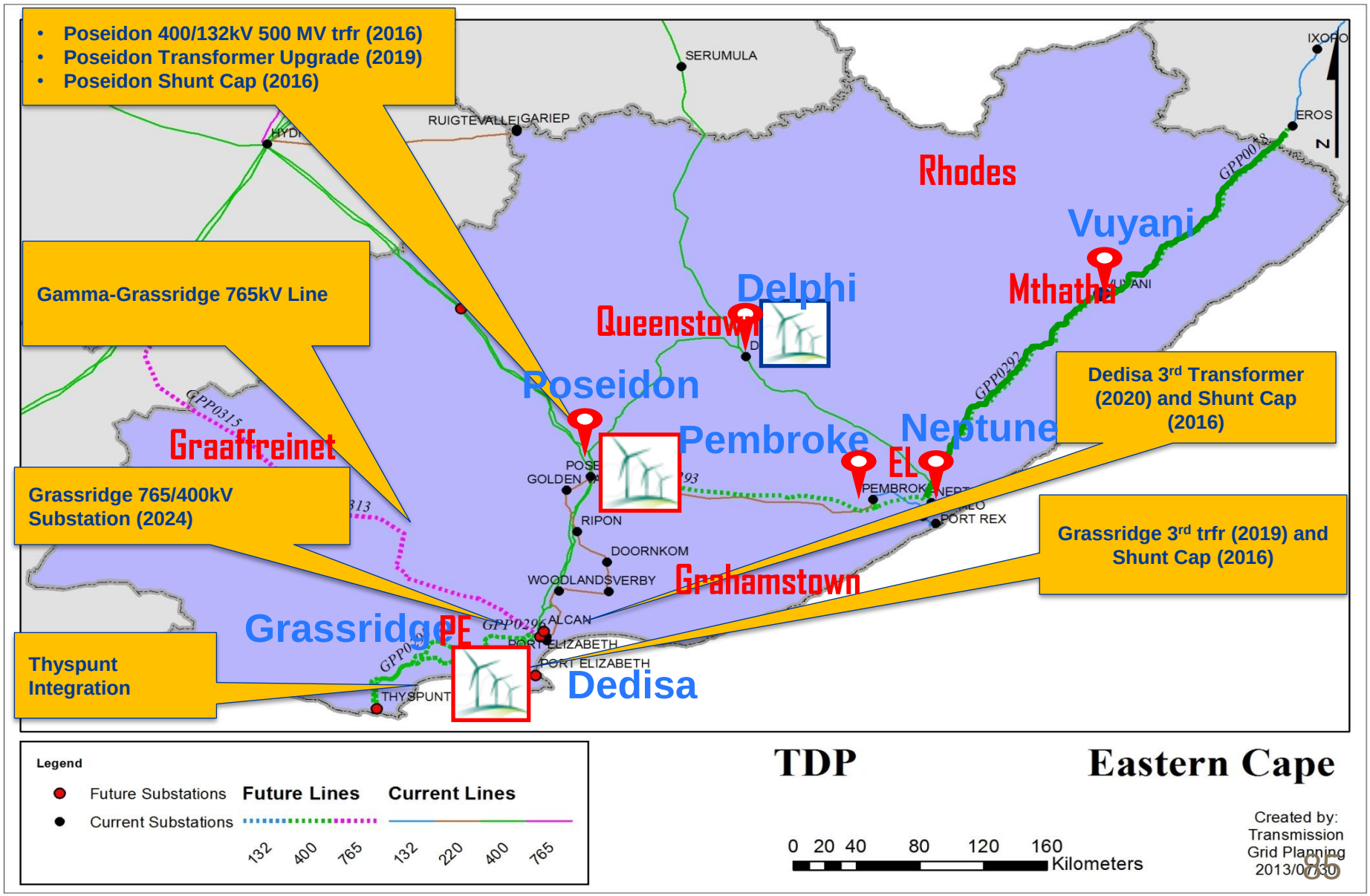
Challenges

- Increasing load will result in low voltages around PE
- More generation will require adequate integration plans
- Maintaining required level of reliability as the load grows

Development Plan - East London CLN



Development Plan - Port Elizabeth CLN



Transmission network development summary

East London Network

- Neptune-Pembroke 400kV line
- Pembroke-Poseidon 400kV line
- Pembroke B conversion to 400kV
- Delphi 100MVar Shunt Capacitor
- Delphi 3rd transformer
- Pembroke and Buffalo transformer normalisation

Port Elizabeth Network

- Grassridge – Dedisa 132kV Line
- Grassridge Third 400/132kV transformer
- Dedisa Third 400/132kV transformer
- Gamma – Grassridge 765kV lines
- Poseidon, Grassridge, Dedisa 1st 100MVar Shunt Caps
- Poseidon 400/132kV transformer (Renewables)
- Poseidon 220/66kV 80 MVA transformer
- Strategic IPP Integration Plans
- Thyspunt Integration

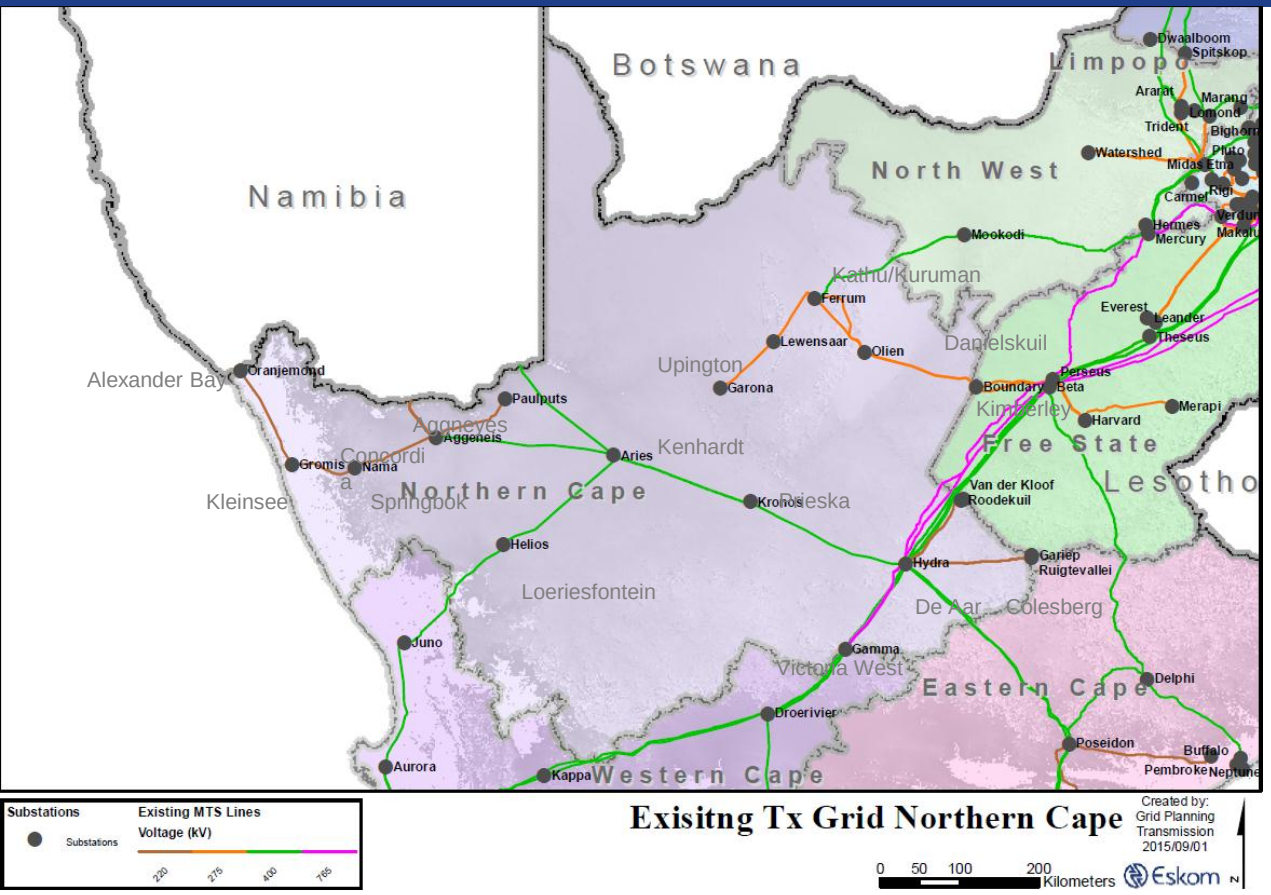
Thank you

Northern Cape Province

TDP 2016 - 2025

Presented by: Jamila Kombe

Northern Cape Province Profile



Generation

- Van Der Kloof PS = **240 MW**
- Gariep PS = **360MW**
- IPPs = **3569MW** (REBID 1 to 4)

Transmission

- Load demand in 2014 = 742MW
- Expected demand in 2025 = 1671MW
- Number of Main Substations = 15

Radial network impacting Reliability and QoS during outages

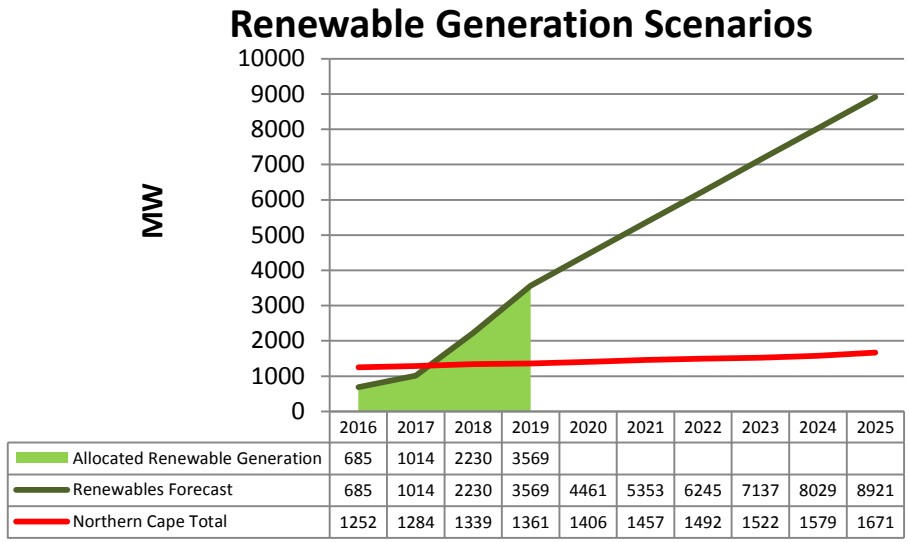
Distribution

Geographical Area: Kimberley and Upington Distribution Zones, 15 Customer Network Centres from Springbok, Calvinia, De Aar to Jan Kemdorp.

Approx. Economic mix:

Commercial (21%)
Mining (52%)
Agriculture (27%)

Northern Cape Province expansion drivers



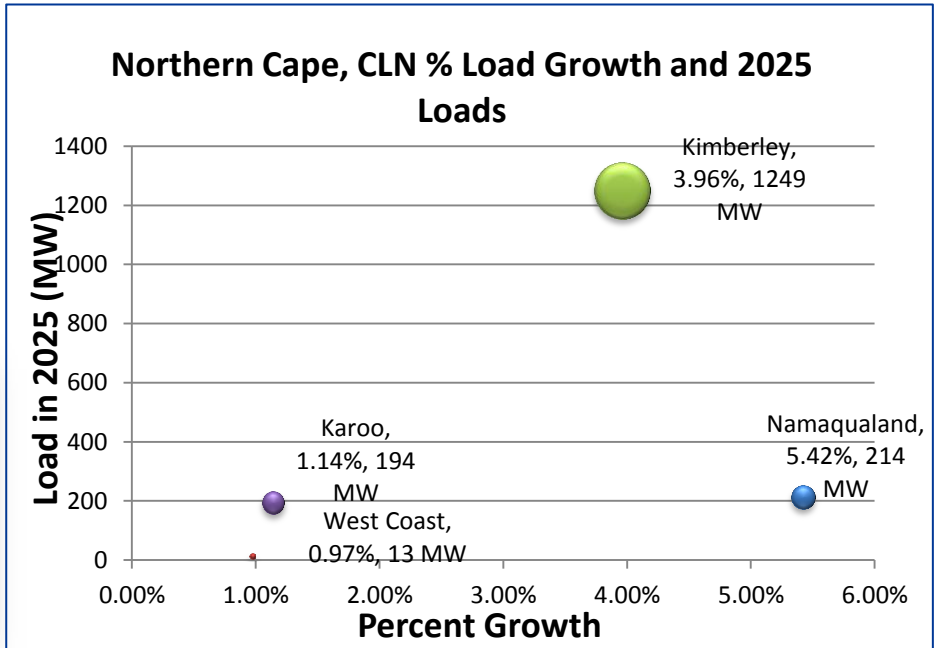
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Allocated Renewable Generation	685	1014	2230	3569						
Renewables Forecast	685	1014	2230	3569	4461	5353	6245	7137	8029	8921
Northern Cape Total	1252	1284	1339	1361	1406	1457	1492	1522	1579	1671

Load Drivers

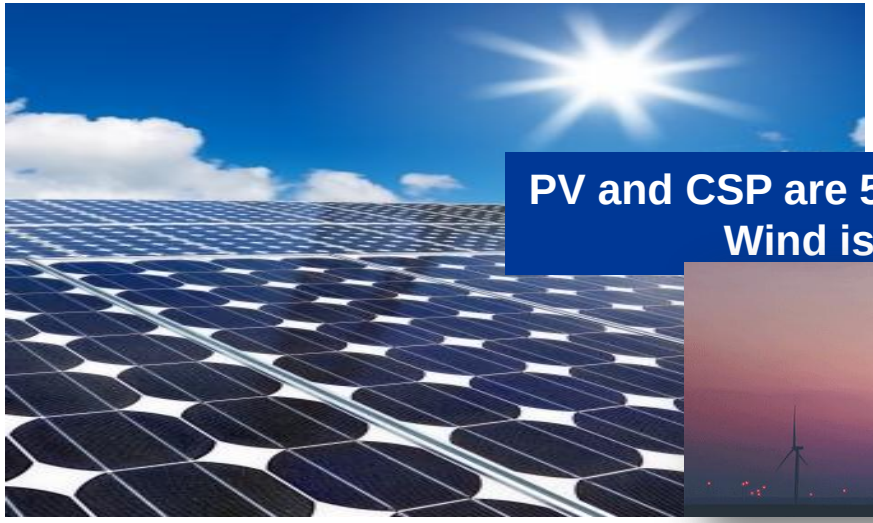
- Anticipated mining loads in the Kimberly area
- Iron Ore line tonnage increase
- Natural load growth

Generation Drivers

- Huge solar resources
- REIPPP programme
  - Round 1 - 685 MW
  - Round 2 - 330 MW
  - Round 3 - 1216 MW
  - Round 4 - 1339 MW
- Generation will exceed load by 2017/18!



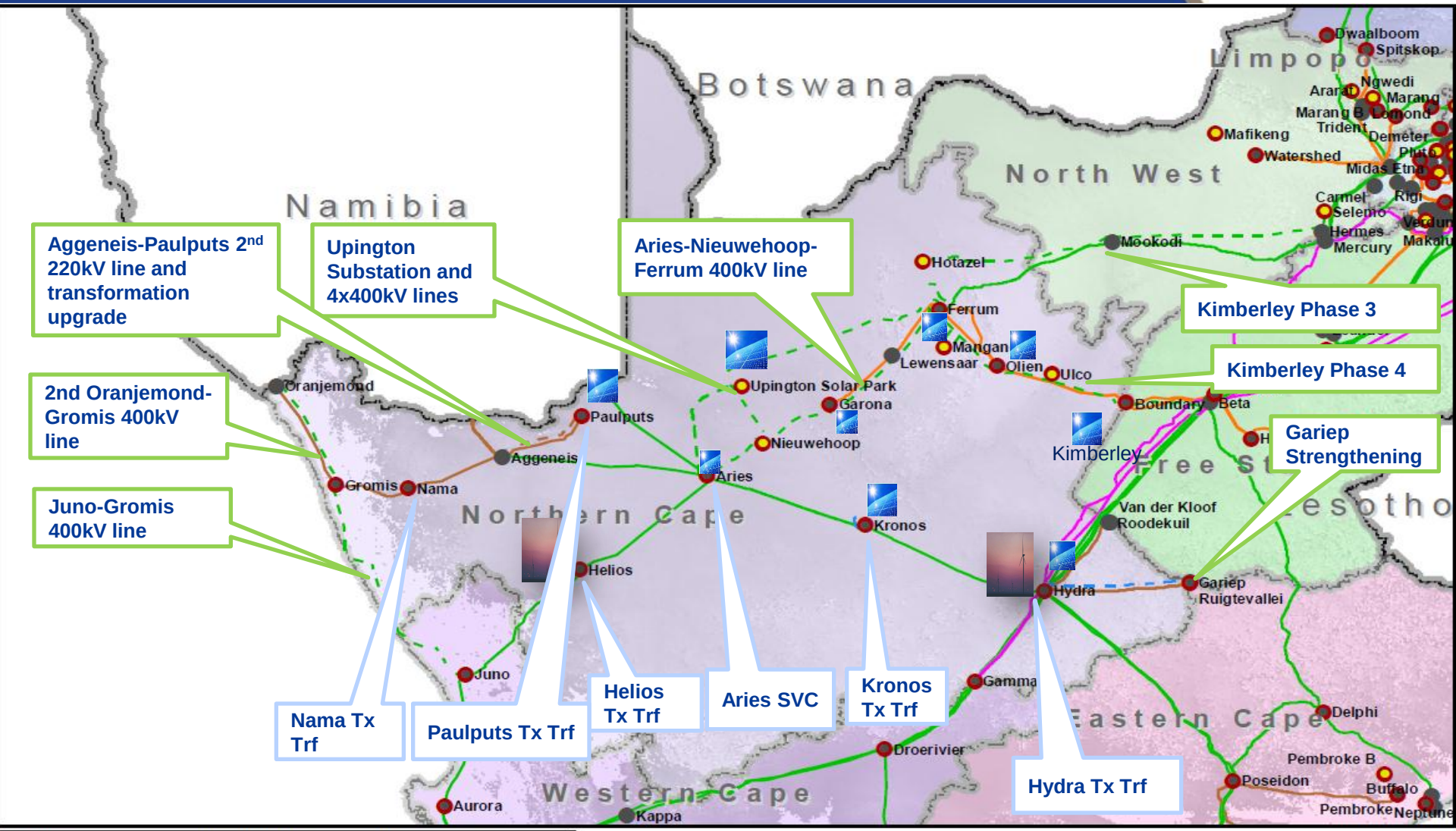
Key developments in the Northern Cape



PV and CSP are 59% of the connections
Wind is 41% by 2018

Transnet Orex tonnage increase and Kimberley potential mining

Northern Cape Province - Development Plan



Thank you

Transmission Refurbishment and Strategic Spares Plan 2016 – 2025

Presented by: Collin Reddy

Introduction

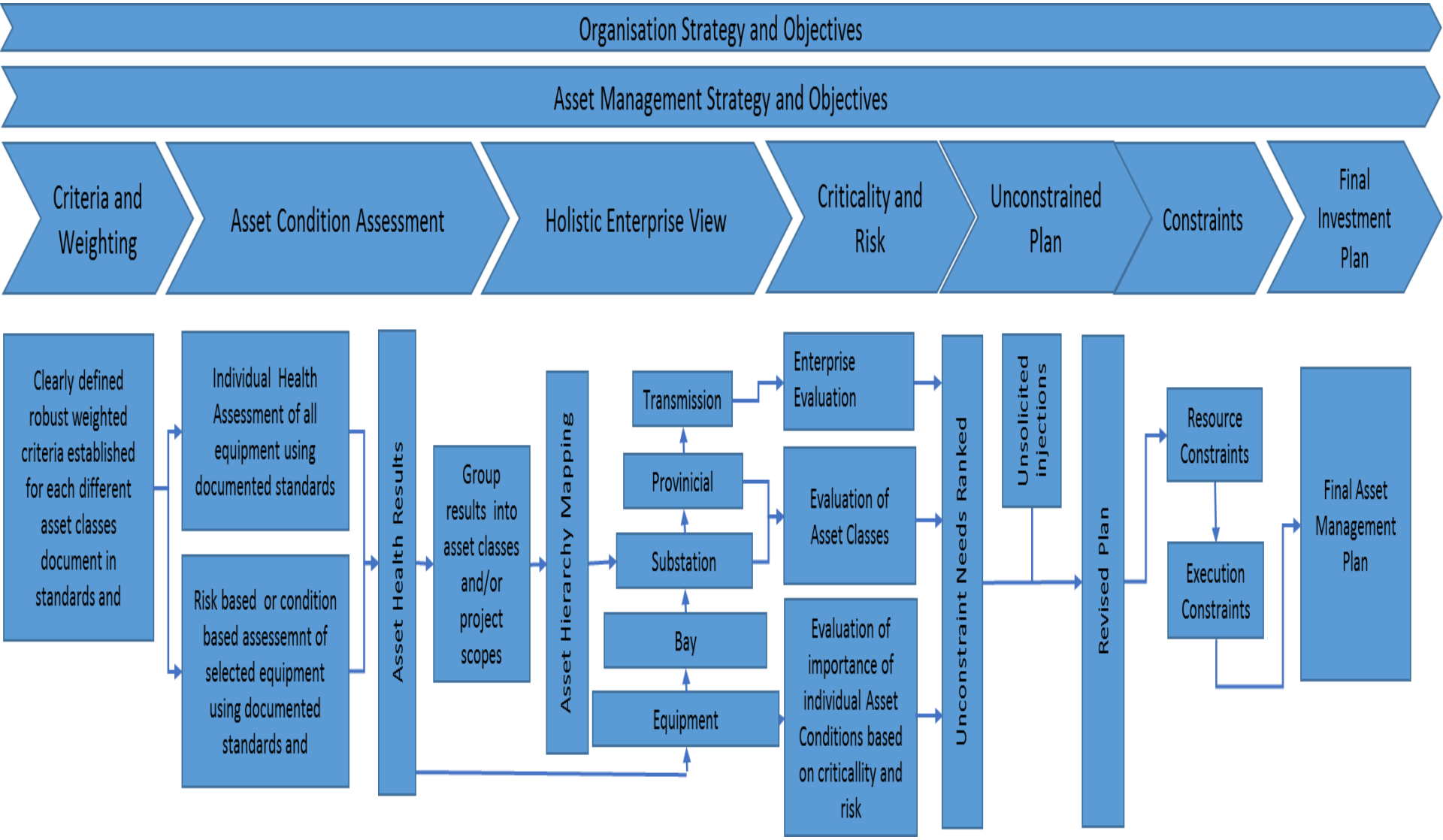
- The South African Grid Code stipulates that the Transmission company is responsible for the renewal, optimisation, reconfiguration and decommissioning of existing assets to ensure sustainability of the network

- The development of the Transmission refurbishment plan is premised on an asset management (AM) framework

- The asset management approach involves asset condition assessment and asset risk assessment, to support the compilation of refurbishment plans

- The AM approach seeks to sustain a reliable and quality of supply, by managing the delicate balance between; network performance, network risks and capital constraints

Development of the TDP 2016 - 2025 (Asset Refurbishment Framework)

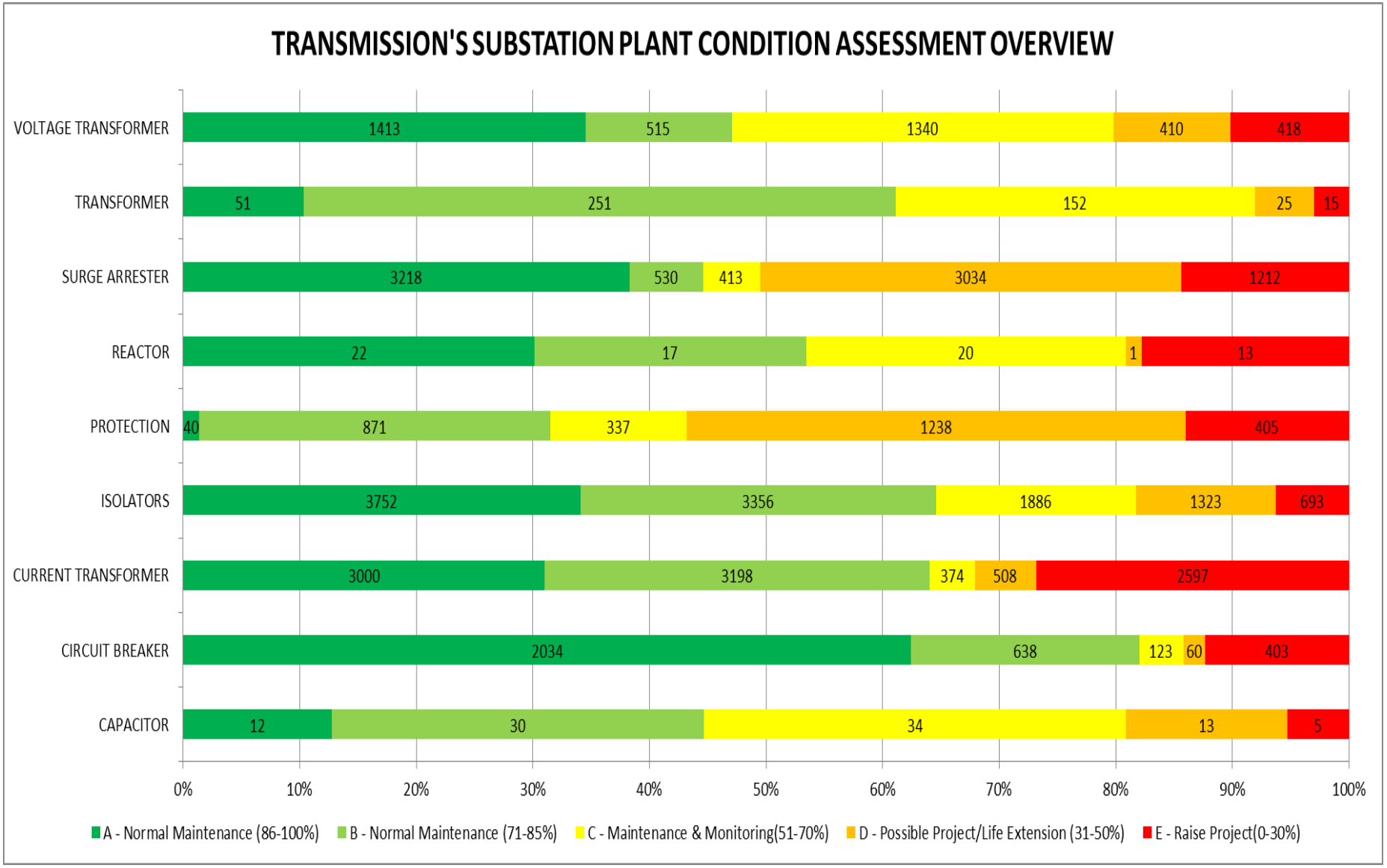


Refurbishment Portfolio Focus Areas

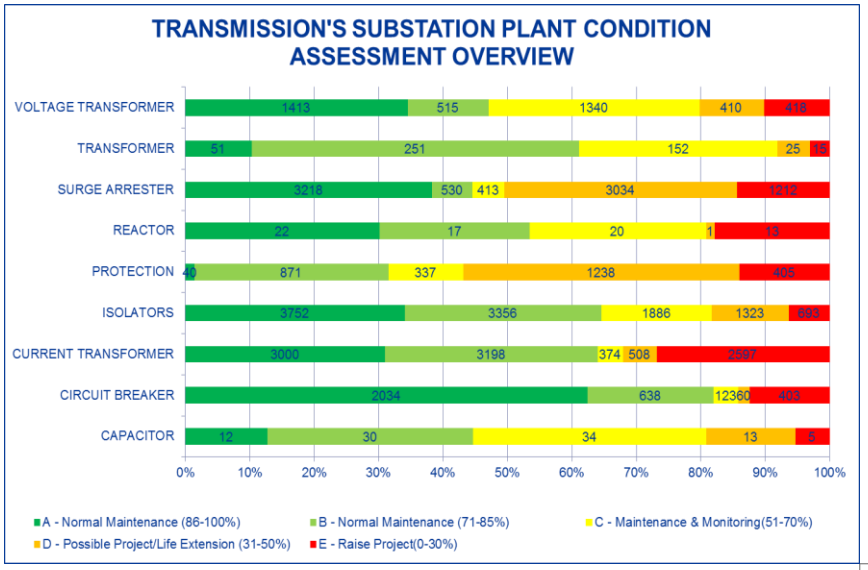
Development Mandate:

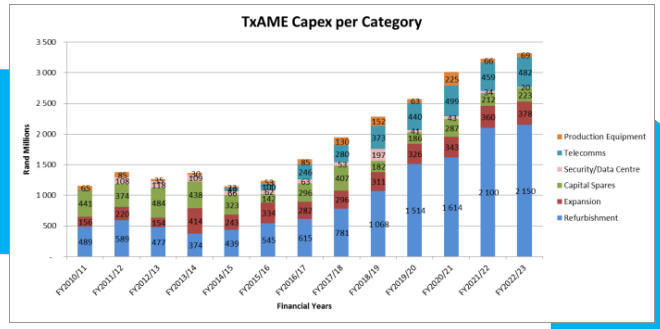
- Capital Spares: Supply restoration
- Production Equipment: Maintenance support
- Customer Connections: Secure revenue base
- N-1 transformation projects for regulatory compliance
- Statutory network requirements
- Refurbishment of network: long term sustainability and reliability of the network, covering asset classes in the following disciplines:
  - Substations
  - Transmission lines
  - Telecommunications
  - Associated general infrastructure

Transmission substations refurbishment requirements (Needs)



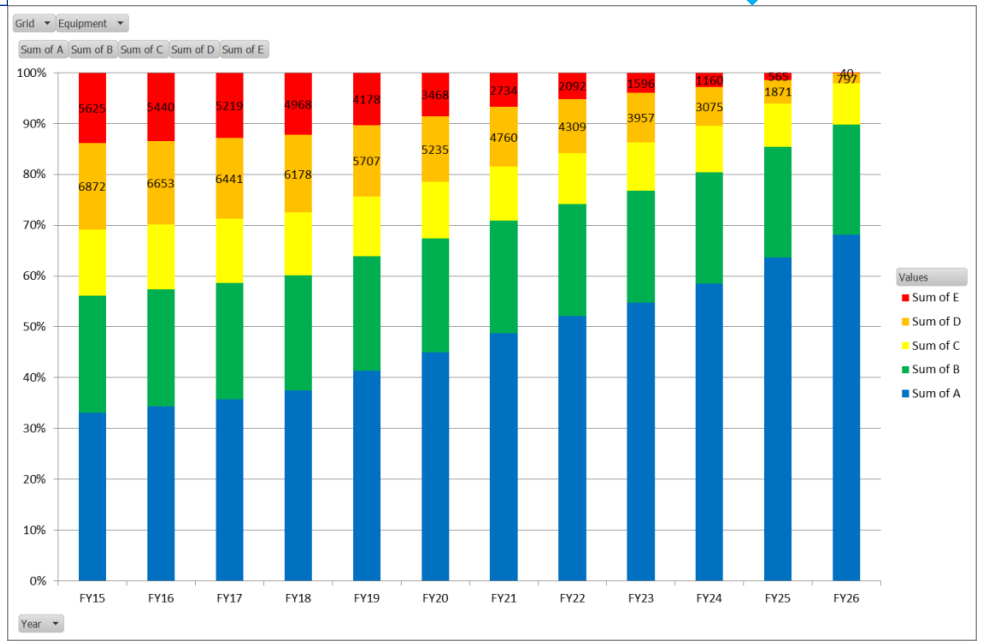
The 10-year Asset Renewal Plan formulation process





Plan Semi-constrained to reflect bottle necks in the Capital Plan value chain

- Starting point: assets identified based on condition rolled up per bay
- Rolled up into substation
- Phased using criticality, importance and impact
- Generated projects to cost and enter into plan



Project Prioritisation Matrix (Snapshot)

Update Constraint Score

ITEM_NAME	STAGE	Bus Score	Ø Type of Customer and value to Customer	Ø Network Stability	Ø Likelihood of Load loss (MW)	Ø Interruption/Restoration of supply	Ø Performance (i.e. without the additional components)	Ø Statutory	Ø Safety and Environmental Improvements	Ø Spares	Ø Type of failure	Ø Cost of maintenance	Ø Prior Refurbishment	Ø Future need	Ø Skill Level	Ø Age	Ø Asset Health Index Score	Ø Tec
			4%	4%	15%	10%	10%	4%	4%	3%	5%	5%	2%	3%	15%	4%		
Kriel HV Yard Refurb	PCRA	7.24	9	9	8	7	9	4	9	5	6	4	8	6	6	9	9	5
Spitskop 2 X 500 Mva 400\132Kv Transformer Upgrade(Era)	ERA	7.2	9	9	9	9	7	9	9	-	4	2	7	6	1	7	7	6
BREAKERS 11KV REPLACEMENT	PCRA	7.12	9	9	7	5	7	9	9	5	5	7	9	6	2	7	7	9
Apollo CS: Breakers 11kV Replacement	PCRA	7.12	9	9	7	5	7	9	9	5	5	7	9	6	2	7	7	9
FORDSBURG SS REFURBISHMENT - ERA	ERA	6.96	8	8	5	6	6	8	9	9	8	1	8	6	2	7	7	7
Drakensberg Refurbishment Phase 1: Generator Breakers	ERA	6.88	9	9	7	8	7	2	4	8	6	7	8	6	2	7	7	6
Venus S/S Replacement Of 3X 275Kv Bushings	ERA	6.78	8	8	6	7	8	2	8	8	7	3	8	6	2	7	7	9
Tabor S/S : Replacement Of 3X275 Kv Bushings	ERA	6.74	9	6	6	7	8	2	8	8	7	3	8	9	2	7	9	9
Phased Replacement Of High Risk Transformers	ERA	6.74	9	6	6	8	9	2	8	3	5	3	8	9	2	9	9	9
Phased Replacement of High Risk TRFRS PH 2	PCRA	6.74	9	6	6	8	9	2	8	3	5	3	8	9	2	9	9	9
Athene S/S Replacement 0F 7X400Kv Bushings	ERA	6.70	8	6	6	7	8	2	8	8	7	3	8	9	2	7	9	9
Invubu S/S:Replacement Of 3X275Kv Bushing	ERA	6.70	8	6	6	7	8	2	8	8	7	3	8	9	2	7	9	9
Prospect SS Refurbishment	CRA	6.68	3	6	9	4	9	8	9	3	4	8	5	7	1	3	7	8
Impala S/S :Replacement Of 4X275Kv Bushing	ERA	6.66	7	6	6	7	8	2	8	8	7	3	8	9	2	7	9	9
PROSPECT S/S RFB SCOPE DEF	DRA	6.64	7	6	9	4	9	8	9	3	4	4	5	7	1	3	7	8
North West Protection Ref - Marang	ERA	6.63	9	4	8	5	6	5	4	9	7	5	9	7	1	7	9	4
Makalu SS Refurbishment	PCRA	6.54	9	8	7	5	6	8	8	6	6	3	8	6	2	7	7	5
Neptune 132kV Reactor 2 Circuit Breaker Replacement	RA	6.54	7	8	7	6	6	5	9	6	7	6	6	7	5	7	7	7
Ariadne S/S :Replacement Of 3X 400Kv Bushings	ERA	6.50	3	6	6	7	8	2	9	8	7	3	8	9	2	7	9	9
Camden Komati Tower No253 Rpl Exe	DRA	6.45	8	8	4	7	8	8	8	8	7	9	9	9	5	9	3	4
Drakensberg Refurbishment Phase 2: Feeder Bays	PCRA	6.38	9	9	5	9	7	2	8	8	7	4	6	8	8	5	7	6
Alpha 11kV Reticulation	PCRA	6.38	6	8	7	5	7	4	9	5	5	7	9	4	5	5	7	7
Replacement of Delle Breakers at Bloedrivier	PCRA	6.37	6	6	5	7	9	4	4	7	4	5	9	8	5	7	7	9
South Grid DC Ref 2013/14-Neptune	ERA	6.36	8	9	7	5	5	9	9	8	6	3	6	5	2	7	7	8
PORT REX - BUFFALO NO 2 132KV LINE TOWER (ERA)	ERA	6.36	8	9	7	5	5	9	9	8	6	3	6	5	2	7	7	8
Hydra Ruigtevallei No1 220kV LineReplacement of 3 wood	DRA	6.34	6	4	7	7	4	8	8	7	6	4	7	6	1	7	9	4
Various Ss Underrated Terminal Equip Ref	DRA	6.33	7	8	8	4	8	6	4	5	5	1	9	6	1	7	7	8
Jupiter-Underrated Terminal Equip Ref	ERA	6.33	7	8	8	4	8	6	4	5	5	1	9	6	1	7	7	8
Prospect-Under	ERA	6.33	7	8	8	4	8	6	4	5	5	1	9	6	1	7	7	8
Zues, Auxili	RA	6.28	6	8	7	6	7	4	4	5	5	1	9	6	1	7	7	7
Acacia SS	RA	6.28	7	8	6	6	7	5	8	6	7	6	9	6	1	7	7	7
Eiger SS Re	RA	6.28	5	9	7	4	8	8	9	4	6	4	9	6	1	7	7	5
Replace Un		6.27	9	8	6	5	5	9	9	4	5	6	9	6	1	7	7	8
Arnot 275kV	RA	6.27	9	9	8	6	6	4	4	3	4	4	9	6	2	7	7	5
Minerva SS	RA	6.26	9	9	9	6	2	8	4	3	8	3	9	6	2	7	7	5
Craighall 88	RA	6.26	9	9	9	6	2	8	4	3	8	3	9	6	2	7	7	5
Acacia SS	RA	6.25	7	9	7	6	7	5	4	6	7	6	9	6	2	7	7	7
Hendrina 132kV Feeder Upgrade Phase 2	PCRA	6.23	9	6	4	6	9	4	4	3	5	4	8	6	6	9	9	6
Hendrina - 132kV Optimum 1&2 feeder bays upgrade	PCRA	6.23	9	6	4	6	9	4	4	3	5	4	8	6	6	9	9	6

16 Weighted criteria

Critical projects never stood out and had not been started

Prioritisation defined to eliminate sensitivity to interpretation

Conclusion

- The current 10 year Transmission refurbishment plan is a reflection of the needs of the network, since it is based on asset condition assessments, asset criticality and network risks

- The prioritisation process that was employed in developing the portfolio of projects for the 10 year refurbishment plan, embodies the requirements and stipulations of the Grid Code

- The plan supports two key strategic imperatives of Eskom Holdings:
  - *Leading and partnering to keep the lights on*
  - *Ensuring our financial sustainability*

Thank you

TDP 2016 – 2025
Capex Analysis

Presented by: Ragini Ramkumar

Transmission Capital Expenditure Drivers

1. **Capacity Expansion and Network Strengthening**:
   - Connection of new and anticipated *customer loads* and *generation*
   - N-1 Reliability Investments
   - Mitigation of Fault-level Exceedances (existing and anticipated)
   - Resolution of Quality of Supply excursions
   - Securing of Servitudes and Environmental Authorisations
   - Compliance (Regulatory, OHSAct, Environmental etc.)

2. **Refurbishment** (i.e. Extension of Life of Existing Assets):
   - Refurbishment based on asset condition (CTs, VTs, Surge Arresters, HV Circuit Breakers and Power Transformers)
   - Replacement of substation batteries and electronic components for protection and control systems, corroded conductors etc. (these not repairable)
   - Targeted Asset Performance Improvements (lines and substation equipment)
   - Physical security improvements and surveillance and monitoring at our key assets and sites
   - Strategic and operational spares holding (to reduce SML<1 and MI risk)
   - Compliance (Regulatory, OHSAct, NKP Act, Environmental etc.)

3. **Asset Purchases**:
   - Specialised equipment for: live-line work; fault location systems, and online condition monitoring, etc.

Transmission 10-year Capex Plan: FY 2016 – 2025

Summary of Transmission Capex Plan (R Million): FY 2016 - FY 2025

	Totals: (FY16-25)
Capital Expansion [1]	151,152
Capital Expansion for IPPs [2]	30,305
Refurbishment	16,948
Capital Spares	2,531
Telecoms	4,019
Aviation	669
Production Equipment	630
Other	1,831
Land & Rights	4,940
	213,026

Notes:

1) Capital Expansion: reliability projects (N-1), network strengthening for load growth, integration of generation (Medupi, Kusile, Ingula, IPPs up to Bid Window 3)
2) Capital Expansion for IPPs - to integrate IPPs beyond Bid Window 3 (Renewables, gas, new coal)

Capex observations

The total Transmission Capital Plan amounts to R213 billion over the TDP period 2016 – 2025 of which:

- R151 billion is required for reliability (N-1) projects, integration of committed generation (Medupi, Kusile, Ingula, IPPs up to Bid Window 3) and connection of new load onto the system

- R30 billion is required to integrate new IPPs (i.e.. RE, gas, coal, co-gen) beyond Bid Window 3 of the DoE's IPP programme

Risk to the TDP 2015

- The liquidity position of Eskom may impact the execution of the Transmission Development Plan.
- The IPP programme may also trigger extensive network reinforcements.
- The time taken to acquire servitudes and secure water use licenses continues to be a challenge to the TDP roll out.
- Under-investments in Transmission infrastructure threatens network reliability and load growth in the country.
- The execution ability to accomplish the plan remains a challenge.

Thank you

Planning for the Integration of South African Renewable Energy IPPs

Presented by: Leslie Naidoo

IRP capacities need to be allocated to market players – so far clear focus on allocating the RE capacities

	New build options							
	Coal (PF, FBC, imports, own build)	Nuclear	Import hydro	Gas – CCGT	Peak – OCGT	Wind	CSP	Solar PV
	MW	MW	MW	MW	MW	MW	MW	MW
2010	0	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0	300
2013	0	0	0	0	0	0	0	300
2014	500[1]	0	0	0	0	400	0	300
2015	500[1]	0	0	0	0	400	0	300
2016	0	0	0	0	0	400	100	300
2017	0	0	0	0	0	400	100	300
2018	0	0	0	0	0	400[4]	100[4]	300[4]
2019	250	0	0	237[3]	0	400[4]	100[4]	300[4]
2020	250	0	0	237[3]	0	400	100	300
2021	250	0	0	237[3]	0	400	100	300
2022	250	0	1 143[2]		805	400	100	300
2023	250	1 600	1 183[2]	0	805	400	100	300
2024	250	1 600	283[2]	0	0	800	100	300
2025	250	1 600	0	0	805	1 600	100	1 000
2026				0	0	400	0	500
2027	250	0	0	0	0	1 600	0	500
2028	1 000			474	690	0	0	500
2029	250	1 600	0	237	805	0	0	1 000
2030	1 000	0	0	948	0	0	0	1 000
Total	6 250	9 600	2 609	2 370	3 910	8 400	1 000	8 400

Firm commitment necessary now

Final commitment in IRP 2012

First Procurement Block by DoE :	1,850	200	1,450	Total 3,500MW
1st Window :	652	150	634	1,436MW
2nd Window :	571	50	423	1,044MW
3rd Window :	787	200	435	1,422MW

1. Built, owned & operated by IPPs 2. Commitment necessary due to required high-voltage infrastructure, which has long lead time 3. Commitment necessary due to required gas infrastructure, which has long lead time 4. Possibly required grid upgrade has long lead time and thus makes commitment to power capacity necessary

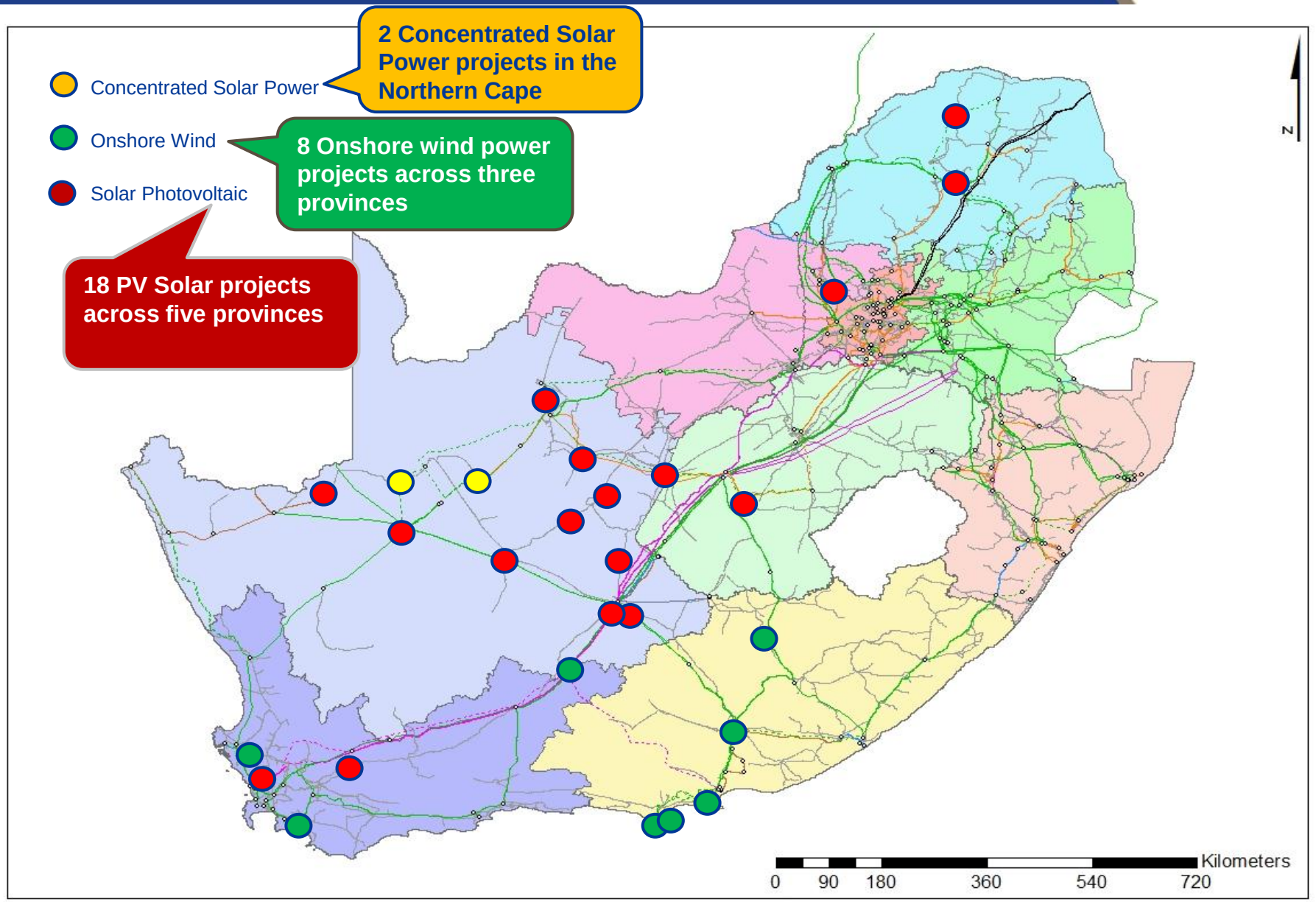
Since 2011, 42 projects (2142 MW) of RE IPPs were connected, ~88% (1 865 MW) of which are in operation

Status of Current IPP Programme – end August 2015

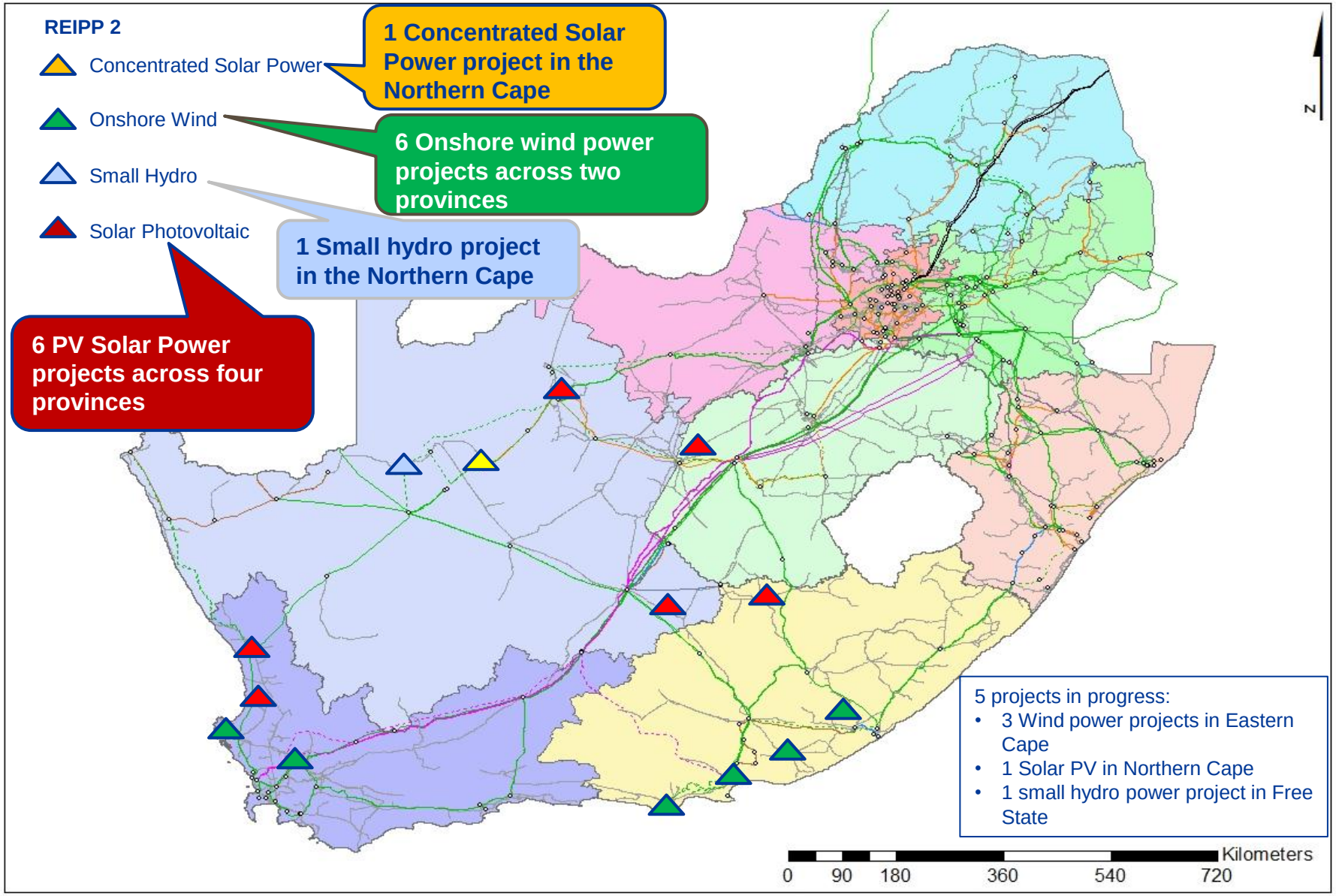
Name of programme	MW contribution	Current status
Bid Window 1 (28 projects)	1436	All 28 projects connected.
Bid Window 2 (19 projects)	1054	14 projects connected (706MW) 5 projects in execution
Bid Window 3 (19 projects)	1656	All budget quotations issued

2142 MW of RE IPPs have been connected to the grid underpinned by a R2.4 billion Eskom investment

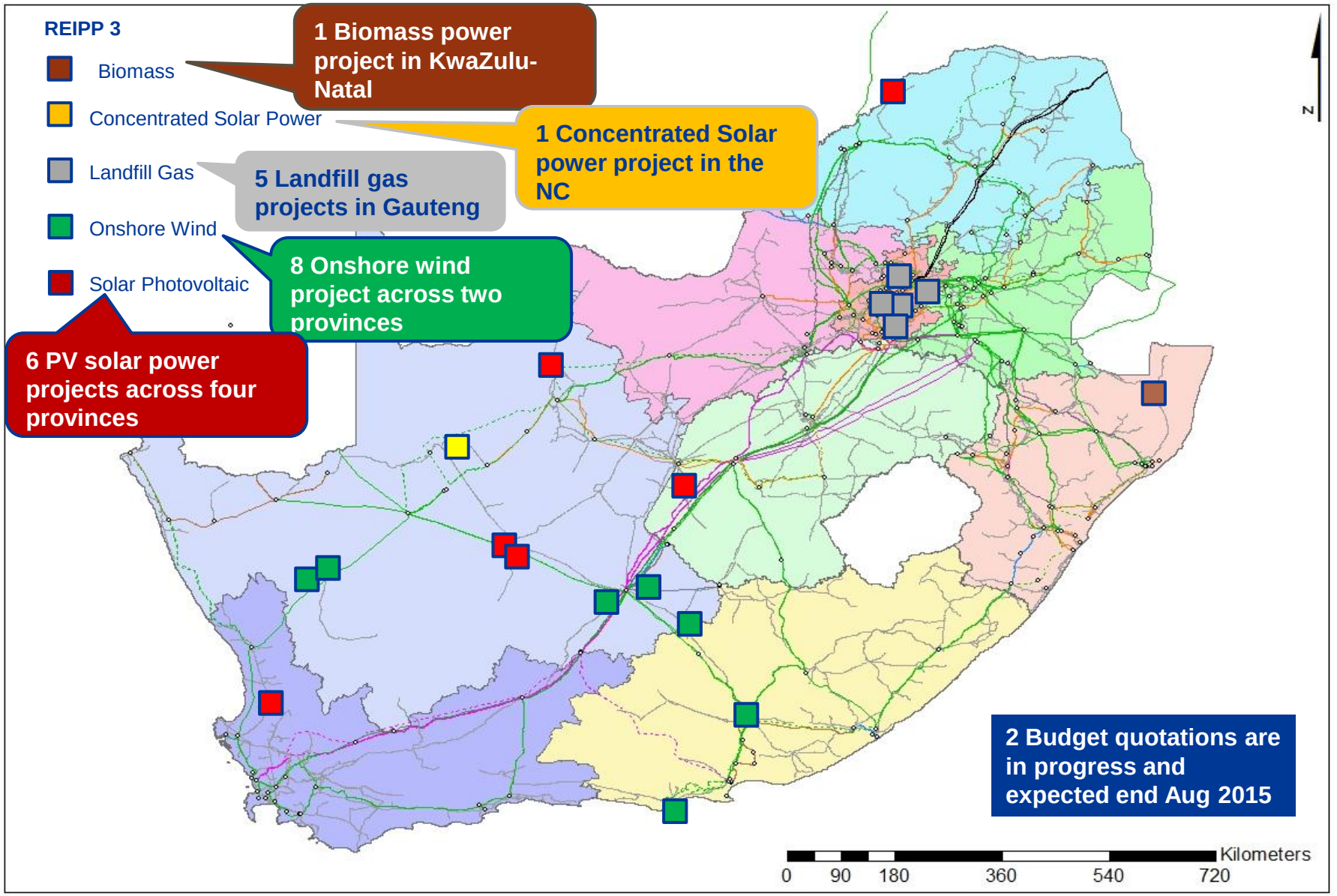
All 28 projects from Bid Window 1 were connected, adding 1 436 MW to the grid



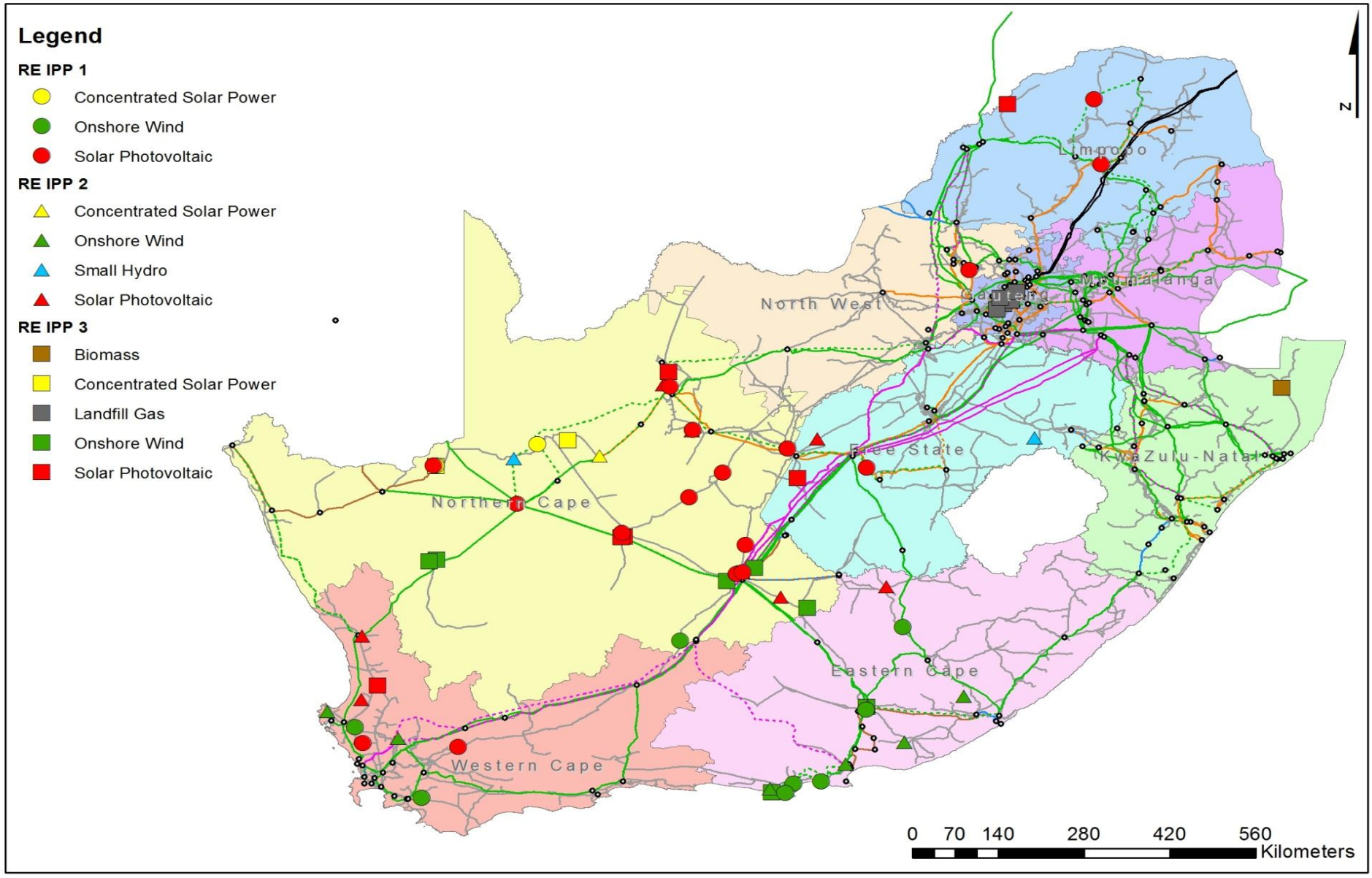
14 of the19 projects from Bid Window 2 have been completed, adding a total of 706 MW to the grid, with 5 projects in progress



19 budget quotations for bid window 3 have been issued

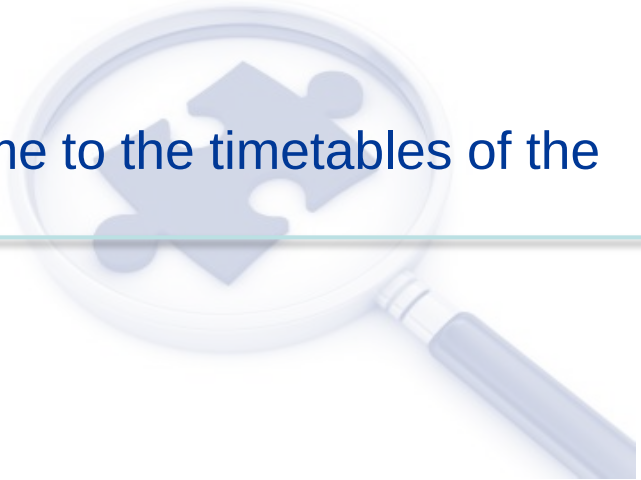


42 projects (2 142 MW) of RE IPPs have been connected, between bid window 1 and 3, at a capital cost of R2.4 Billion



Opportunities to maximise IPP grid connections

- Direct IPP projects towards areas where network capacity is already available
- Target specific geographic areas for IPP projects to optimise on timelines for readiness of the grid infrastructure
- Expedite the EIA, servitude acquisition and Water Use License Authorizations (WULA) processes
- Align the timetables of the IPP programme to the timetables of the feasible grid plans.



Transmission
Strategic Grid Planning

Integrating Future IPPs

Presented by: Ronald Marais

Strategic Planning - Overview

- Context
- What has been done
- Long Term Grid Assessment (The 2040 Tx Study)
- Medium Term Requirements for IPP Grid Access
- Impact of Generation Scenarios
- Way forward

Strategic Planning - Context

- Planning is part of a Process Framework to deliver transmission infrastructure
- Planning is based on the Transmission Load Demand Forecast and the Integrated Resource Plan (IRP)
- Current official document is the 2010 IRP
- The TDP is based on spatial assumptions for the 2010 IRP (The view that Eskom has taken)
- The GAP is the agreement with stakeholders on the physical location and associated timing of the future generation

What have we done

Eskom

Determining the Future Grid

- Conducted Transmission 2030 Study
- Conducted Transmission 2040 Study

Expanding the Grid

- Publish Annual Transmission Development Plan

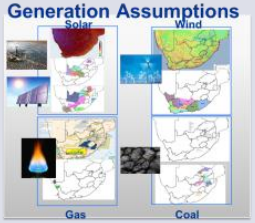
On Time Grid Access

- Prepared Generation Connection Capacity Assessment (GCCA)
- Created Generation Connection Application Procedure
- Developed a Tx Self -Build Policy
- Developed Streamlined Application Process

- Identify Future Corridors
- Flexibility to move to Different Scenarios
- Reduce Implementation time to meet generation & demand development
- Impact of Intermittence
- Grid Capacity
- Provide information on spatial network capacity available to connect Generation
- Enable faster implementation to ensure success of REIPP

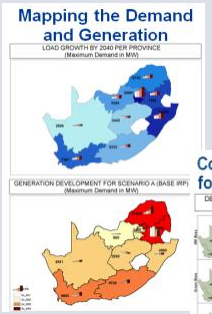
Outputs and Studies Completed

Generation Assumptions

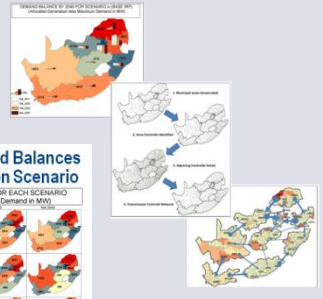


Engagement
Within ESKOM
Outside ESKOM

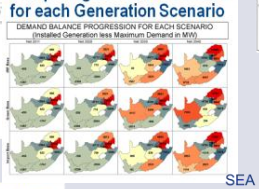
Mapping the Demand and Generation



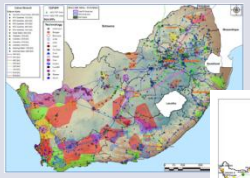
Scenario Corridor Analysis



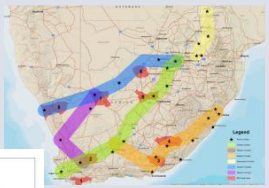
Comparing Demand Balances for each Generation Scenario

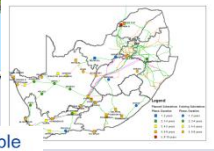


Renewable Energy Application Integration Analysis Cluster Area Study

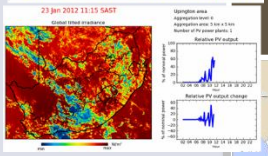


SEA Corridors for SIP 10 project

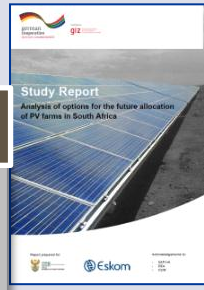




Intermittency - Renewable Energy Cloud Cover Impact

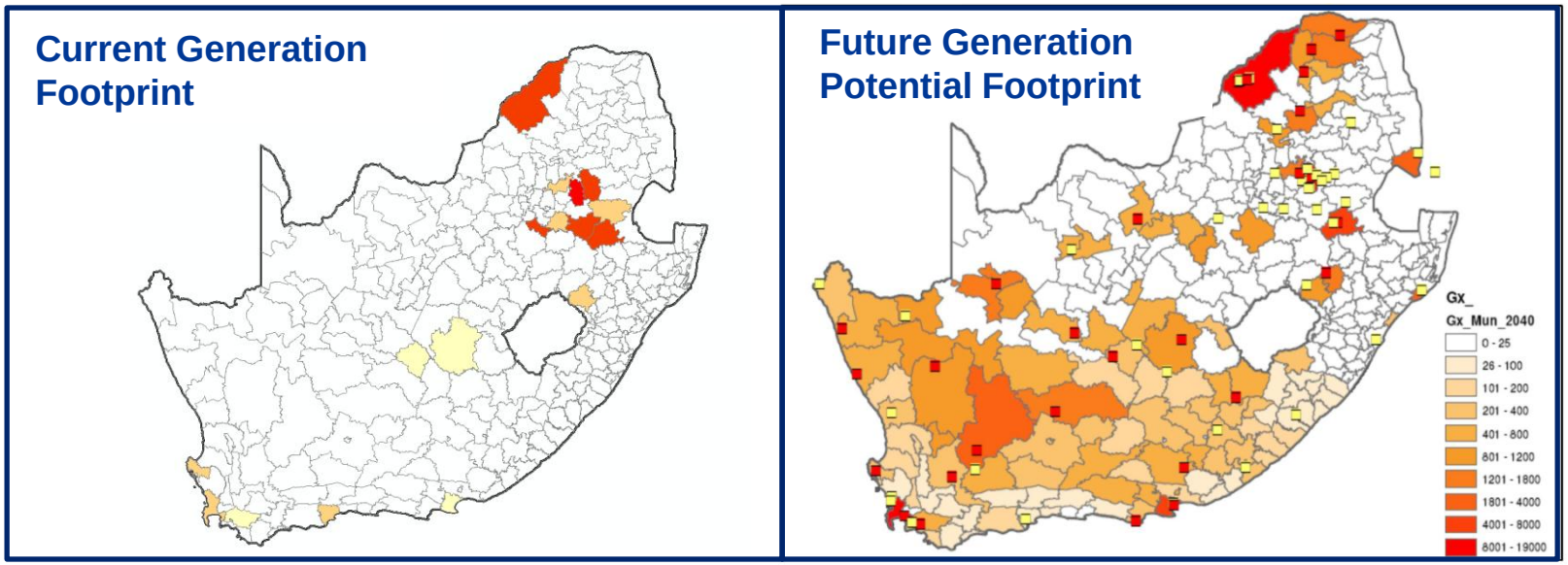


Final SIP 10 Corridors



Change in Generation Spatial Footprint

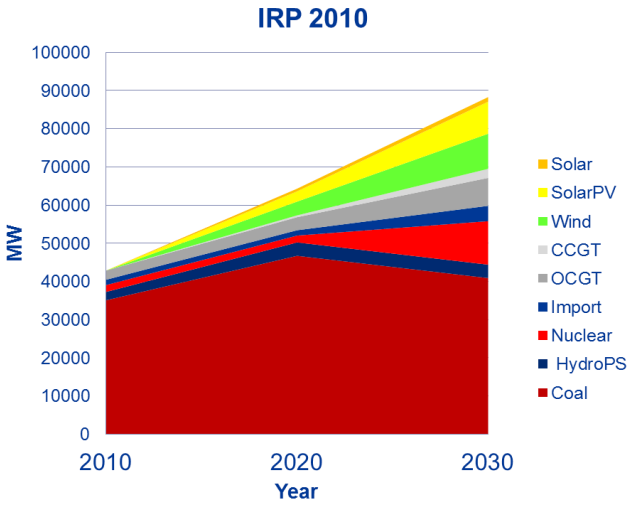
- Need to be able to **adapt to the uncertainty of future**
- Identify and invest in **critical power corridors** for the future transmission network
- Unlock and create a **flexible and robust grid** to be able to respond to the changing future



Irrespective of generation scenario

2040 Tx Study – Generation Spatial Allocation

Transmission to enable IRP requires Spatial Information

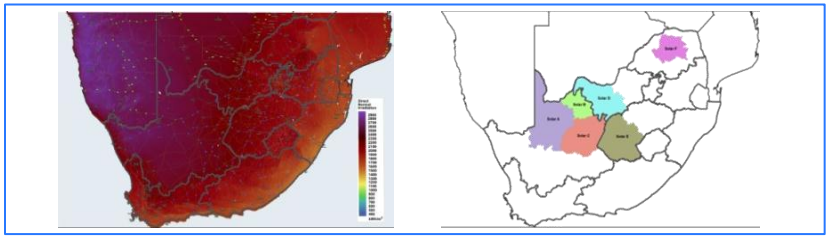


However there is uncertainty in

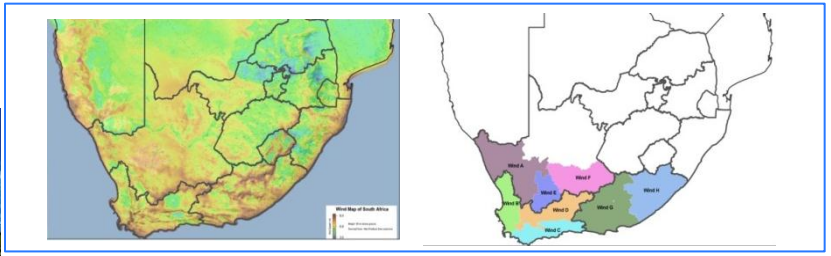
- Where is the location?
- What is the size?
- What is the type?

Generation Energy Resources for Electricity

Solar

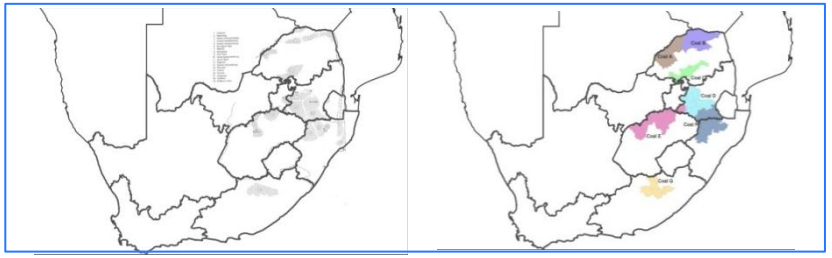


Wind



Gas

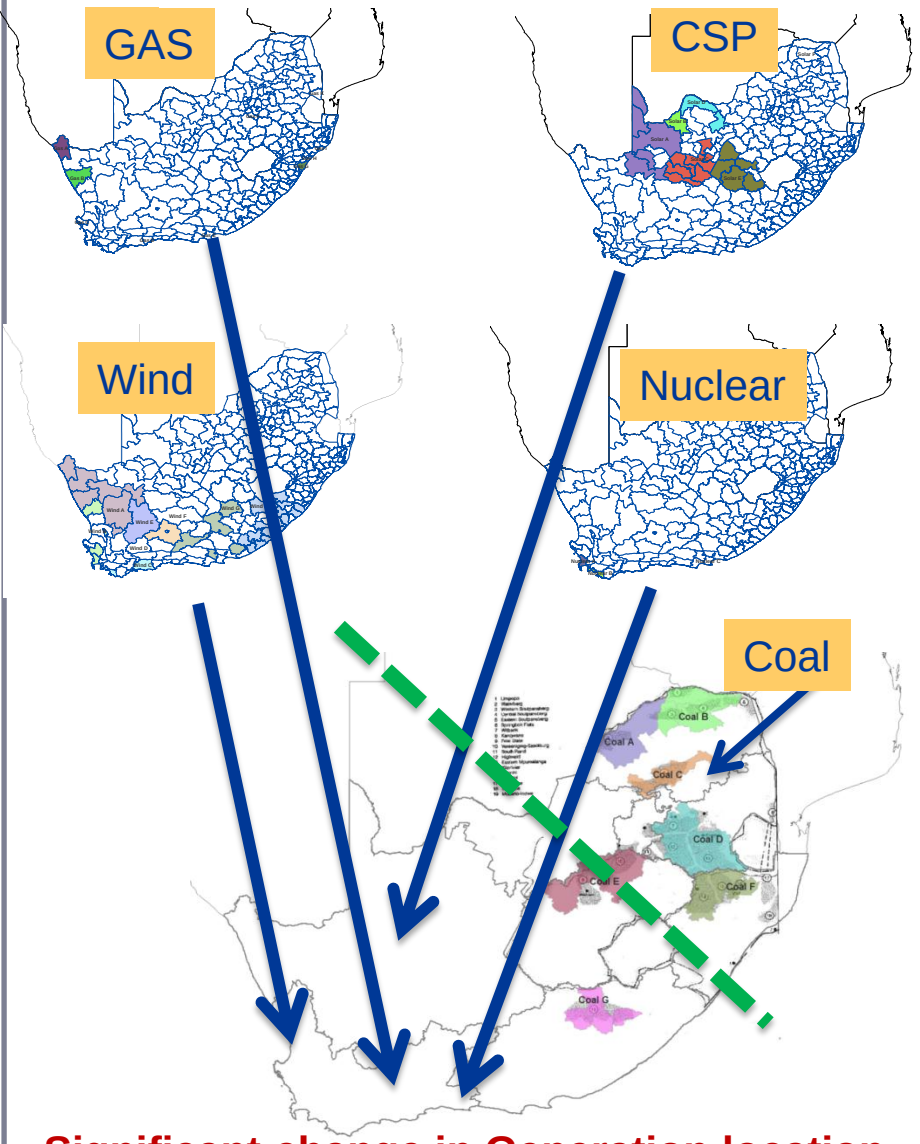
Coal



2040 Tx Study – New Generation Allocation

Generation

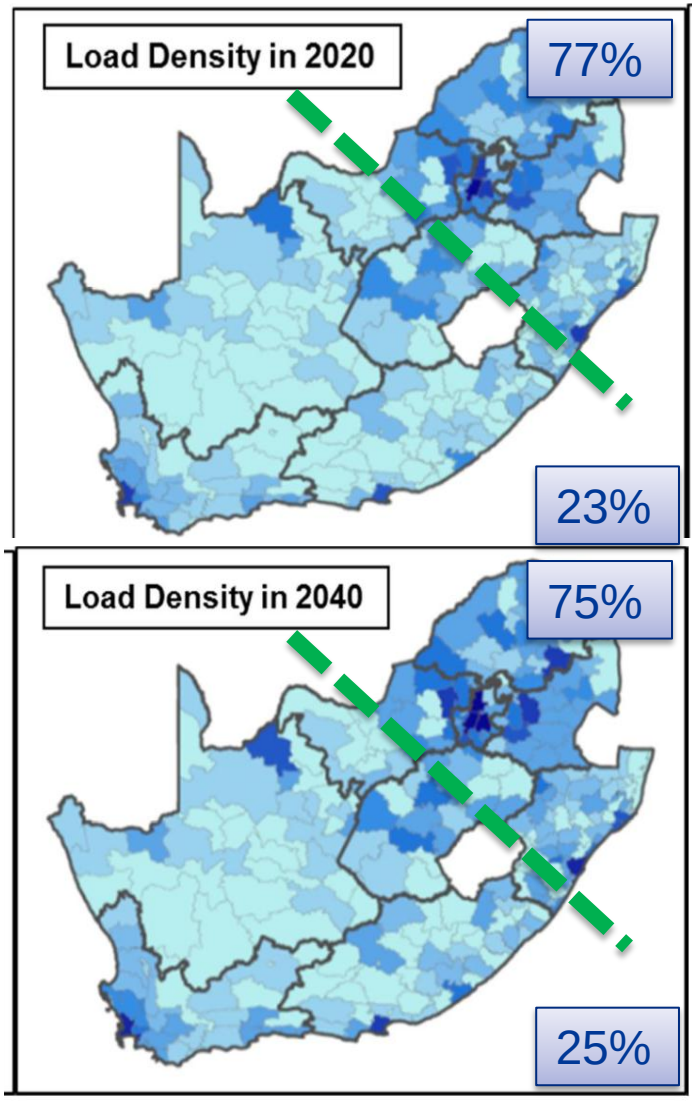
Energy resources for electricity



Significant change in Generation location

Demand

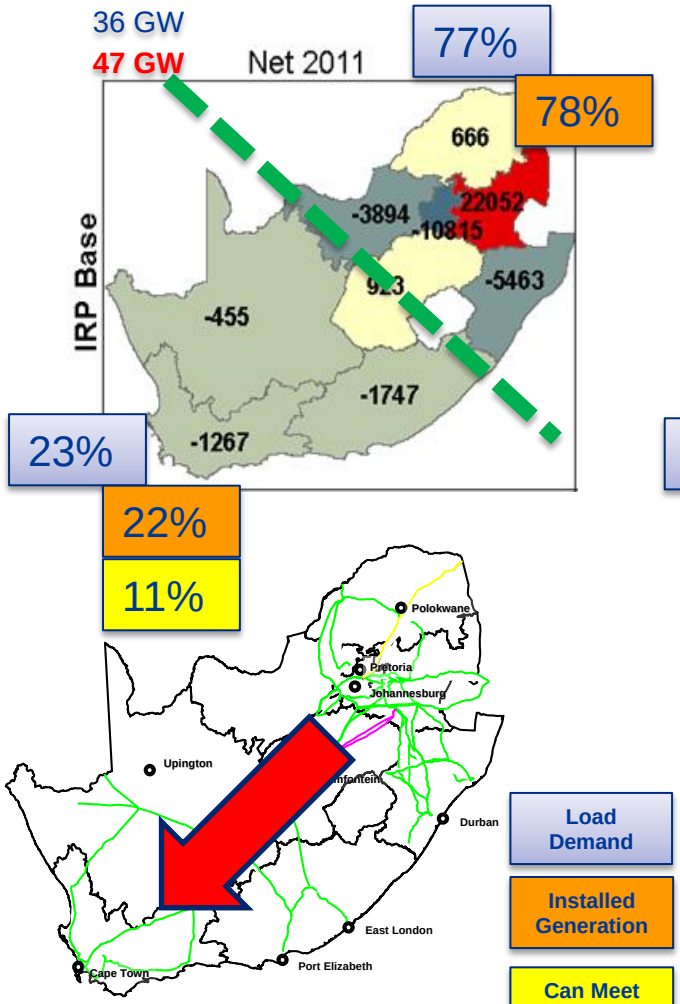
Load Demand for each area for 2020 & 2040



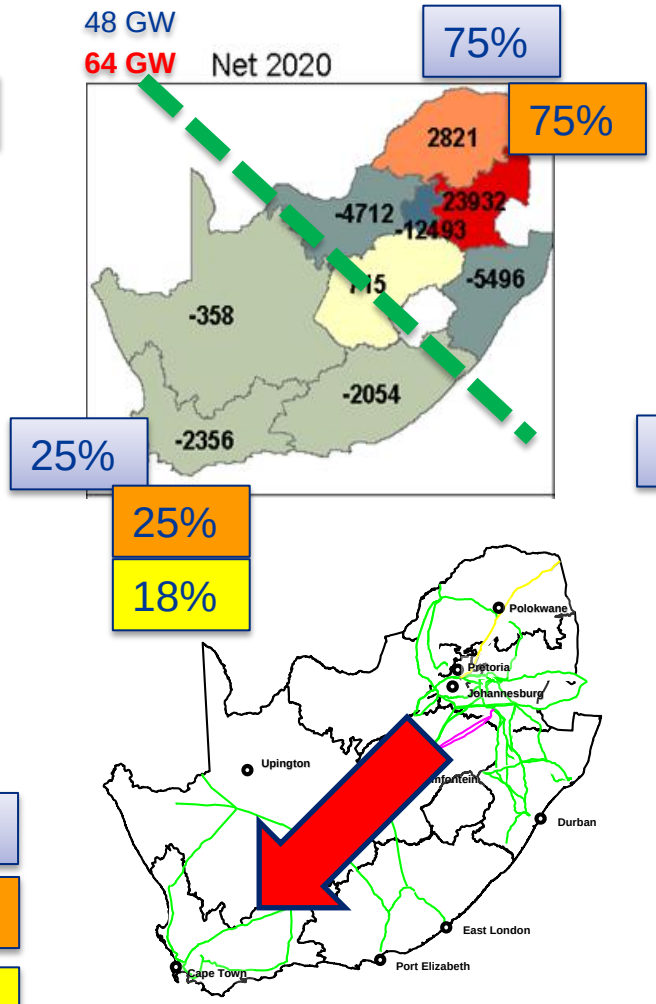
No significant change in load location

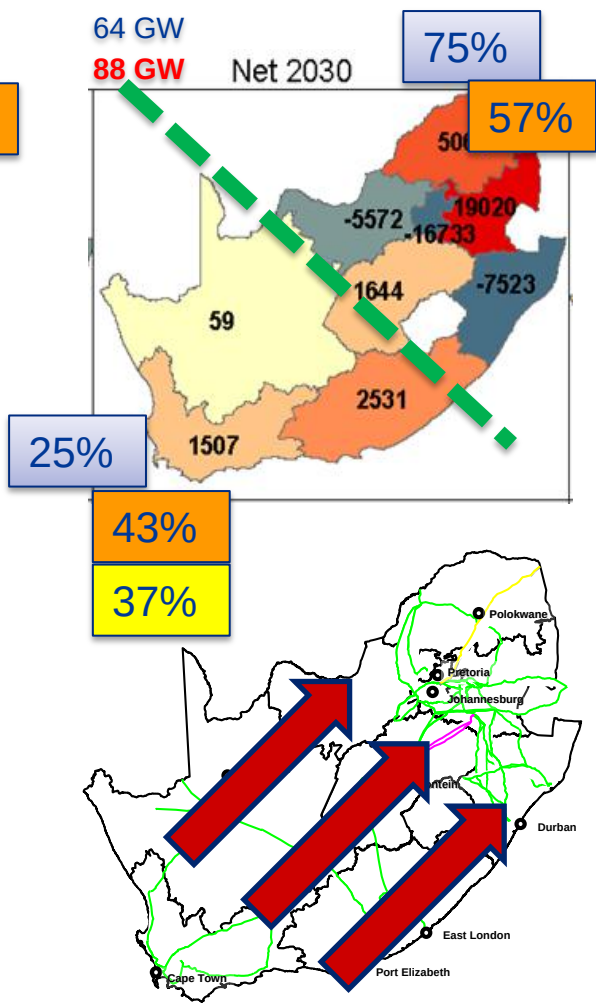
Comparing Demand Balances for each Generation Scenario

Current Network Transfer



Future Network Transfer





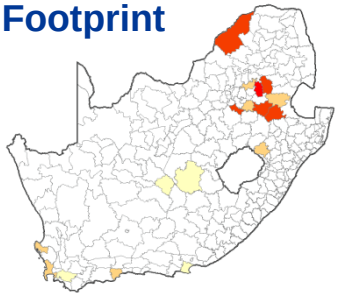
Tx Strategy to increase Grid Access to meet future needs of the IRP and customers

Change in generation diversity has major impact on future Tx Grid

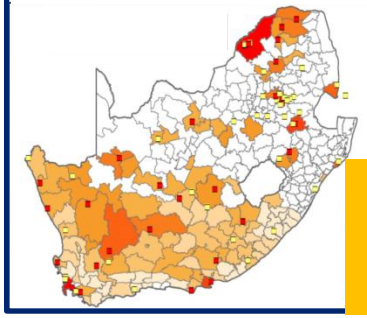
- Grid Access - Increased connection capacity needed in new areas (delivery time > 8yr)
- On Time Connection - Smaller IPP generation plant can be constructed faster (delivery time < 5yr)
- Unknown locations - Multiple unspecified IPP sites require market access for best price

Change in Location - Spatial Footprint

Current Generation Footprint

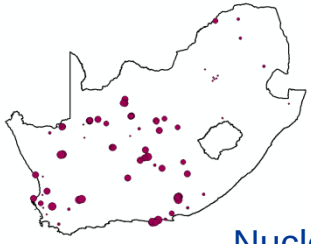


Future Generation Potential Footprint

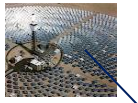


Change in Construction 3yr - 5yr Speed of IPP plant rollout

Current Eskom Wind, Solar & REIPP 1.2.3.4



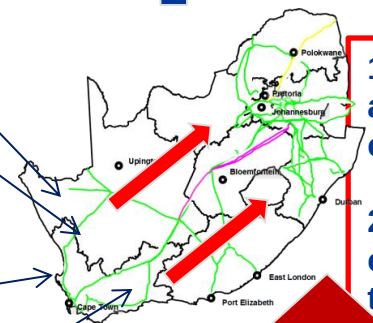
Solar



Wind

Gas

Nuclear



Beyond 2020 Demand Balance significantly changed by dispersed generation in South

Significantly More Transmission Corridors and Grid Access required

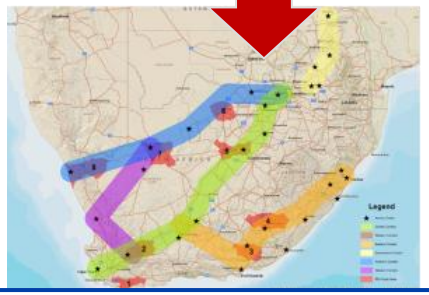
Strategic EIAs & Servitudes can enable faster grid development

Transmission Line Project Timeline

1. Strategic Investment in the EIAs & Land acquisition is critical to meet future IRP connection timeframes

2. Reducing Tx investment today compounds future Tx Grid roll out leading to high risk of Gx capacity delays

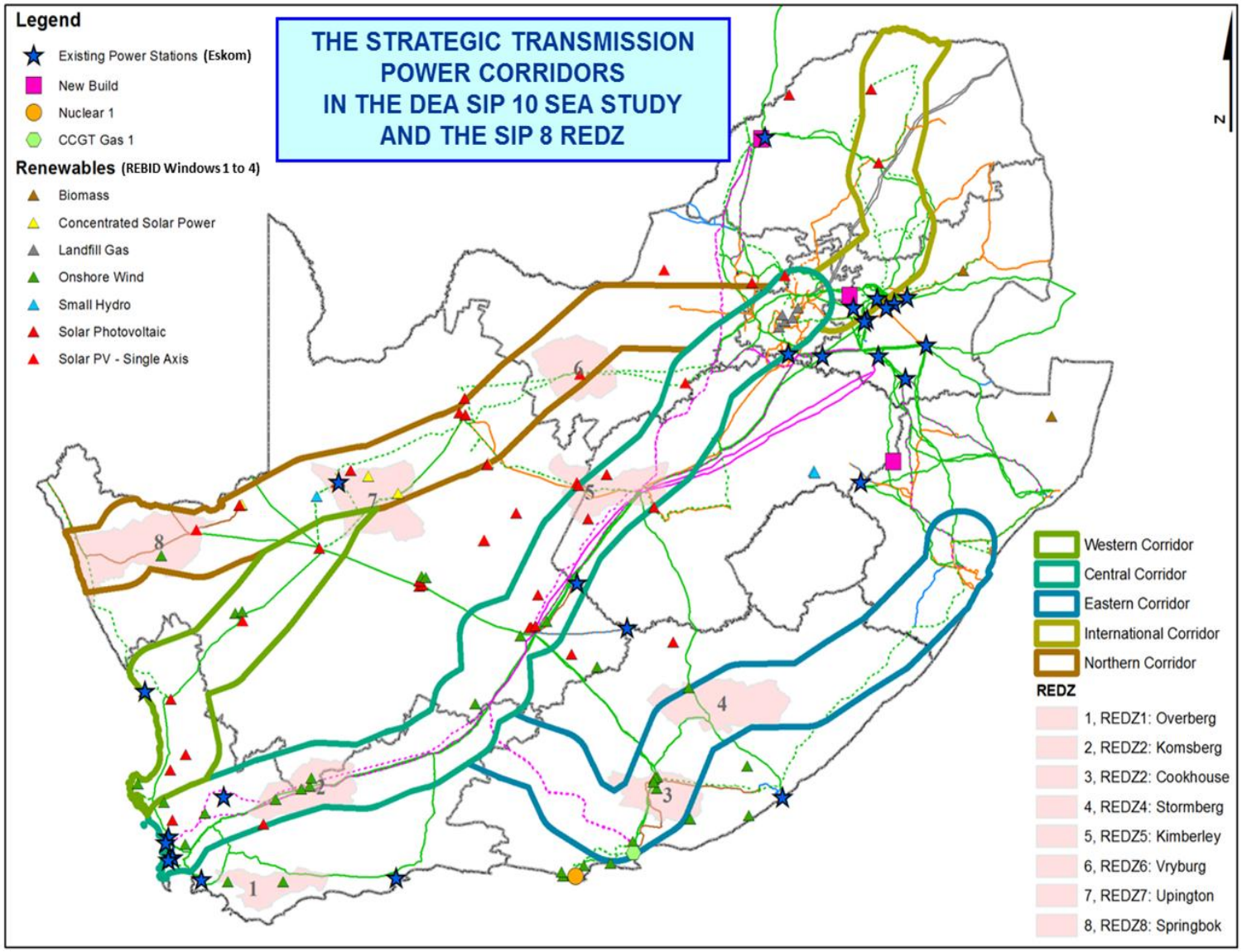
SEA Corridors



Change of Spatial Footprint into areas with limited Demand requires additional Transmission Capacity

Need to reduce the time to increase grid access by investing in strategic access and corridors servitudes

The REDZs and Strategic Power Corridors



- The 2040 Network Study findings and supporting studies enabled the five power corridors to be further refined.
- DEA has used SIP 10 SEA studies to undertake all the Environmental Impact studies which will be valid for a longer period.
- Relatively simple process to be put in place to secure final environmental authorisation.
- Plan is to gazette corridors and the process by March 2016

SIP 8 REDZ project to be gazetted by early 2016. Additional REDZs to be identified in a new phase.

IPP related Infrastructure requirements beyond Bid Window 3

Future IPP Programmes

Name of programme	MW Contribution	Target Dates
RE-IPP Window 4 and RE-IPP Window 4B	1121 1084	Dec 2019 Dec 2019
RE-IPP Expedited Program Future RE-IPPs	1800 7700	Dec 2019 2020 - 2025
Coal / Baseload	2500	2018 - 2022
Cogeneration[1]	800 1000	2016 - 2017 2017 - 2018
Gas: Power barges LNG Plant	1770 3000	2017 - 2019 2020 - 2022
Total	**19 005**	

1. It is assumed that Cogeneration will be consumed within the developers' operations; hence minimal network investment will be required

IRP Generation by 2025 with uncertain location

Assumptions made for Gen sites for 2020 to 2025

Final sites dependant on DoE programmes

Certain Tx projects in TDP - but additional projects required if all gen projects in as assumed by 2025

Distributed RE Generation

7x new 400kV MTS plus lines

Possible sites

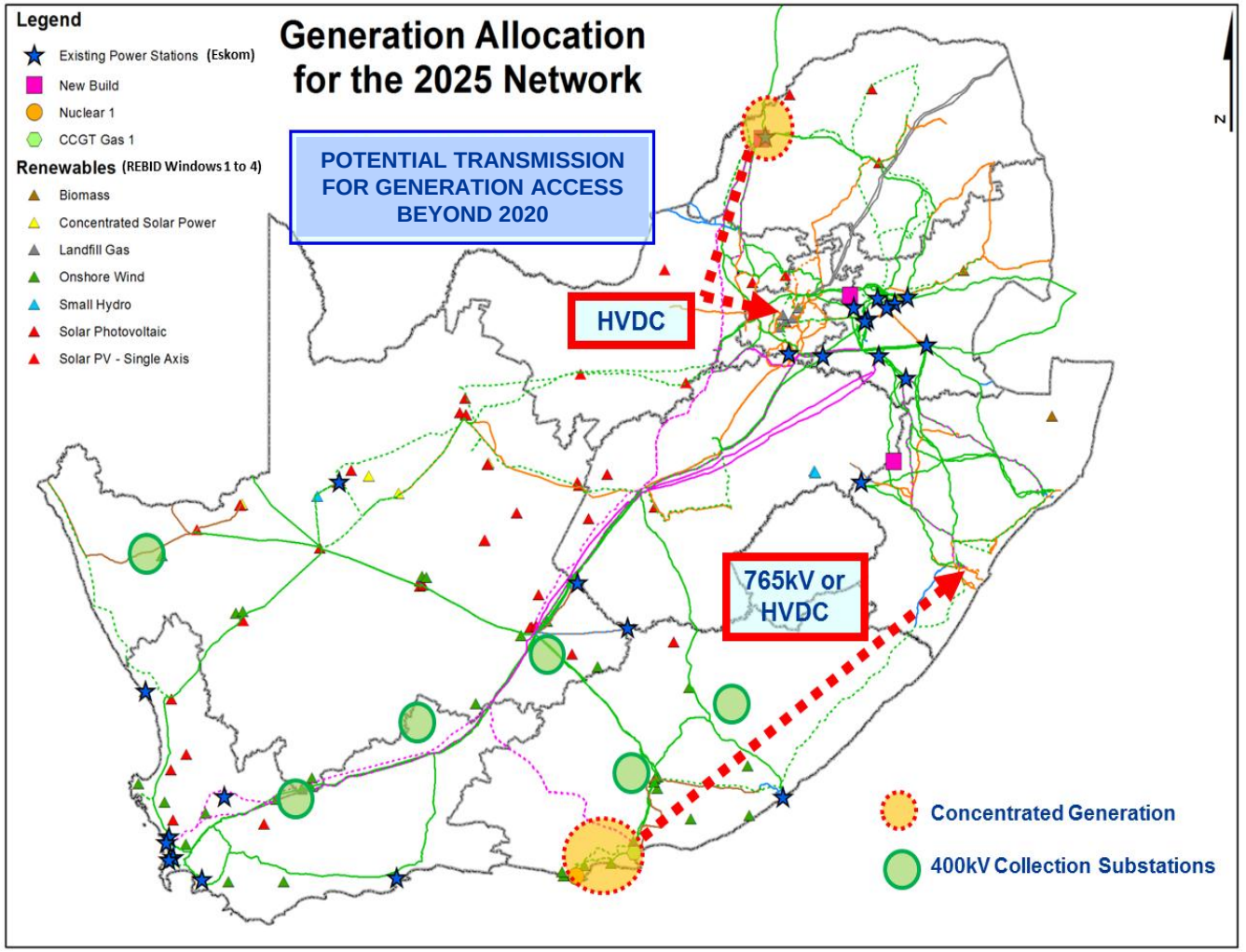
Concentrated Generation

Two sites:

1x Coal

1x Nuclear & Gas

Tx Project needed



Strategic IPP Tx Connection Projects to unlock capacity

- GP identified Tx projects to create additional grid connection capacity as quickly as possible for the on-time connection of DOE programmes
- These consisted of phased transmission substation and line projects
- Proposal is to undertake the preparation works for all the projects to reduce the response time to implement

Tx Project Phasing

Phase 1: Limited work at existing substations/projects (<2 yrs)

Phase 2: Limited work at existing substation with limited Tx line work (2-4 yrs)

Phase 3: Existing projects or New substations with some Tx line work that requires full EIA studies and long lead lines (4-5 yrs)

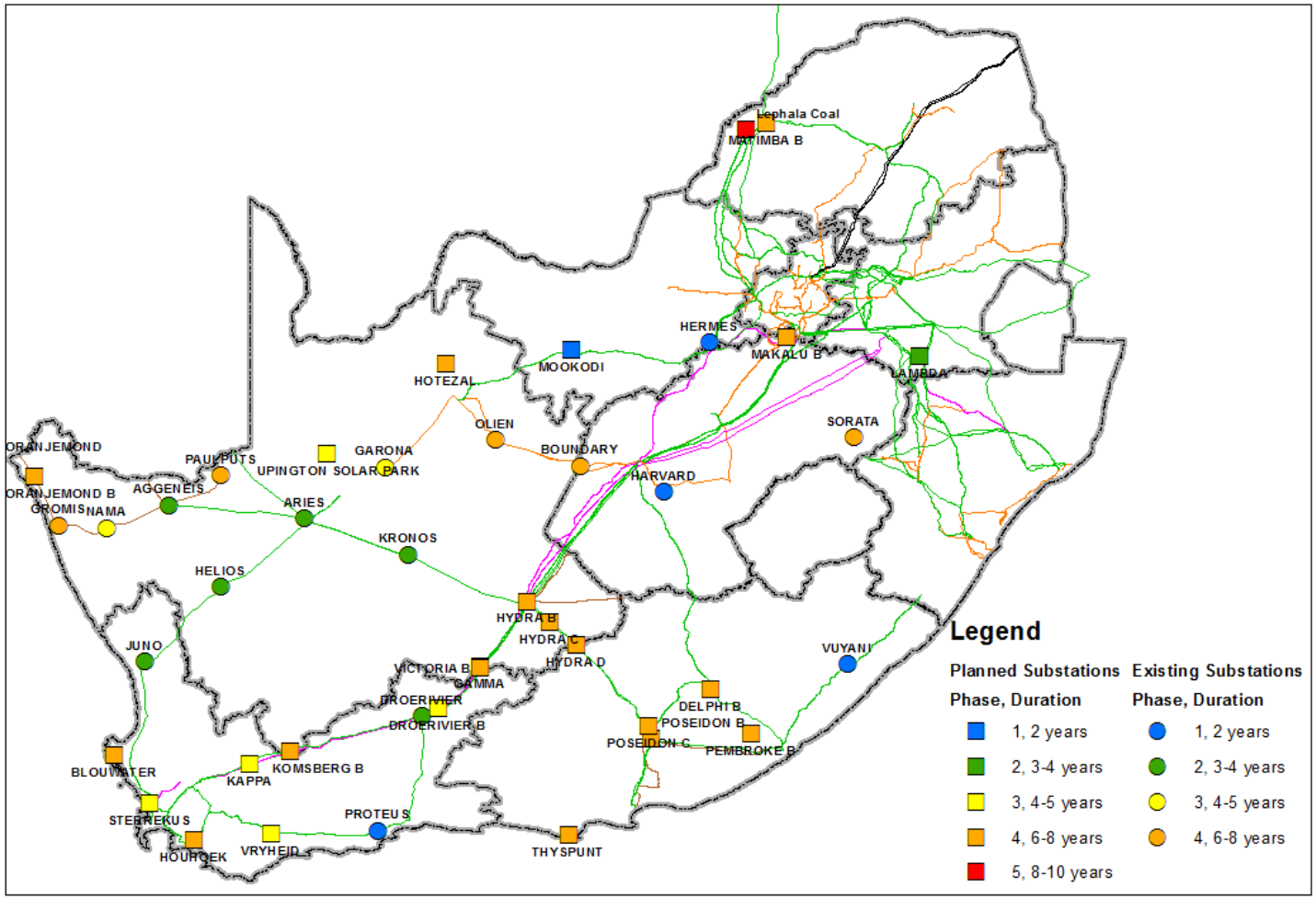
Phase 4: Existing projects or New substations with backbone Tx line work required with longer lead time (6-8 yrs)

Phase 5: New projects or New substations with backbone Tx line work required with longest lead time. (8-10 yrs)

Location of Strategic Tx Projects

Potential projects include:

- at existing MTS substations
- at new TDP substations
- at possible new RE gen collection MTS substations



Strategic Unlocking Implementation Time

Status of Strategic Tx Projects preparation

Preparation Status

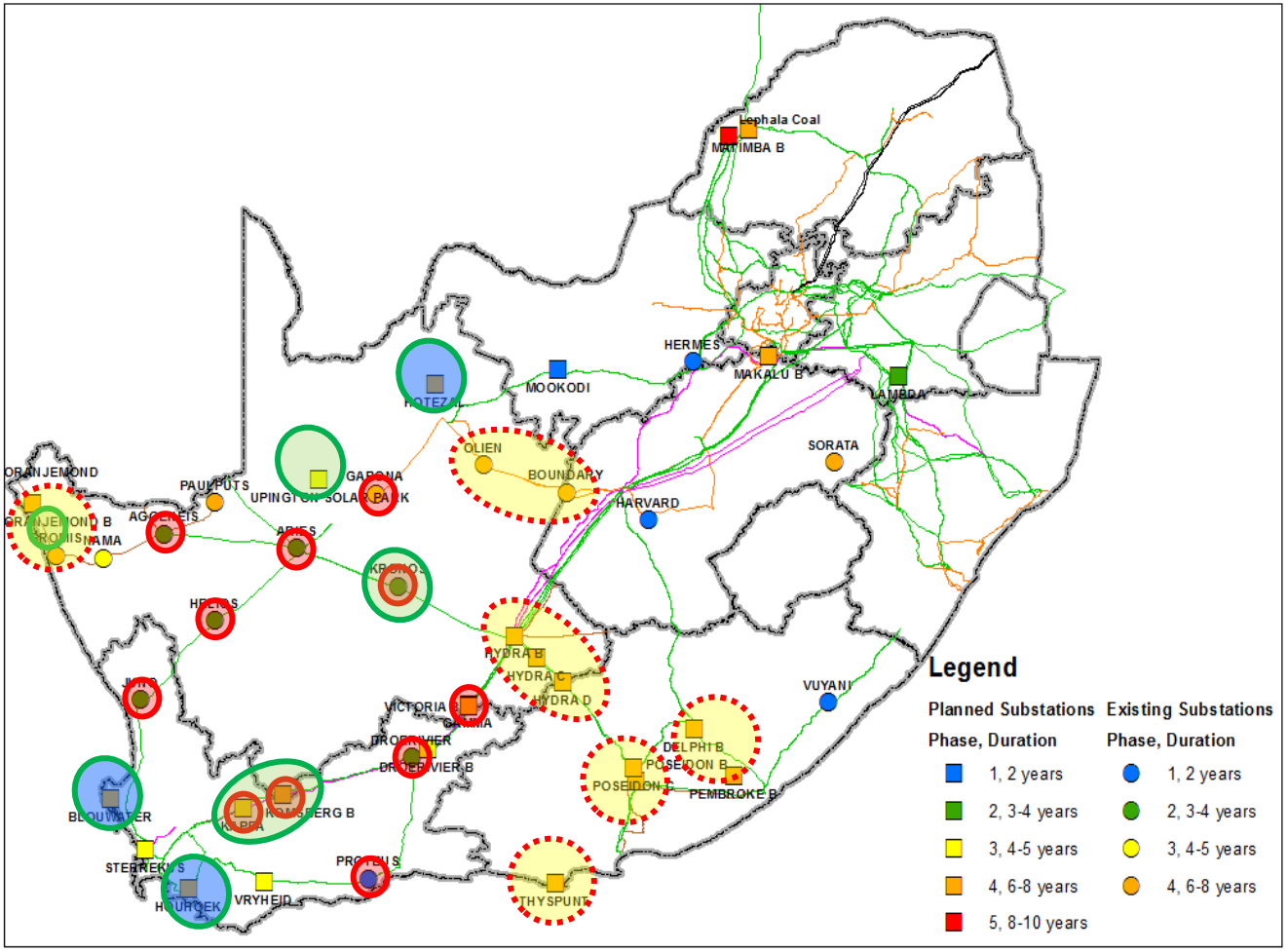
Already in TDP and projects to be accelerated

Projects triggered by successful RE Bids

Projects defined and ready to be developed

Complex projects still to be fully defined for development

Costing for all above projects being prepared



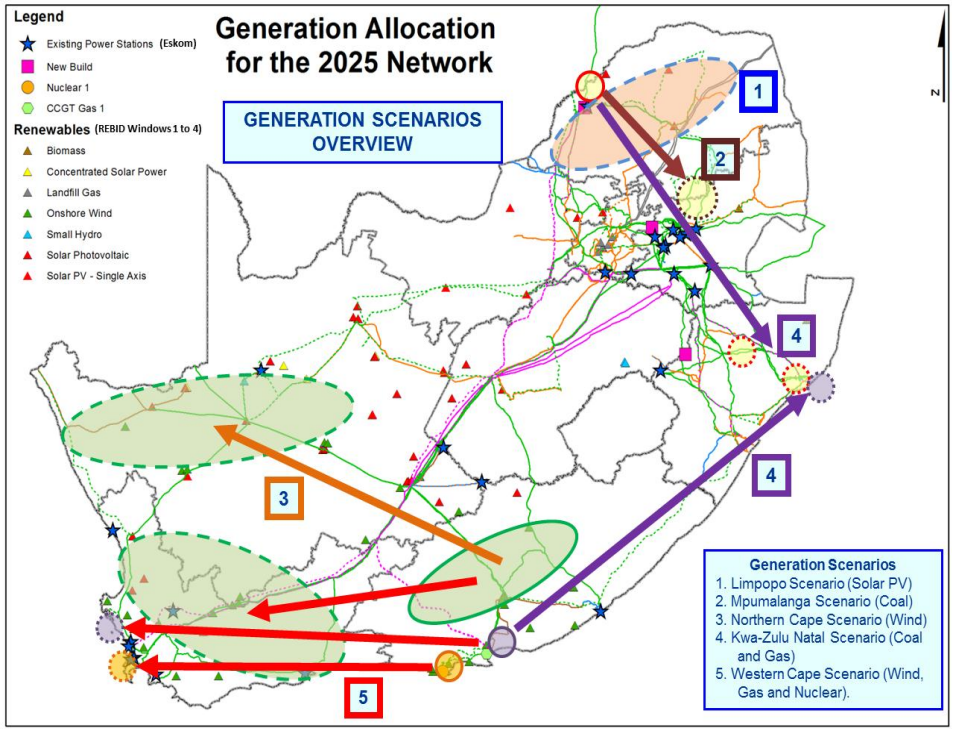
Impact of Gen Scenarios with different locations

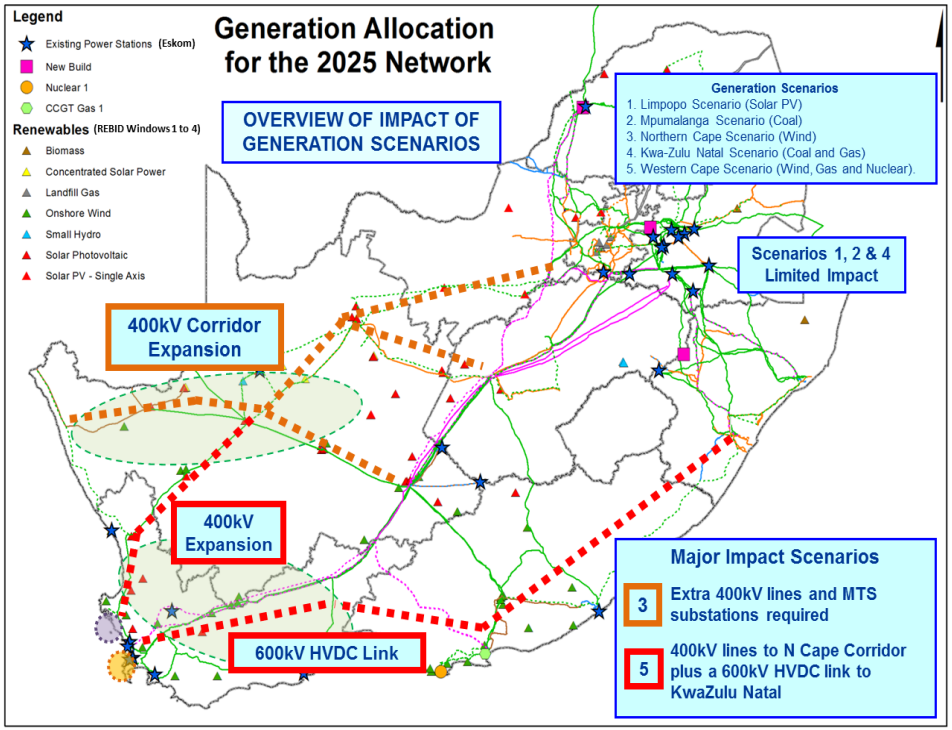
Scenarios

- TDP studies done on IRP Baseline Scenario
- DoE requested impact of different locations for some of generation from 2020 to 2025
- Five scenarios considered
- Based on relocation of large RE, coal, nuclear and gas

Impact

- Three scenarios have limited impact
- Moving 2000 MW to N Cape will require extra 400kV lines & MTS in Northern Corridor
- Locating nuclear, gas and additional wind to W Cape will require extra 400kV lines to and through N Cape plus direct HVDC to KZN





The way forward

- Know what is required in the long term (Power Corridors, gas integration, coal integration, nuclear integration and REDZ collection networks)
- Identified the Tx options to create grid access for IPPs and other generation options
- Issue is the sequencing of the implementation of the Tx options (practicalities and timing)
- Need to formalise the Process Framework from assumptions to release of Tx projects to enable alignment for on-time delivery
- This alignment is required for the next TDP update studies and the future MYPD applications

Thank you